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Application of Blockchain Technology for Tracking and Tracing of Supply Chain System

Bsc. (Hons) Ethical Hacking & Cyber-security

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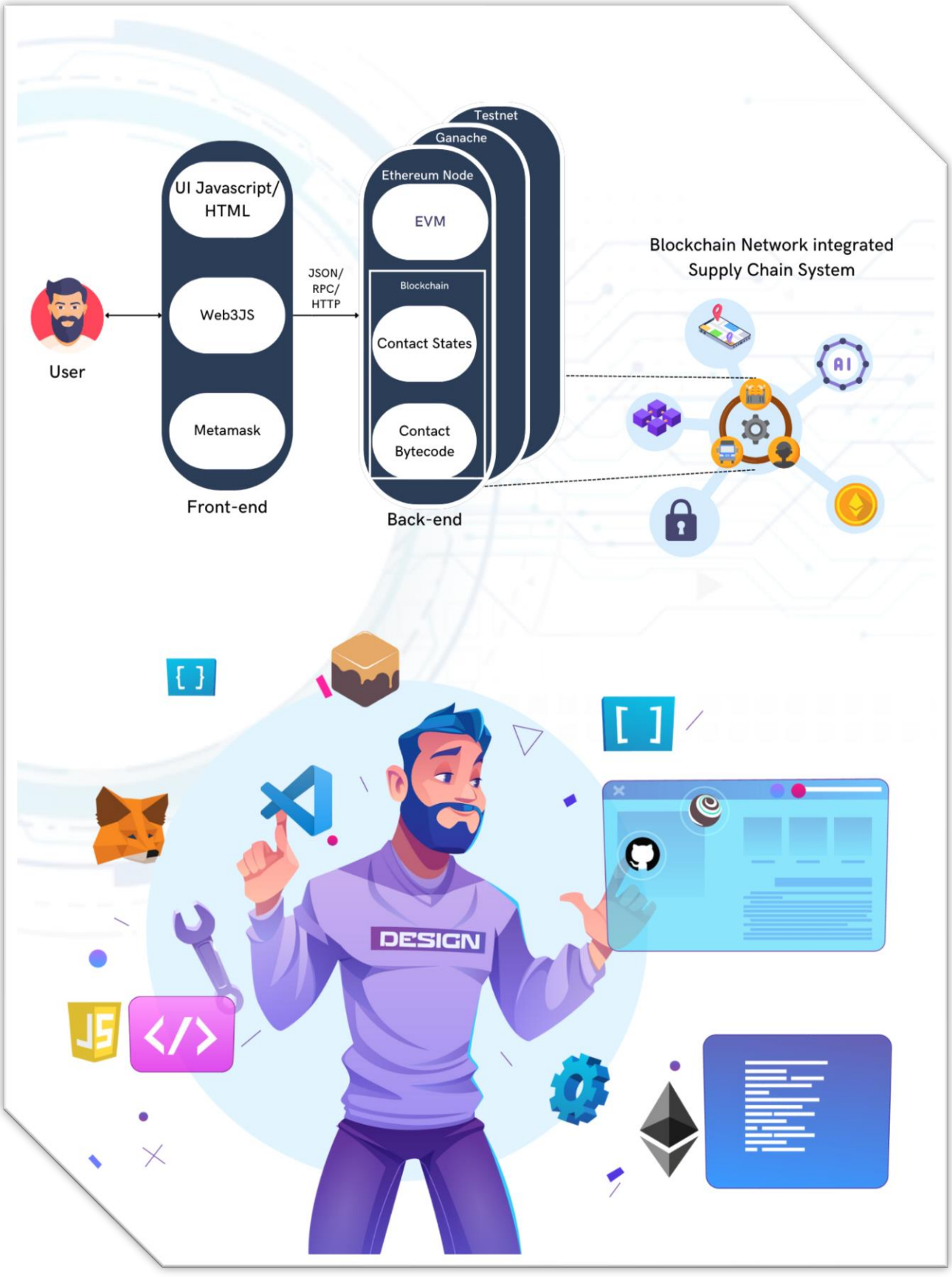
CONCEPT PAGE



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Thanking You,

Bipin Adhikari

ABSTRACT

Medical suppliance is an essential part for the enhancement of civilization and country growth. So, to provide medicinal supply, there is a chain that defines consumers, suppliers, factory, and logistics. The chain is referred as “Supply Chain System”. The supply chain system demonstrates the relation between the initial supplier to the end consumer. Following the traditional technique, the supply chain system is non-transparent, causing lack of trust in between the supplier and consumer for further business. As a solution to the issue, implementation of Blockchain Technology can take the necessary steps for the relation in the market as well as for transparency of the product. In order to demonstrate transparency in the product in terms of medicinal supply for the consumers, it is important to study the feasibility for execution of this particular technology. The project is based on the first implementations of the Solidity and Blockchain systems for improving medicine delivery in underdeveloped nations like Nepal. The initiative so created will be able to track and trace the pharmaceuticals from their very early stages. This technology will improve tracking in such a way that frauds and supply-side manipulation may be considered. To keep track of all the items delivered for medical purposes, the supply chain for this system has to be enhanced. By being transparent to the customer and supplier, the use of this new technology has a positive impact on the product's traceability and trackability from the source and raw materials. When discussing supply chain technology and business, the term "tracking" refers to the ability to find inventories both in the present and in the past. With the use of this method, firms may log production changes in a standardized manner to a single ledger, ensuring data transparency and providing a single source for time-stamped transactions and product status. Most organizations use the track-and-trace system for product authentication, authenticity, and ethical supply chain practices, either through the blockchain method or other comparable technologies.

KEYWORDS

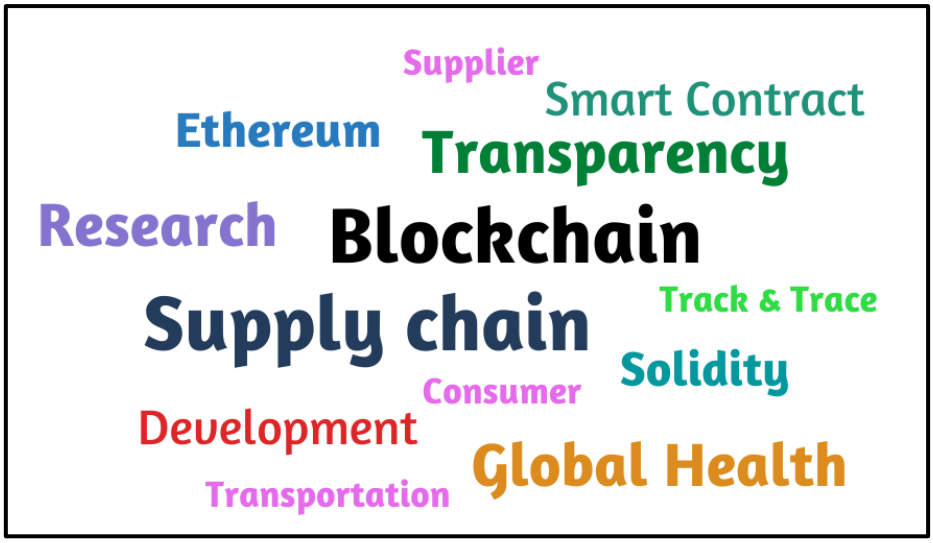


Figure 1 Keywords

TABLE OF CONTENTS

Concept Page 1
Acknowledgement 2
Abstract 3
Keywords 3
Table of Figures 6
Introduction 7
Aim 8
Objective 9
Justification 10
Research Question 12
Scope 13
Ethical Considerations 13
Literature Review 14
Case Studies 15
Johnson & Johnson 16
Amazon and Nestle (AWS) 16
CISCO Systems 18
Development Methodology 19
Tools and Technologies 20
Cryptocurrency 20
Techniques 21
Supply Chain Contract 22
Raw Material Contract 22
Medicine Contract 22
Transaction Contract 22
Product Traceability and Source Verification 22
Event Request and Response Mechanism 23
QR-Code Scanning for Tracking and Tracing 23
DAPP and Smart contract 24
Distributed ledger Architecture 24
Game Theory 25
Project Development 26
Blockchain Architecture 26
AI Integration (RASA Architecture) 28

Availability and Security 29
Backup and Recovery Strategies 29
Updates and Upgrades 30
Findings 30
Issue and Risk Management 32
Issues 32
Recommendation 34
Future Work 34
Conclusion 36
References 37
Appendix 42

TABLE OF FIGURES

Figure 1 Keywords 3
Figure 2 Relation between blockchain and medical products in Project 7
Figure 3 Hype Cycle of Blockchain 2022 8
Figure 4 Objectives of the Project 9
Figure 5 Traditional supply chain system 10
Figure 6 Application Development Initiation 10
Figure 7 Enhanced supply chain via Blockchain Technology 11
Figure 8 Traditional Ledger vs Distributed Ledger 11
Figure 9 Research Questions 12
Figure 10 Scope of the Project 13
Figure 11 Ethics Visualized 13
Figure 12 Desk based Research 14
Figure 13 Top 25 companies using supply chain as per Gartner Report 15
Figure 14 Johnson & Johnson implementing high-tech Supply chain system 16
Figure 15 Amazon and Nestle using Blockchain Technology 17
Figure 16 CISCO Product Supply Chain System 18
Figure 17 AGILE Methodology Implementation 19
Figure 18 Tools & Technologies used in the Project 20
Figure 19 System Implementation Technique 21
Figure 20 Event Request and Response Mechanism 23
Figure 21 Dapp and Smart Contract (Anon.2019) 24
Figure 22 4C's of Distributed Ledger 25
Figure 23 Game theory representation 25
Figure 24 Blockchain implementation for Supply Chain 26
Figure 25 Blockchain Working Mechanism 27
Figure 26 Peer verification and Endorsement 27
Figure 27 RASA Architecture, AI Integration for Chat bot 28
Figure 28 Supply chain Security 29
Figure 29 Summing the Findings 31
Figure 30 Risk Domains from Blockchain 33
Figure 31 PESTEL Analysis 34
Figure 32 Past and Future prediction of Blockchain 35

INTRODUCTION

The development of the project is based on the first implementations of the Solidity and Blockchain systems for improving medicine delivery in underdeveloped nations like Nepal. The initiative so created will be able to track and trace the pharmaceuticals from their very early stages. This technology will improve tracking in such a way that frauds and supply-side manipulation may be considered. For the purpose of ensuring the quality of the product offered, the finished product that will be delivered to the user must be well-polished and undisturbed after creation. Due to a lack of openness, users of medical supplies are currently ignorant of the prescriptions they have purchased. Additionally, the chain's items being tampered with has made it challenging to look into questionable and dishonest behavior. To keep track of all the items delivered for medical purposes, the supply chain for this system has to be enhanced. (Anon.a)

The supply chain network may be improved and maintained using blockchain technology, which is created as a distributed system. This technology, which consists of a chain of data blocks connected by specialized cryptographic methods guaranteeing the integrity of the data, is very resistant to any change of the data. In terms of security, data cannot be changed or updated unless it is accepted by and transparent to all the connected blocks. Consequently, from the perspectives of security and the dependability of modern technology Blockchain transparency can offer a standardized infrastructure for information transmission. Blockchain is used to secure digital data and record cryptocurrency transactions, and its application to the supply chain may be very advantageous from both the supplier's and the customer's points of view. (Luo et al. 2018)

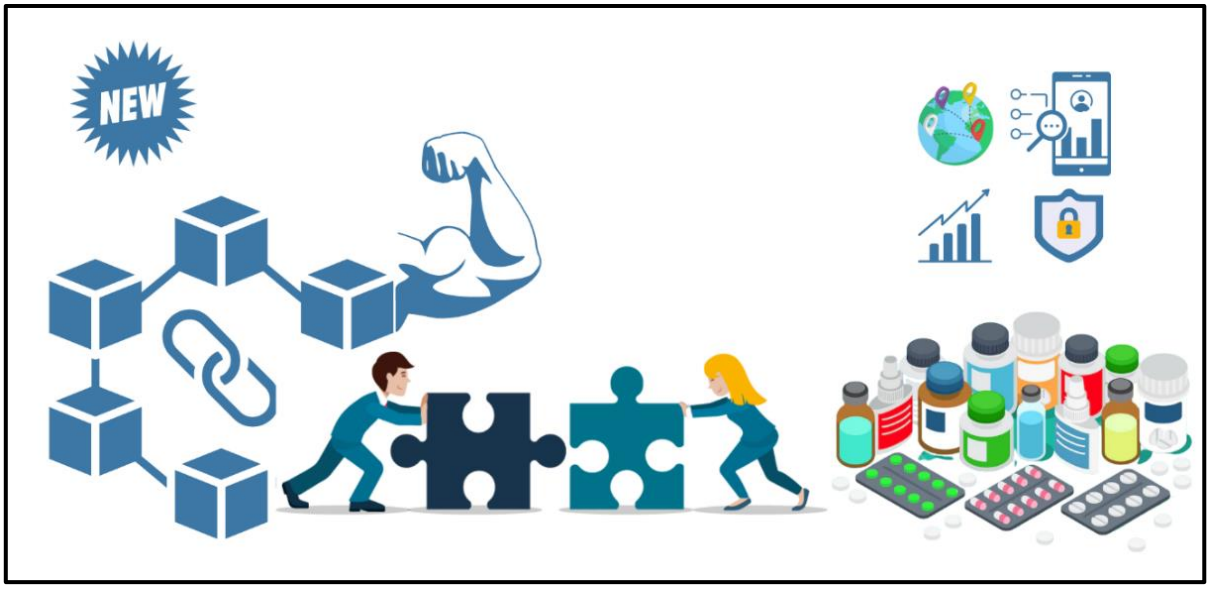


Figure 2 Relation between blockchain and medical products in Project

The usage of this new technology has a favorable effect on the product's traceability and trackability from the source and raw materials, being transparent to the customer and supplier. Tracking in the context of supply chain technology and business refers to the capacity to locate inventory both in the present and in the past. This approach helps businesses record production updates to a single ledger in a standard format that offers data transparency as well as a single source with time-stamped transactions and product status. For product verification,

authenticity, and ethical supply chain procedures, the majority of businesses employ the track-and-trace system, either via the blockchain approach or other related technology. (Insights 2022)

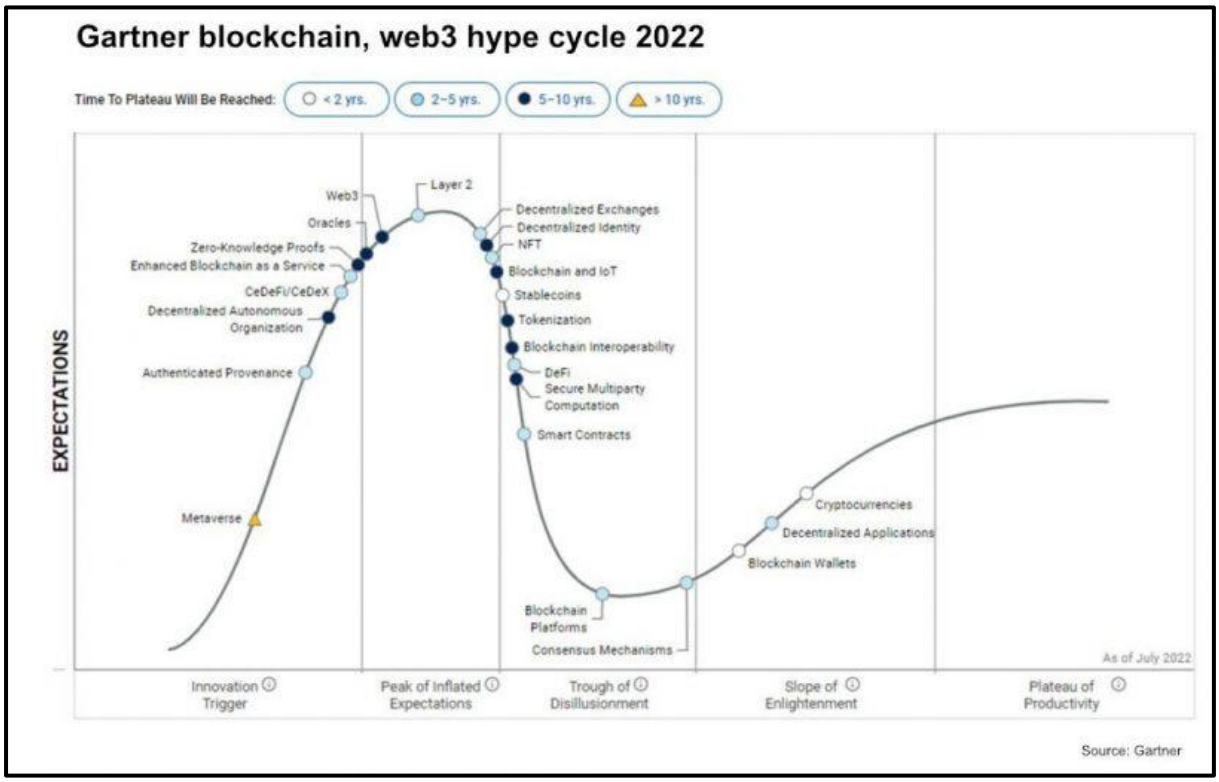


Figure 3 Hype Cycle of Blockchain 2022

Blockchain has passed the peak of expectations and is on the verge of entering the trough of disillusionment, according to Gartner's most recent technological hype cycle. They predict it will take between 5 and 10 years before it reaches the production plateau or the mainstream. The research group highlighted five trends: DIY biohacking, transparently immersive experiences, Democratized AI, and Digitalized ecosystems. Any business that prioritizes the customer experience sees higher financial results because satisfied customers are loyal to them. Because of this, businesses are able to leverage artificial intelligence to enhance their customer service, customer loyalty, and brand reputation, freeing up staff to work on jobs that have a higher economic value. AI-powered bots may assist every touchpoint during the full customer life cycle by proactively engaging in dialogues with customers, providing pertinent information, and starting conversations. The Rasa framework aids the suggested system in accomplishing this task. Rasa is a framework for creating industrial-grade chatbots that are AI-powered. (Weber et al. September 1, 2017)

AIM

Application of Blockchain Technology (Hyperledger) for Tracking and Tracing of Drugs and Medication Supply Chain.

OBJECTIVE

Figure 4 Objectives of the Project

JUSTIFICATION

Understanding the value of medical equipment has been necessary due to tampering of the products within the phase of supply chain of medicinal supplies. Working with the enhancement of the system, not only the medical but raw materials should also be tracked accordingly for integrity of the drugs, to be manufactured. As per the traditional method and concept, the supplier is only able to view the product whereas the consumers are unaware about the product and its delivery methodology. Even for the owner or supplier, they cannot trace and track the product all the time with the help of pen and paper ledger. Tampering of the product has been a problem for medicinal products as they are expensive and, in some cases, unaffordable for some consumers. If they are not regulated for integrity, quality degradation is for sure to be seen in the final product. This technology can be more enhanced if the Government of the country itself takes part such that the illegal transaction of medicinal products also is reduced. (Brakeville, 31, and 17, 2019 | Published March)

One way system has been an improper and traditional technique in-terms of this chain. The supplies from raw materials and chemicals are sent for further manufacturing, followed by a regulation and integrity maintenance. After a proper regulation of product, the logistics department is responsible to transfer the product to either wholesaler or the retailer (hospital, pharmacy).

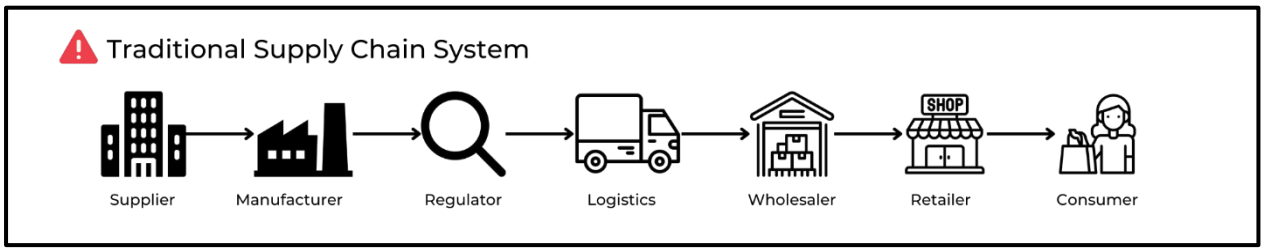


Figure 5 Traditional supply chain system

In order to enhance the supply chain system in terms of drugs and medical product supply, development of a system and its usage is expected. The development cycle of the following order will be effective such that it is planned and delivered accordingly. The development is done on the basis of requirement with an integration of **tracking** and **tracing** technologies via Blockchain. There are multiple methodologies that can be implemented although integration of Blockchain and AI with QR scanning can be regarded as one of the proper solutions. The solution for enhancement of traditional supply chain can be executed and implemented following blockchain or even Hyperledger technology.

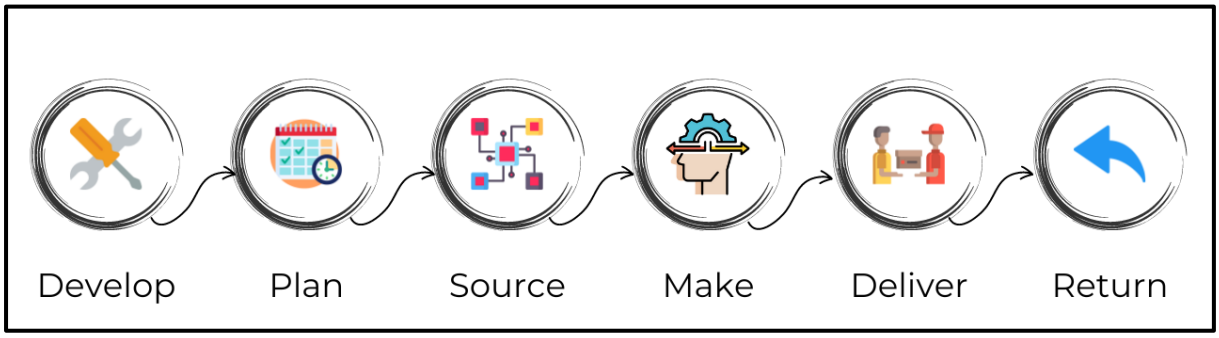


Figure 6 Application Development Initiation

Blockchain itself is an open, distributed ledger that is used in effectivity in storing transaction records in between the two parties following specific standard in between the two parties in a verifiable as well as permanent way. In order to solve counterfeit medicines, blockchain can be used, because this technology is decentralized, distributed, transparent, and immutable. (Gaur and Gaiha 2020)

After implementation of the application, the system will have an enhanced system and with integration of AI in the drugs and medicinal supplies which leads to loyalty, maintain integrity, improve customer service. Furthermore, it enables an easy access for blockchain-based medical intelligence.

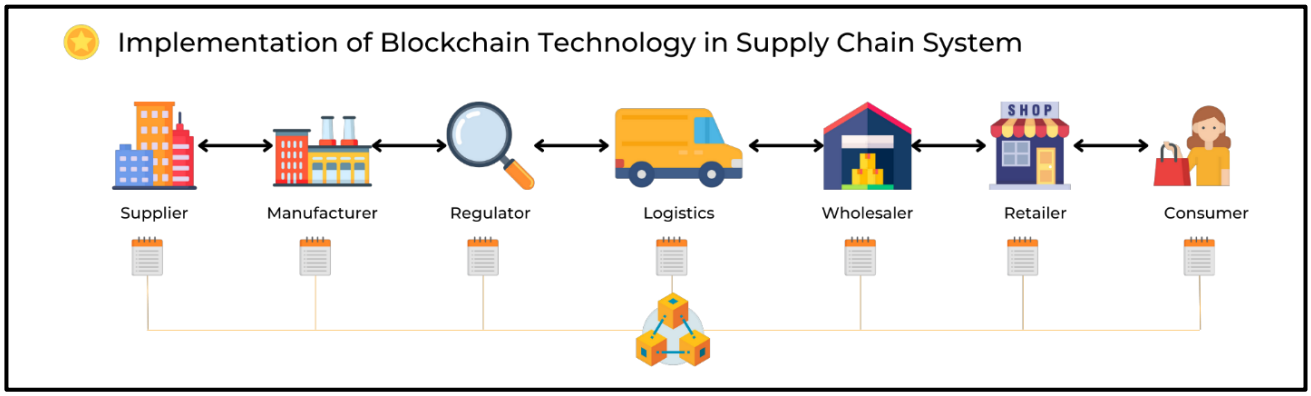


Figure 7 Enhanced supply chain via Blockchain Technology

The colorful enhanced system above shows how the system works after implementation of blockchain in the supply chain system. Each and every track and trace of the product are stored in the log of chain of blocks. As the product moves from one end to another, multiple stages are serially traced using QR code of the registered product. The data stored via blocks keeps the record secure in such a way that even though one block is false or tampered, other blocks will not be able to match causing alert to the top end user or owner. (Anon.b)

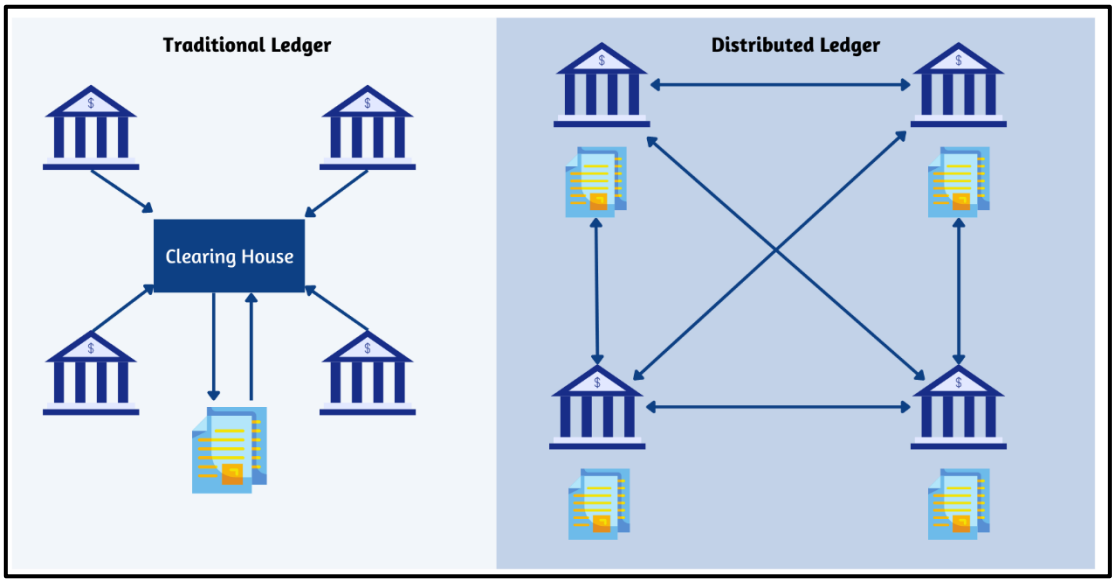
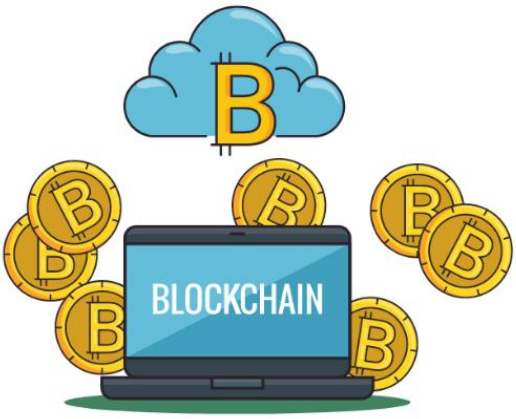


Figure 8 Traditional Ledger vs Distributed Ledger

RESEARCH QUESTION

How can blockchain technology implement in keeping the **Tracks** and **Traces** of drugs, medicinal products and its supply chain?

What are the benefits of using Blockchain in this type of system and is it feasible to implement in a developing country like Nepal?



What are the possible ethical and technological challenges associated with the implementation of Blockchain technology in terms of the supply chain?

Figure 9 Research Questions

SCOPE

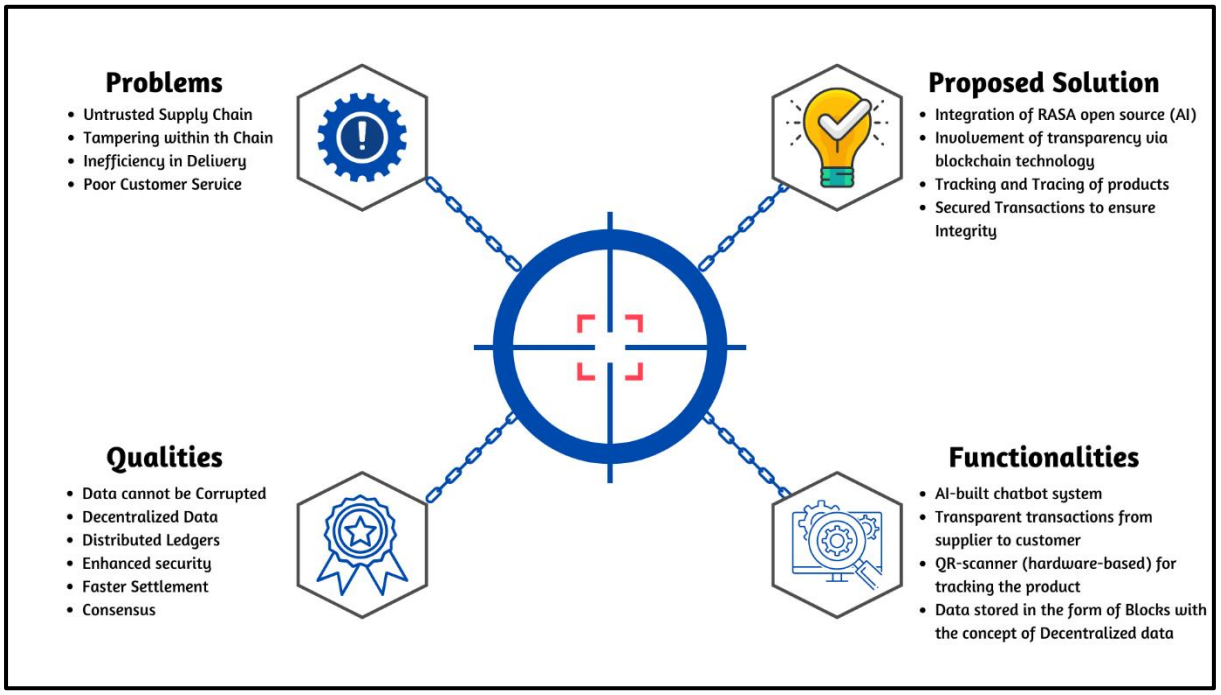


Figure 10 Scope of the Project

ETHICAL CONSIDERATIONS

The dissertation is completed in such a way that the resources are valid and which neither aims nor intends to harm any individual or group. Solving the current issue of the supply chain, the developed project stands as a proposed solution with moral guidelines along with the acceptance of the society. The objectives are fulfilled following human independence, for ethical decision making and facts analyzation. As a student from cybersecurity background, it is the responsibility to maintain the CIA Triad for the dissertation and project.

Figure 11 Ethics Visualized

The integration of AI for future work and current implementation satisfies all the legal standards that are to be applied. The ethical consideration indicated and considered for the research, dissertation report and project completion include the consent of not harming the any source of anonymity, confidentiality, integrity, and copyright.

LITERATURE REVIEW

Research of the project are completed via multiple sources starting with the problem and topic identification for the sector. The sector of the research is analyzed in the initial phase. The project and report consist of detailed study of problem, along with the proposed solution. Sources are identified via valid research papers and journals. Desk based research consists of guidance to the addressed problems and issues. Solution to the possible problems is combined from multiple papers, and are visualized, analyzed as per the necessity. (Anon.2021)

Figure 12 Desk based Research

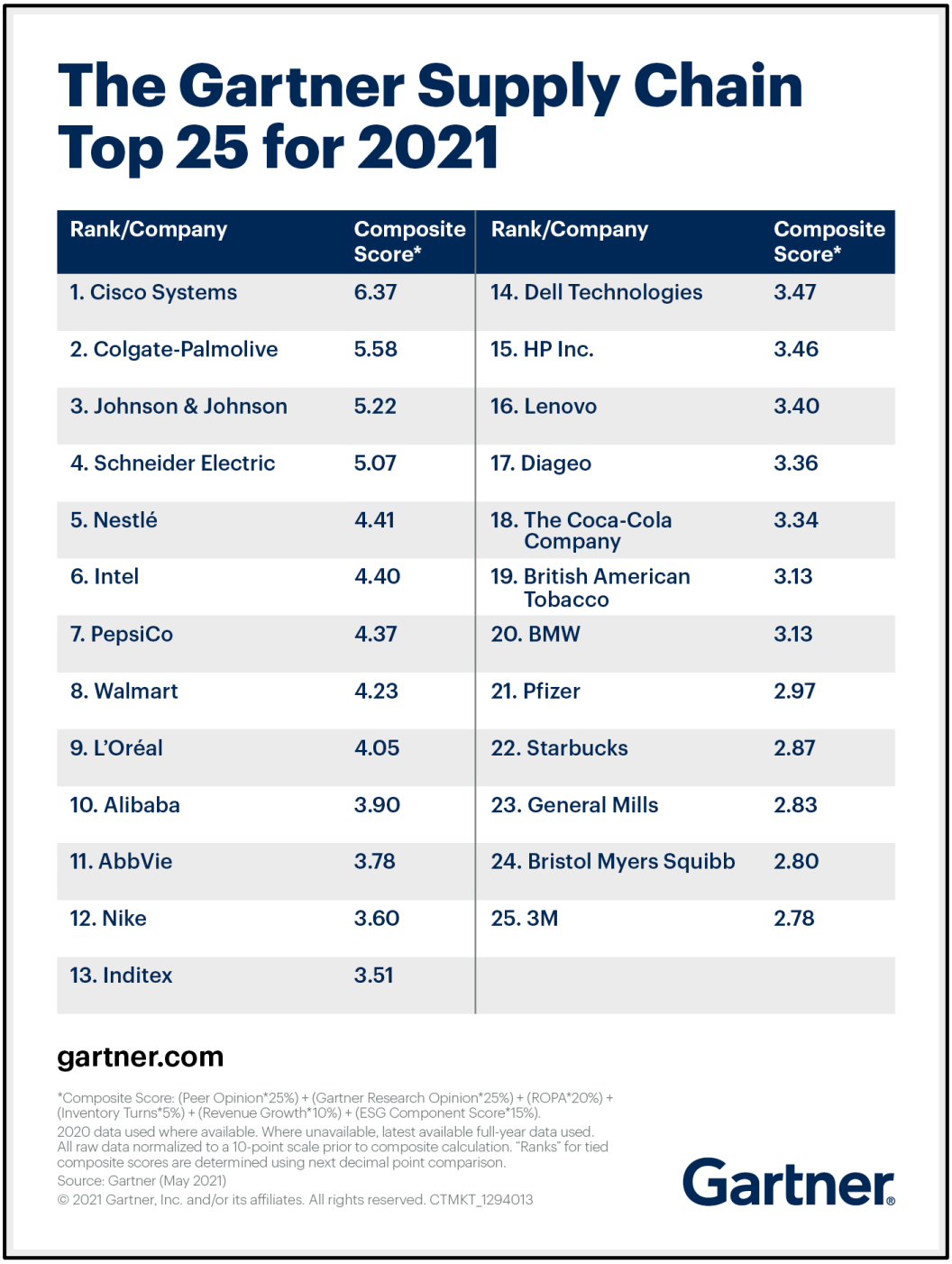
The data thus analyzed are implemented in the project accordingly. Implementation of the tools and techniques in the project will be able to enhance the system as per the necessity, from the current situation. Desk based research are conducted before initiation of the project such that, the project and report will be able to address all the possible risks factors and work on mitigating those problems.

This technique of research is considered to be one of the most effective and low-cost technique in comparison to the on-field research and report collection. Proper utilization of the available facilities and resources leads to a standard conclusion although, it could also be regarded as a total waste of time, in case of ineffectiveness. Some of the resources for desk-based research are:

- Available data on the internet (research papers, libraries, and journals)
- Government as well as NGO agencies with relevant data and project executing reports
- Educational Institutions
- Business information sources (Magazines, Newspapers, TV)

CASE STUDIES

The supply chain system is being implemented in various top supplier companies. As per the report from Gartner, top 25 companies using supply chain system are listed below. These top companies have stated that creation of intelligent supply chain and implementing it accordingly along with automation and integration of AI is the standard approach to boost the performance of the brand as well as customer experience in a simultaneous format. (Gartner 2021)



The Gartner Supply Chain Top 25 for 2021

Rank/Company	Composite Score*	Rank/Company	Composite Score*
1. Cisco Systems	6.37	14. Dell Technologies	3.47
2. Colgate-Palmolive	5.58	15. HP Inc.	3.46
3. Johnson & Johnson	5.22	16. Lenovo	3.40
4. Schneider Electric	5.07	17. Diageo	3.36
5. Nestlé	4.41	18. The Coca-Cola Company	3.34
6. Intel	4.40	19. British American Tobacco	3.13
7. PepsiCo	4.37	20. BMW	3.13
8. Walmart	4.23	21. Pfizer	2.97
9. L'Oréal	4.05	22. Starbucks	2.87
10. Alibaba	3.90	23. General Mills	2.83
11. AbbVie	3.78	24. Bristol Myers Squibb	2.80
12. Nike	3.60	25. 3M	2.78
13. Inditex	3.51		

gartner.com

*Composite Score: (Peer Opinion*25%) + (Gartner Research Opinion*25%) + (ROPA*20%) + (Inventory Turns*5%) + (Revenue Growth*10%) + (ESG Component Score*15%).
2020 data used where available. Where unavailable, latest available full-year data used. All raw data normalized to a 10-point scale prior to composite calculation. "Ranks" for tied composite scores are determined using next decimal point comparison.
Source: Gartner (May 2021)

Gartner®

Figure 13 Top 25 companies using supply chain as per Gartner Report

JOHNSON & JOHNSON

Johnson and Johnson (JNJ) is regarded as the top company to integrate medical supply chain in Global context. As per the Senior Directors of the company, they are heading towards improvised customer service as a part of global supply chain system. They have been working in an advanced planning for further enhancement. The customer of this current generation will demand and expect self-service therefore, the company has started working on the requirement via using digital technology. (Anon.c)

The development of company shows that the core goal for them is AI integrated and intelligent supply chain and importantly **data**. The capability of the company is growing on a daily basis from chatbot enhancement to implementation of new technology. The company has also been able to analyze the customer and patients' data on the basis of data tools for certain forecasts as advanced planning. The data can also be used for calculating the average time for completion of the products' supply chain journey. (Anon.d)

Figure 14 Johnson & Johnson implementing high-tech Supply chain system

In the current index, most of the European and American nations have used J & J antidote for Corona pandemic. The company has data of most of the developed and developing countries and have prepared accordingly for the necessary further actions. Alternatively, the company has a strong and applied chain system, which are monitored consistently failing to meet the expectations for growth.

AMAZON AND NESTLE (AWS)

Amazon Web Services define supply chain as a global network growing the manufacturers, suppliers, logistic companies as well as the retailers for customers. The system is getting more enhanced and complex due to unusual expansion. The company states that if a unique strategy is not used for the maintenance of supply chain, the company is sure to downfall. In order to

expand the consumers and retailers, transparency of the product is necessary such that the end users are aware of the product from very initial state. The AWS system has also focused on transparency of the product such that delays, errors and increased costs are addressed.

AWS have focused on Tracking and Tracing for all the companies associated with supply chain via AWS, for maintaining transparency. It identifies the present location of all the products in the inventory, along with history of all the products. They have also worked with multiple technologies for efficient implementation. The company has also stated that "*tracking provenance throughout this journey is crucial to ensuring product authenticity*."

WHY AMAZON WEB SERVICES (AWS)?

Amazon is the company that initiated Tracking and Tracing of supply chain using blockchain and Hyperledger technology. Therefore, it is able to provide the necessary peer-to-peer network and data verification via multiple transactions. The single source of truth can be visible as per the time stamp which get up to date on a regular basis. Also, they have stated that use of blockchain causes less product tampering due shared ledger and distributed authorization with cryptographic records of all transactions. (Alonso et al. 2007a)

Nestle is the featured company that has been using blockchain technology for supply chain system. Typically, the company has been using Hyperledger fabric model such that the data are manageable within the partner organizations and customers. The company has also stated that the customers are on their track after the implementation of blockchain from the farm to consumption. Not only for Food and agriculture, but AWS has also been working for implementing blockchain in multiple sectors like Pharmaceuticals, Product Manufacturing, and Mining.

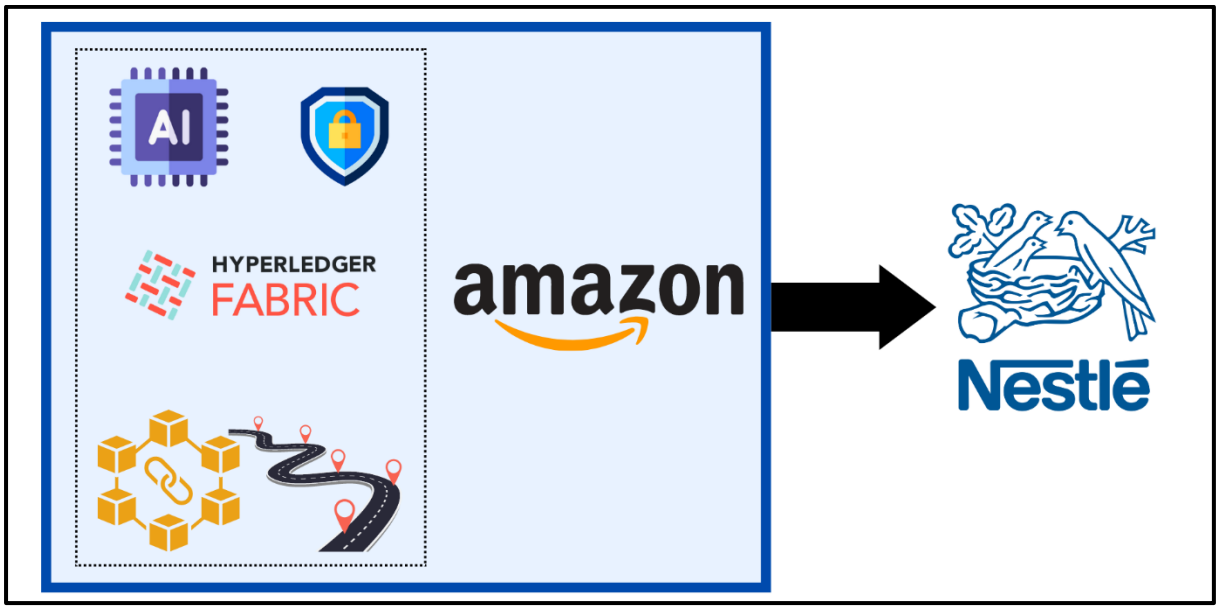


Figure 15 Amazon and Nestle using Blockchain Technology

CISCO SYSTEMS

CISCO is the most active company on the basis of global supply chain system with more than 300 product families in-built with increasing number of targeted spectrum of customers for requirements. The Cisco products are based on customer orders with large percentage of growth within it along with it, the process needs to be Cisco core operations integrated within itself. (Anon.e)

The company claims that the sustainability of the company is based on supply chain and customer satisfaction. This system can be smooth and enhanced by the use of new techniques of supply chain for products. Cisco also aims in sustaining the circular economy with holistic approaches giving value to the assets and turn them into new products along with ecosystem balancing of the operations.

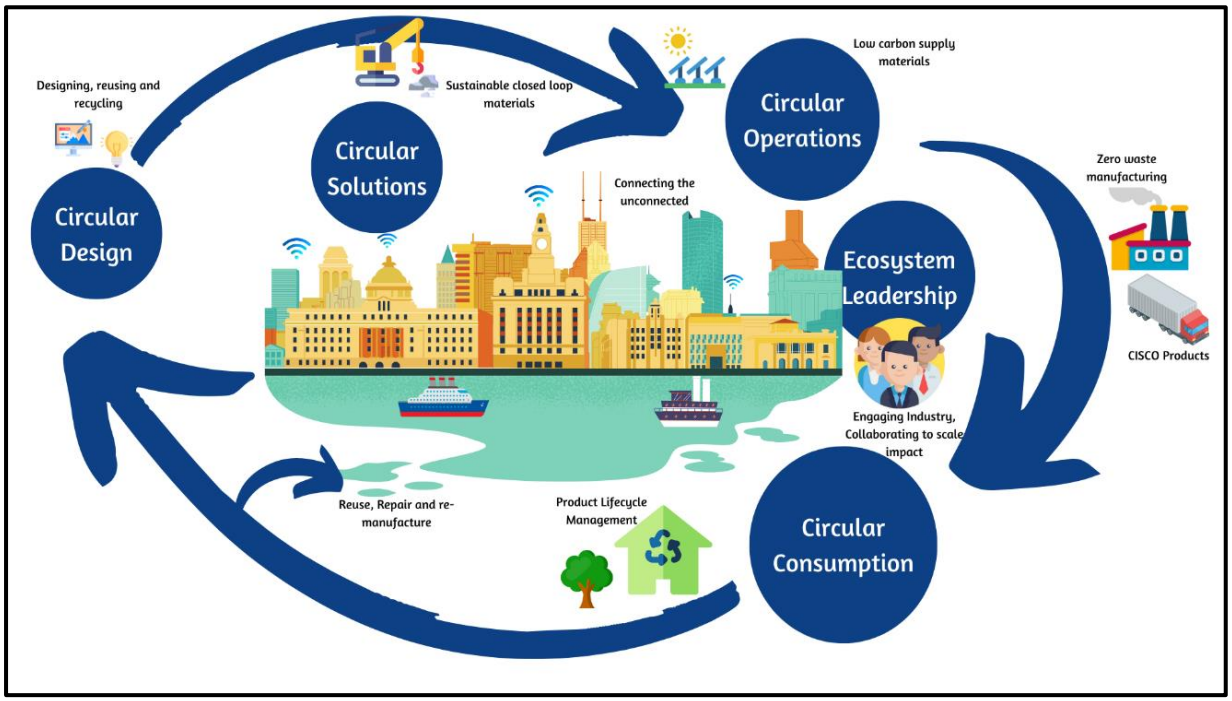


Figure 16 CISCO Product Supply Chain System

Cisco has multiple policies to be followed up for maintenance of supply chain one of them is Supplier guide mentioning sustainability, risk, and security of the product. Blockchain technology has also been maintained by Cisco for Minerals to be used for the final product that are being made, such that the origin of minerals is mentioned in the product data. The company has been working for transparency of the raw materials used and security sector enhancement.

DEVELOPMENT METHODOLOGY

The development of project is based on Agile methodology for increased customer satisfaction, less defect rates, faster development times which also serve as the solution for rapidly changing the project requirements. The project can also have multiple changes due to the feasibility of implementation. The project is accomplished with a cycle starting from planning the project followed by a blueprint and discussion, idea sharing. There are many projects that have changed the format while developing it due to the errors and encountering them.

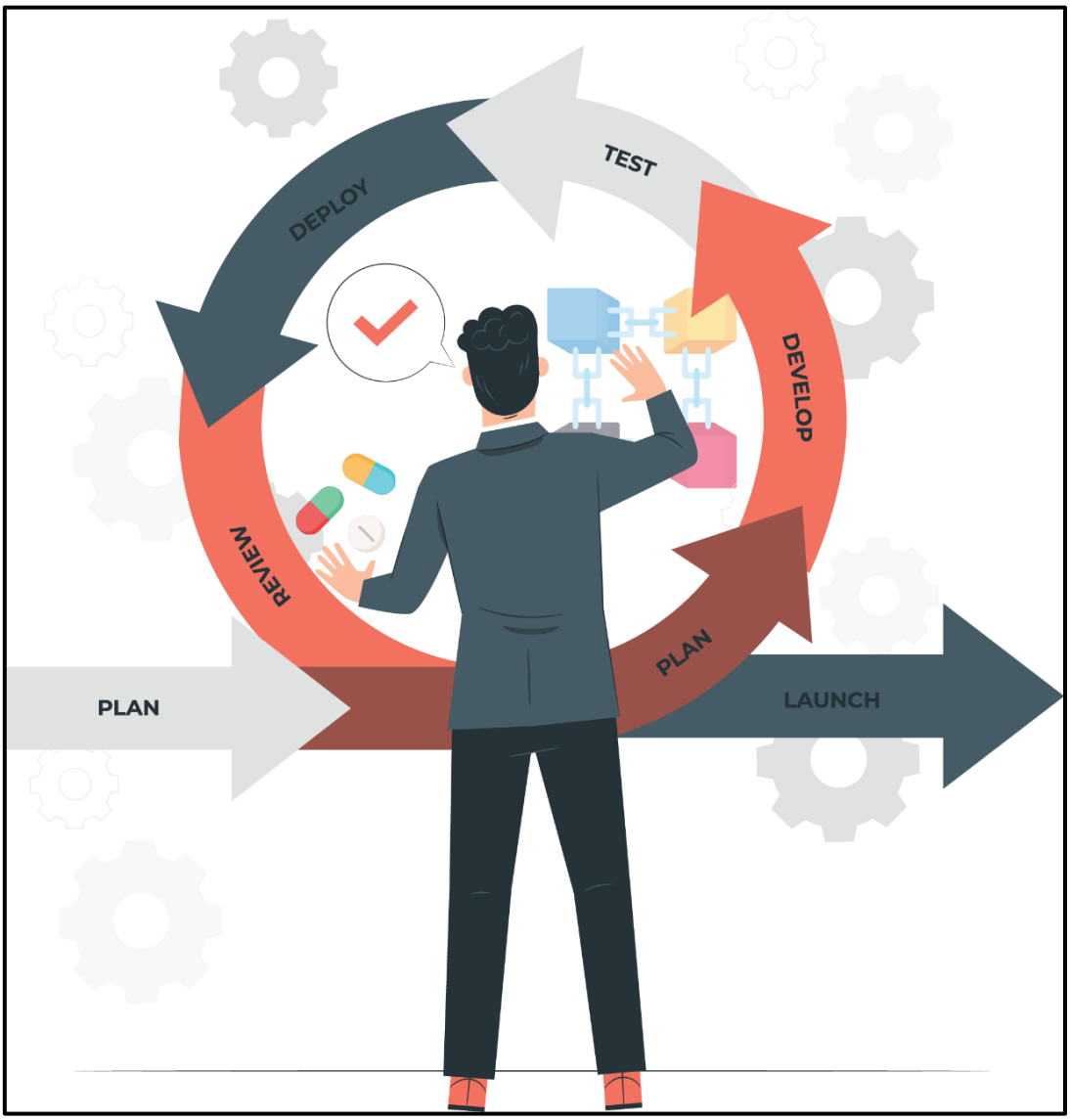


Figure 17 AGILE Methodology Implementation

After completion of the project, it needs to be tested. In this case, the project should be tested and should run successfully after the use of Ethereum and Ganache. There will be problem in development for sure while deploying the final system due to some major as well as minor issues in the program. Once the project is deployed successfully, the project should be reviewed by multiple users such that the major bugs can be fixed and can be launched finally or is ready to be displayed.

TOOLS AND TECHNOLOGIES

Truffle frameworks is a format that is followed for the better compilation as well deployment of the smart contracts. For simplicity in developing the DApp, development tool **Truffle** is used for Ethereum Solidity Language along with testing framework. For a free and powerful open-source editor, Visual Studio Code is used which supports solidity IDE with multiple plugins for the project completion. JavaScript is also used as Web3.js is the library that supports Ethereum, which can also be used for client-side interaction with blockchain. The front-end of the project is completed via ReactJS, such that users can have a standard and interactive flow with different functionalities of DApp.

Figure 18 Tools & Technologies used in the Project

The frontend consists of an interactive logic, written in JavaScript assisted by ReactJS framework. Interaction can be completed with the core blockchain technology used via UI consisting of multiple functionalities of the DApp. Designing tools like Canva and Adobe Illustrator are used to design the architecture of the project along with a strong blueprint of the project. The project is not only based on software basis, integration of hardware is also possible for **QR-Code** scanning, which can be included for the future work.

CRYPTOCURRENCY

A cryptocurrency is a form of digital or virtual money that uses encryption to prevent fraud and duplicate spending. Blockchain technology—a distributed ledger enforced by a dispersed network of computers—underpins several cryptocurrencies, which are decentralized networks. In general, cryptocurrencies are not issued by any central authority, making them theoretically impervious to intervention from or manipulation by governments. This is a distinguishing characteristic of cryptocurrencies.

TECHNIQUES

The concept of smart contract design has been implemented for the project consisting of top layered supply chain contract, followed by the raw materials used for manufacture. Medicine contract is supplied by the recognized distributor with transaction of each and every product with details. The decentralized data storage technology has made the transaction to be shared among multiple users such that integrity of product is maintained at each and every point of supply system. (Singh and Kumar 2012)

The contracts made in each state are recorded in the form of contracts via distributed ledger. Server is the contract which directly interacts with the customer via AI and chatbot such that customer support services is always available.

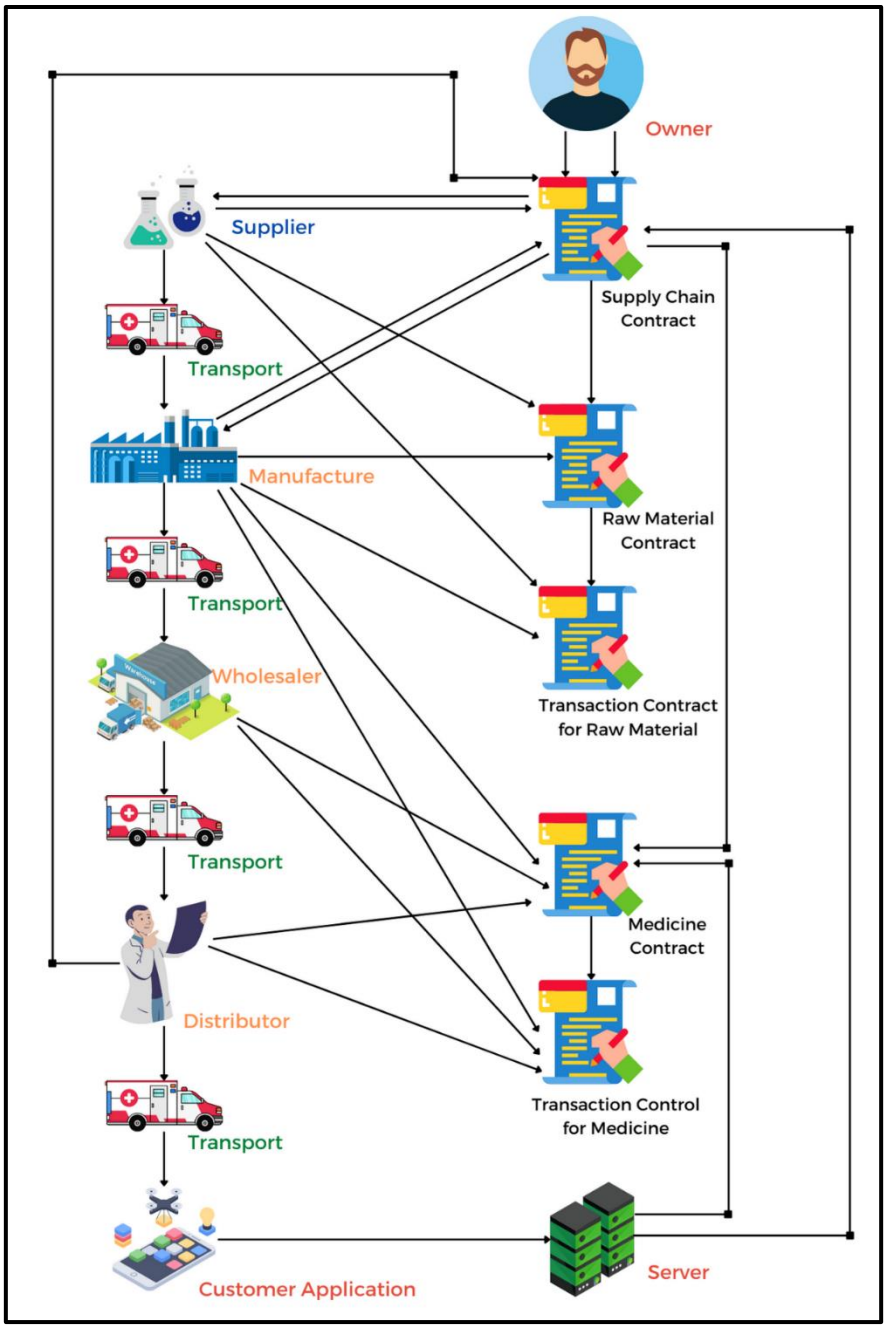


Figure 19 System Implementation Technique

SUPPLY CHAIN CONTRACT

The chain's Owner is the one who deploys this contract. It is made up of a variety of supply chain participants, including the owner, supplier, transporter, manufacturer, wholesaler, distributor, and customer. It also comprises numerous Solidity events that are utilized to interact in real-time with the front end. Only the roles that have been allocated to each service in the contract have access to it. With Solidity's "modifiers", the process is accomplished.

As a result, no entity can access a certain function without playing a particular role. By doing so, the security and usability of data stored on or accessed from the blockchain are improved.

RAW MATERIAL CONTRACT

The Raw Material Contract is deployed by a certain Supplier. The supplier that produced the raw material adds it to the supply chain after it is physically produced. Data like the Supplier's Ethereum Address (EA), Date Time, Transporter's EA, Transaction Contract Address, and so on are required from the Supplier when producing a raw material to be added to the chain. Additionally, it has events that can calculate the package's location on a real - time basis. The event request-response method is used to update the EA of the receiver (manufacturer) later. Additionally, it keeps track of who is currently in possession of the raw materials and the medication's current condition.

MEDICINE CONTRACT

The Medicine Contract is implemented by the relevant manufacturer. A medication is added to the supply chain by the manufacturer once it is physically produced. The manufacturer is asked for information such as the Ethereum address of the raw materials used to make the medicine, the day and time, the transporter's EA, the transaction contract address, etc. when the medication is being made to be put to the chain. Additionally, it has events that may determine the location of the package instantly. Based on the event request-response method, the EA of Wholesaler, EA of Distributor, and EA of Customer are updated later. Additionally, it keeps track of the medicine's present location, or who owns the package at the moment.

TRANSACTION CONTRACT

The Raw Material and Medicine smart contracts deploy the Transaction Contract automatically whenever they are formed. The contract collects information like the date and time, the sender’s, and receiver's EAs, the location, the transaction hash, and the prior transaction's hash. A 32-byte transaction hash is used. An example of transaction data in the smart Transaction contract is the previous transaction hash, which is saved so that entities may confirm the origin of the items in the chain.

PRODUCT TRACEABILITY AND SOURCE VERIFICATION

To create a fresh drug, the manufacturer must need some materials. In that situation, the supplier, who needs the raw material, serves as the seller and the manufacturer serves as the buyer. After the aforementioned procedure is finished, the Supplier will update the transaction information in the relevant Transaction contract in accordance with the product address, and the new raw material recipient is updated in the Raw Material contract. The system expects that

the transaction details won't be updated until both parties to the transaction have truly triggered the aforementioned actions. The source of the product will be believed to be reliable.

EVENT REQUEST AND RESPONSE MECHANISM

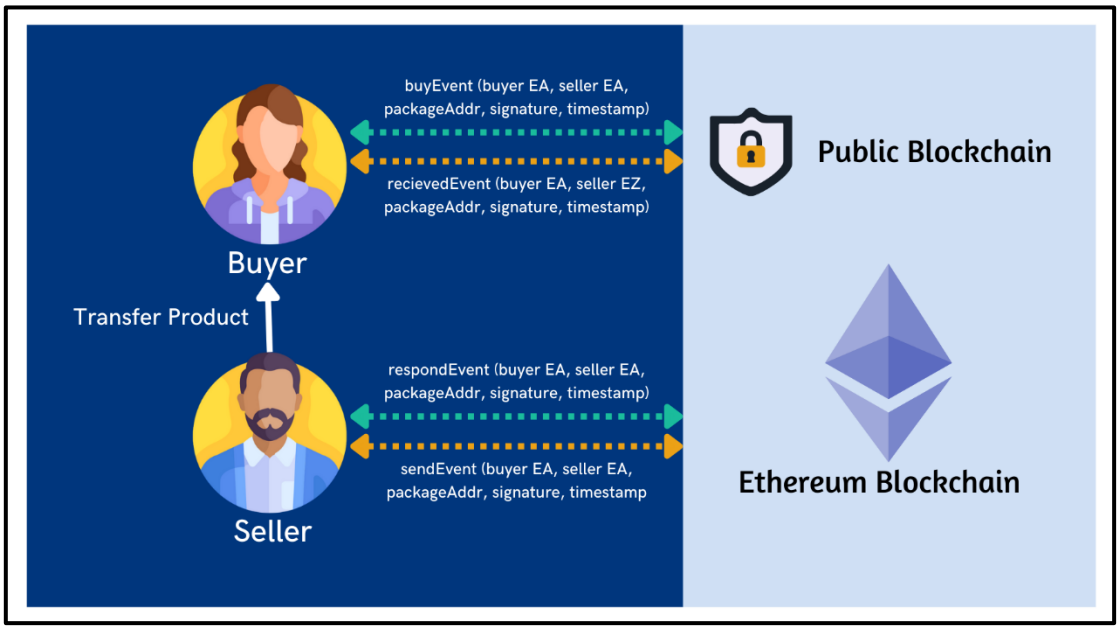


Figure 20 Event Request and Response Mechanism

A purchase request is first made by the buyer. Following that, the Supply Chain contract's buyEvent() event is triggered. The address of the raw material or medicine to be acquired, the buyer's and seller's Ethereum addresses, a signature signed with the buyer's private key, and the request's timestamp are all included in the event. In these situations, the signature is passed along to attest to the parties' identities and the legitimacy of the request. Since each seller may search for their records using their Ethereum address, the seller addresses have been indexed.

The Seller then checks the authenticity of the signature present in the events by querying the log records pertaining to himself using his Ethereum address. If the verification is successful, the seller will trigger an event called respondEvent() to react to the buyer's request and sign it using their private key.

The Seller then uses the Transporter to deliver the item to the Buyer. To demonstrate that the raw materials or medications have been delivered, an event sendEvent() is triggered. This event includes the Ethereum addresses of the seller and the buyer (Seller EA and Buyer EA), the product address, a signature signed with the seller's private key, and the timestamp of the product transfer. Finally, an incidence occurred when the buyer initiates Event() to confirm that the products have been received after delivery. (Anon.f)

QR-CODE SCANNING FOR TRACKING AND TRACING

As the product gets ready, the use of QR Code is done by the manufacturer along with the contracts and the raw materials integrated within it, keeping all the necessary information about the product and manufacture. The generated information is sent back to blockchain and is protected from tampering along with creation of hash values after it.

DAPP AND SMART CONTRACT

Distributed decentralized apps have a high fault tolerance and are especially resistant to attacks. Because they are part of a blockchain, they have direct access to its features and value structures, such as tokenized ownership and identity management, which provide super-simple user authentication and payment processing. The blockchain can instantly transport or move data thanks to smart contracts, which are pieces of code. These instructions specify when and how data should move. These instructions become helpful when combined with the other features of the blockchain because they don't need to be approved by a central authority. (Anon.2019)

A decentralized application's backend represents the full business logic, while the frontend reflects what you see. One or more smart contracts interacting with the underlying blockchain serve as representations of this business logic. Decentralized storage networks like Swarm or IPFS may host the frontend as well as data like images, videos, and audio. Traditional Web apps render a webpage using tools like HTML, CSS, and JavaScript. The data is all kept in a single database that this page communicates with. When you use a service like Twitter, Facebook, Amazon, or Airbnb, for instance, the website will utilize an API to process and display your personal information and other essential data that is stored on their servers. Since individualized data is stored on the server of the service provider, modest degrees of security are employed for identification and authentication using user IDs and passwords.

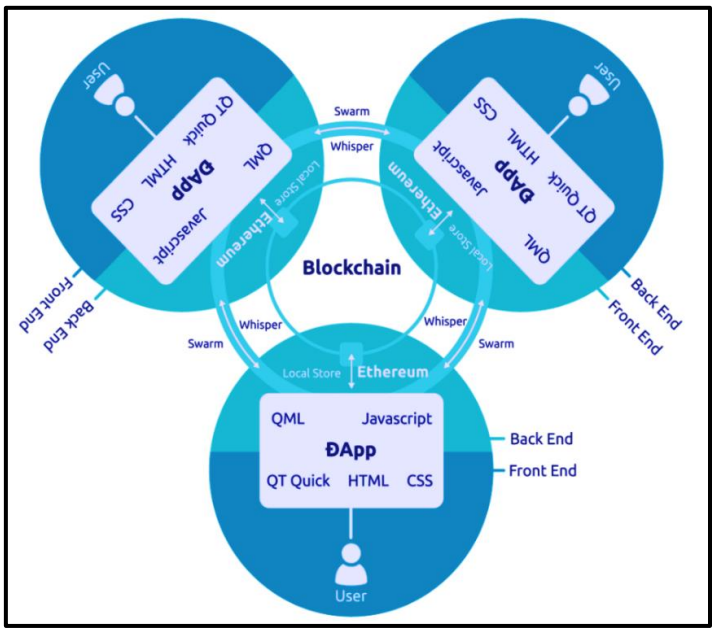


Figure 21 Dapp and Smart Contract **(Anon.2019)**

DISTRIBUTED LEDGER ARCHITECTURE

A sort of database that is shared, copied, and synced across the participants in a decentralized network is known as a distributed ledger. The distributed ledger keeps track of all interactions between network users, such as the trading of goods or information. The ledger's entries are updated by consensus among network participants, who also regulate the system. There isn't any involvement from a centralized authority or a neutral third party, such a clearinghouse or financial institution.

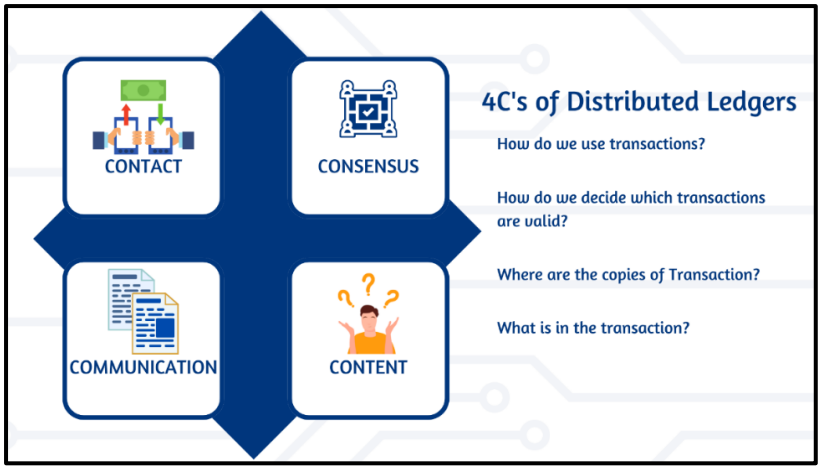


Figure 22 4C's of Distributed Ledger

The distributed ledger is an auditable, immutable record of all network transactions since each record includes a date and distinctive cryptographic signature.

GAME THEORY

The game theory is a simplified representation of the conflict situation, but it can also represent potential cooperation, because game theory's underlying assumptions deal with the search for solutions in conflict situations. Thus, it appears to lean toward the process approach (which focuses on relationships between players), but when considering the game's design assumptions, which include information possession, communication skills, potential outcomes (payoffs), and the usefulness of those outcomes, thoughts are moving toward a systemic approach. Analyzing the supply chain's overall strategy is challenging. However, the analysis's focus may continue to be on distinct supply chain subsystems centered around a few key strategic choices that are fundamental to the strategy's development.

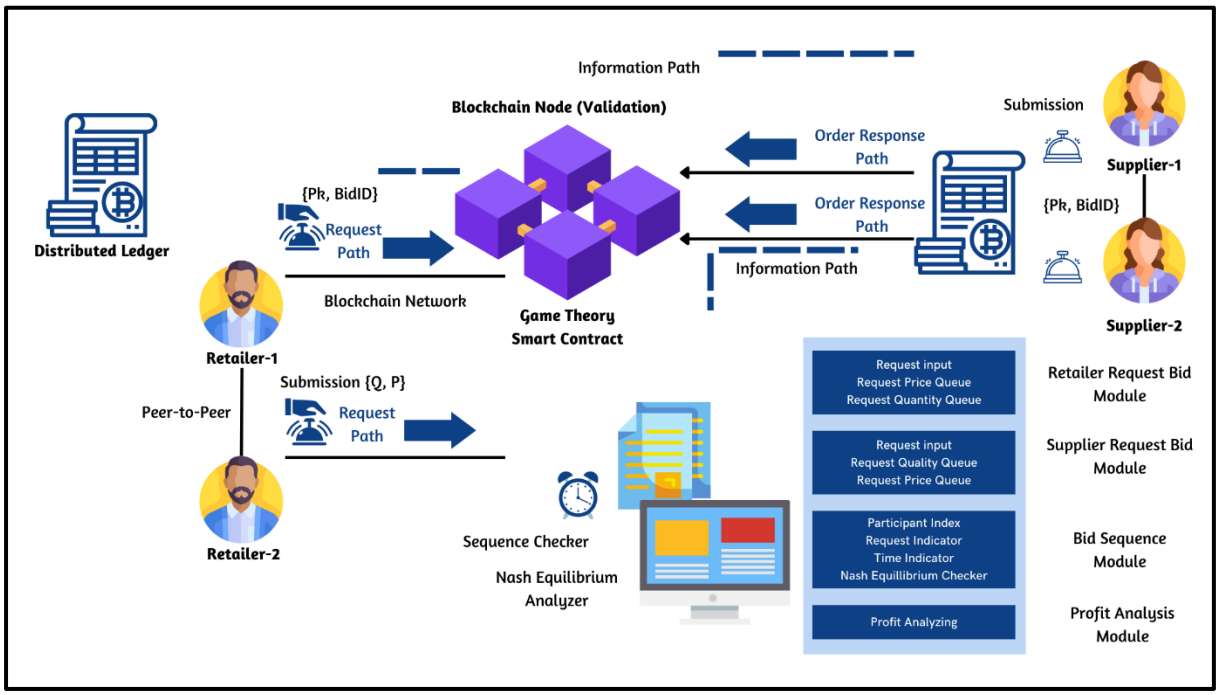


Figure 23 Game theory representation

PROJECT DEVELOPMENT

BLOCKCHAIN ARCHITECTURE

The decentralization and data immutability of blockchain technology are used to implement the system model of the product traceability process in this section. Every node can exhibit both supply and demand characteristics during the process. In the process of creating a product transaction, an event response mechanism is created to make sure that both sides to the transaction agree on the receipt and delivery of pharmaceuticals. Using smart contracts, the transaction data will be permanently preserved in the blockchain. Integration of AI via RASA architecture incorporates chatbot for customer support which can be applicable for mobile application.

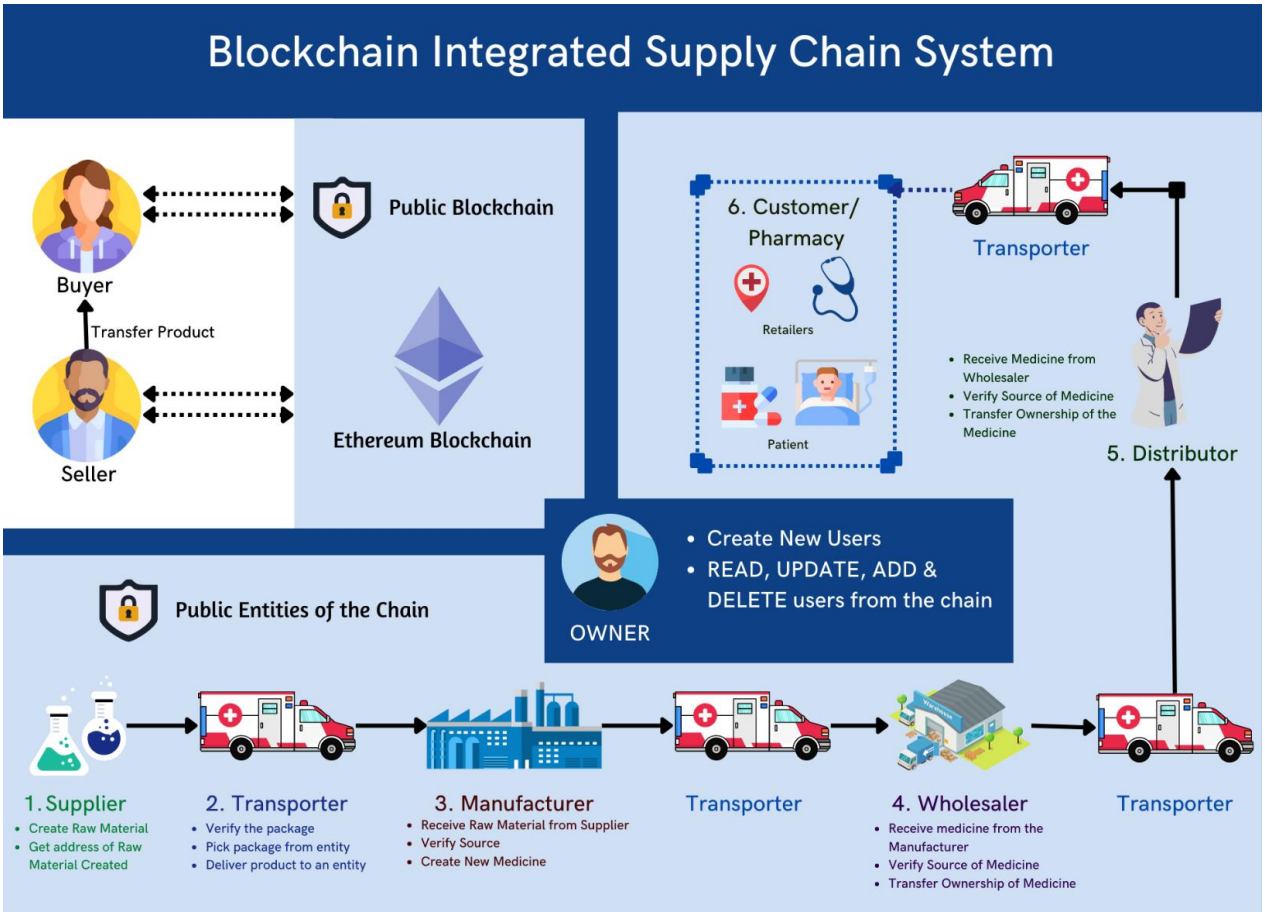


Figure 24 Blockchain implementation for Supply Chain

Furthermore, the figure above displays the architecture consisting of how the system can be completed with the functions. As the proposed system consists of multiple entities from supplier to customers and retailers linked via decentralized platform.

With the growing acceptance of digital currencies like Bitcoin, a new technology called blockchain is rapidly gaining ground. A distributed ledger database is essentially what it is. Blockchain maintains a database of all network nodes' up-to-date records of all transactions, and the entire process is open, transparent, and irreversible. The participants claim that it may

be separated into public, consortium, and private blockchains. The consortium blockchain and the private blockchain are referred to as the permissioned blockchain jointly. (Anon.g)

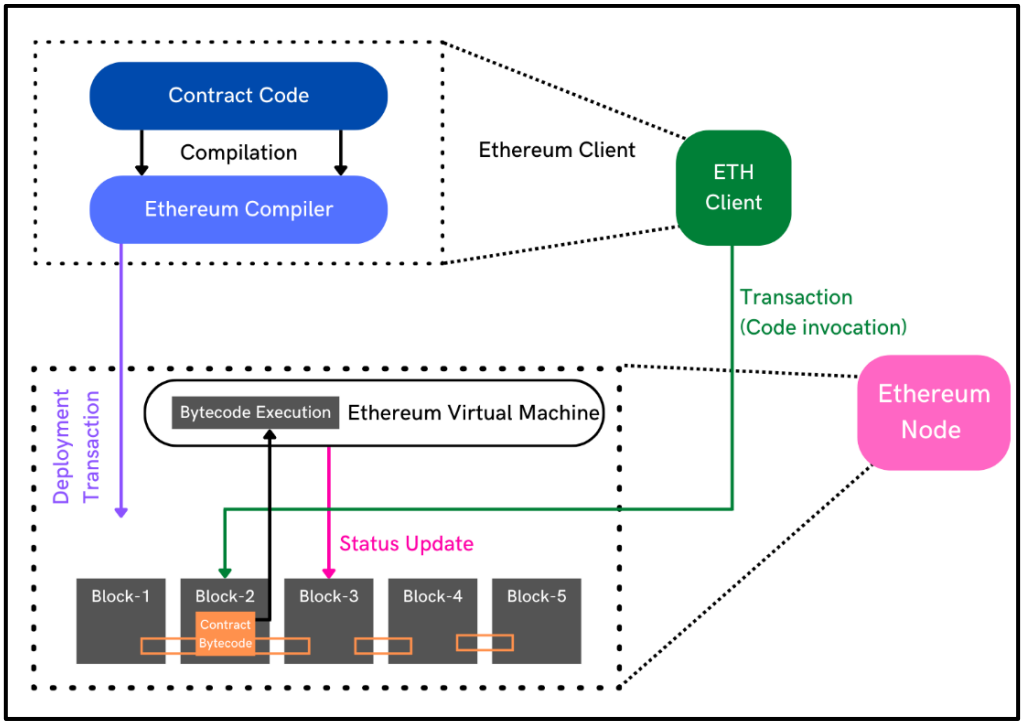


Figure 25 Blockchain Working Mechanism

In reality, the public blockchain is totally decentralized. Any node may join or leave the decision to create a new block at any moment. But under the permissioned blockchain, only a select group of trustworthy nodes may decide whether to create a new block. It has been used in data storage services, identity authentication, and copyright management. (Gaur and Gaiha 2020)

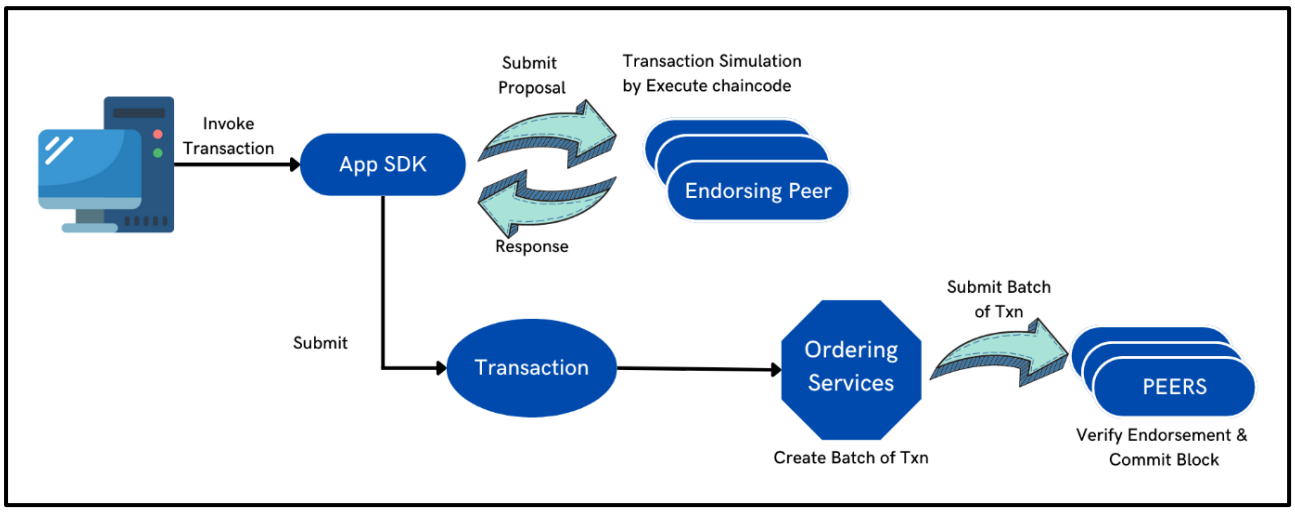


Figure 26 Peer verification and Endorsement

AI INTEGRATION (RASA ARCHITECTURE)

NLU Pipeline uses an NLU model produced by the trained pipeline to handle user utterances. The dialogue management feature determines the subsequent action in a discussion based on the circumstances. The Dialogue Policies are what are shown in the diagram of architecture.

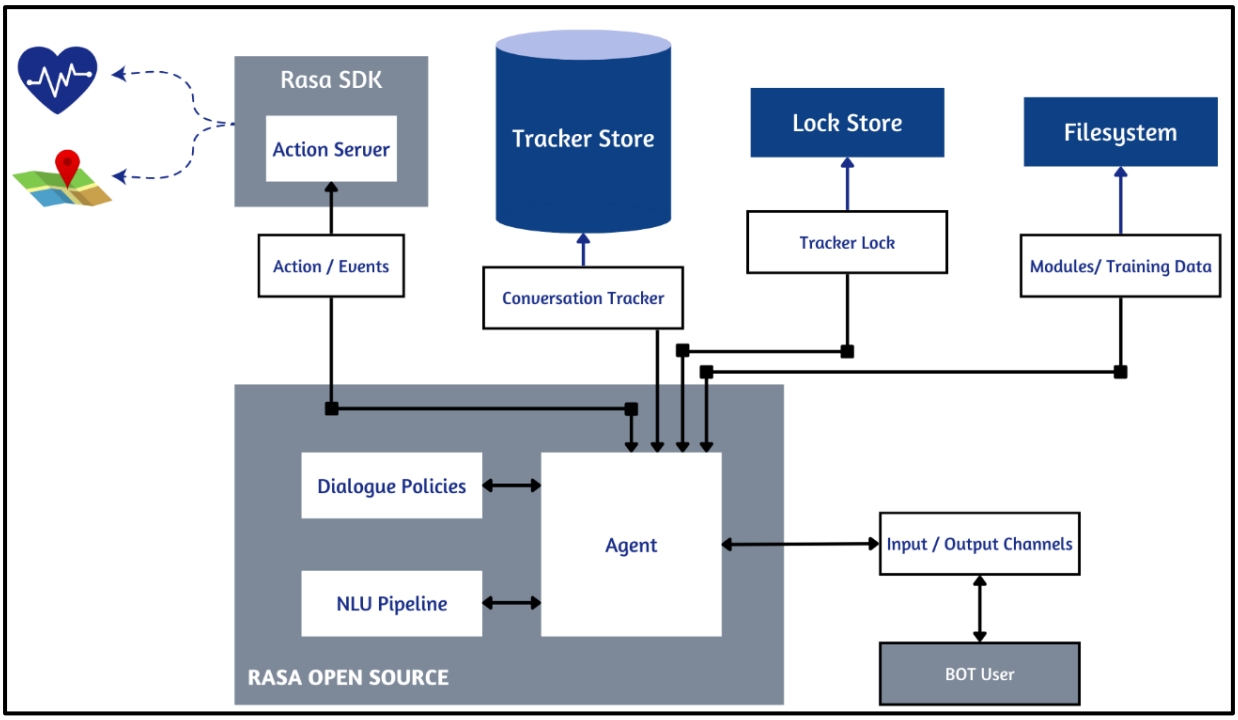


Figure 27 RASA Architecture, AI Integration for Chat bot

A machine learning framework for automated text- and voice-based dialogues is called RASA. RASA can be utilized to decipher messages, engage in discussions, and establish connections to APIs and messaging channels. The processes a Rasa-built assistant takes to react to a message are as follows:

- The message is sent to the interpreter, who interprets it and creates a dictionary of the original text, intent, and entities found. NLU keeps track of the whole process.
- The conversation's current status is recorded by the tracker object. It is informed that a fresh message has been received.
- The tracker's current condition is sent to the policy.
- The next course of action is determined by the policy.
- The chosen action is noted by the tracker.
- The user receives a response.

In the system, a relevant message is returned to the user based with the intent. RASA's chatbot is included in the development such that customer can select the drug available along with the quantity. The validation of user input is done after bill generation. The conversation is stored in MongoDB database for integrity maintenance. Additional feature of the system is that the customer can set the location to fetch queries and the nearest store in the location as per the database. Once the customer has received the product, they can verify the drug via QR code scanning and origin of each and every raw material.

AVAILABILITY AND SECURITY

Supply chain optimization makes the fruitful use of current technology as well as resources with integration of IOT and AI. This technology is used to improve the efficiency and performance of any supply network. The companies like IBM, AWS, Microsoft as well as Oracle have the use of blockchain technology for product tracking. These companies provide the supply chain system to the necessary customers. Although, use of Hyperledger technology, (Hybrid) has started growing, and multiple companies like Nestle have started the use of it. (Alonso et al. 2007b)

Cryptography, decentralization, and consensus are the three pillars on which blockchain technology is built, ensuring the integrity of all transactions. A transaction or group of transactions are contained in each block of data in the majority of blockchains and distributed ledger technology (DLT). In a cryptographic chain, each new block is connected to every block that came before it in a way that makes tampering almost difficult. A consensus process validates and approves each transaction included inside a block, guaranteeing that each transaction is truthful and accurate. (Simplilearn 2021)

Due to the engagement of users over a dispersed network, blockchain technology facilitates decentralization. No single point of failure exists, and only one user is able to make changes to the transaction history. But there are certain important security concerns where blockchain systems diverge.

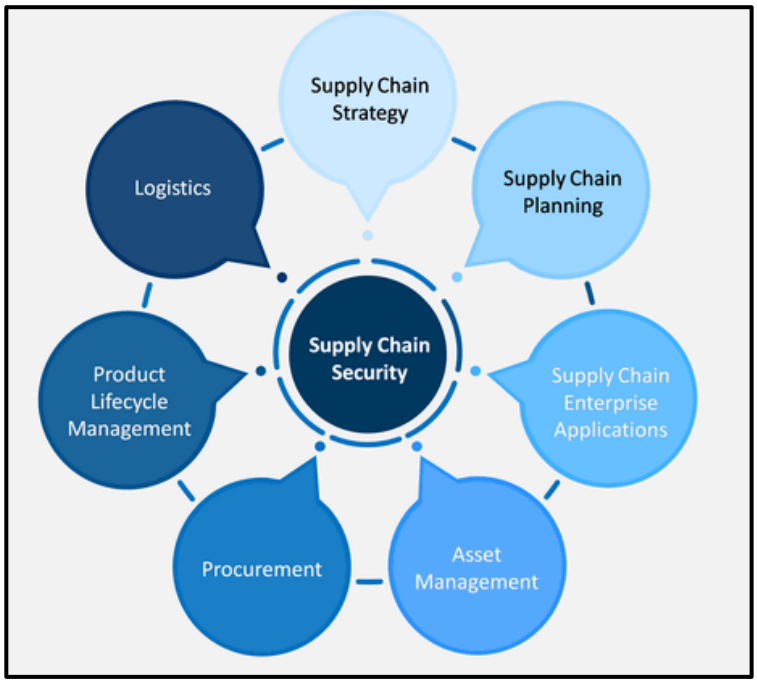


Figure 28 Supply chain Security

BACKUP AND RECOVERY STRATEGIES

Blockchain disaster recovery plans are more adaptable than those for traditional databases since the chain's material is automatically copied to (and recoverable from) other network nodes. However, there are two valid justifications for backing up individual nodes.

First and foremost, it is pertinent to back up the wallet and its keys if the private keys for a node's addresses are not being inadvertently kept outside the wallet. Furthermore, no additional transactions may be carried out on behalf of an address if the private key is lost forever. (Anon.)

Second, it could make sense to back up the node's full state if a node needs to recover fast from a system failure without the latency incurred by downloading and reindexing the blockchain's contents. Below are descriptions of each of these approaches as well as details on how to recover various backup types. Additionally, it should be highlighted that clustering can be used in place of backups and as a workaround for the requirement that nodes be stopped in order to backup their whole state.

UPDATES AND UPGRADES

The enhanced supply chain system consists of tracking and tracing of the products, whereas there are furthermore plans that are to be executed on a standard basis. Release of updates as per the necessity is required such that new additional features like QR Scanning can be added. Furthermore, the frontend of project is done via Web3.js, which can be more enhanced accordingly.

The supply chain system and new strategy are being build up by multiple big companies from time to time in a competitive form. They tend to execute new technique and later followed by other similar companies. Therefore, it is sure that updates and upgrades will be available to the end users as well as suppliers after a certain time period.

FINDINGS

Implementation of Blockchain, has enhanced the supply chain system along with tracing and tracking ability in each sector after delivery of the medicinal drug products. For ensuring the safety of the product, the products implement tracing and tracking mechanism from the very early stage i.e., from raw material and manufacture. In the end, consumers will have the feature of product tracing with QR code scanning methodology, from which they will be able to find out the origin of the drugs they have been treated with. Integration of AI (Artificial Intelligence) along with QR generation has simplified the effectiveness of the product’s traceability.

QR code generation for each product can be integrated such that the inventory management for studying the fact of the product. Because businesses do not need to buy scanners to effectively record inventory transactions, QR codes help keep costs down. Because smartphones are more practical and simpler to use, staff of storage facilities and warehouses prefer to scan QR codes with them. Smartphones can be used for inventory management tasks in a warehouse without needing to be physically linked to or near a computer. In conclusion, QR codes are increasingly being used in supply chain operations since they can be read by smartphones simply and carry more data and information.

There are multiple benefits of using blockchain for supply chain system enhancement, although in case of developing countries like Nepal, there are multiple obstacles. Blockchain system has been tested in the agricultural sector of Nepal, in the case of supply chain system. For the use of blockchain, legalization of cryptocurrency is necessary. Due to political instability, and issues, it has been illegal since the early stage of blockchain globalization. There are companies like

eSatya that have started the use of blockchain technology for the socio-economic growth of Nepal. Although for the standardization of the system, the cryptocurrency should be legalized and should be implemented in every sector of data management, which still has not been the solution. Summarizing, the system of blockchain has been a problem for creating an impact in supply chain and its enhancement.

As the blockchain technology is vast and complex for implementation in terms of supply chain, the distributed ledger system has helped data management in a systematic manner. During the deployment of the system, there is sure to have multiple errors due to unfamiliar data. Blockchain is much slower at retrieving and committing records than a conventional database is. It also calls for a lot more computational resources, and the scalability of those resources is a major worry. In addition, any systems engaging with the Blockchain must be interoperable. The fee should be brief and adaptable enough to allow for cashing in any other currencies (including FIAT money). In the subcategories that follow, the project concentrates on these two topics from the prior subsections, Scalability, and Interoperability. (Nur, Hakim, and Amrozi 2020)

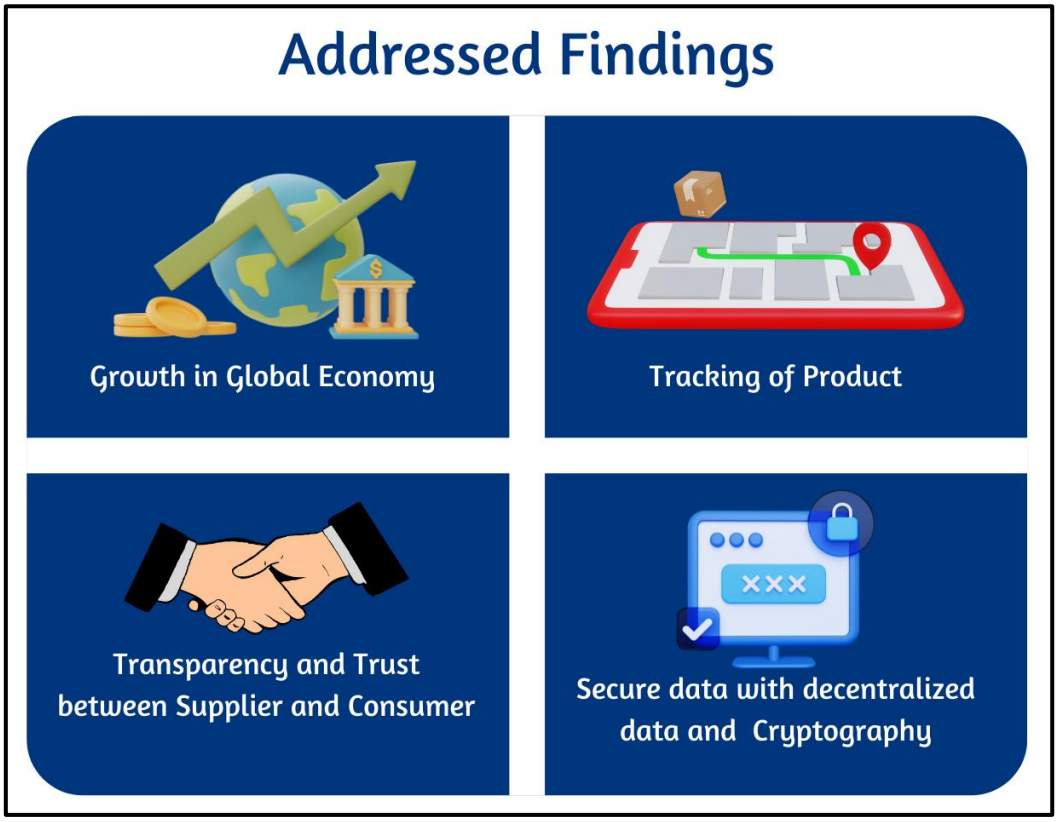


Figure 29 Summing the Findings

After the integration of blockchain technology in the supply chain system, database of the using companies has been standardized into the next step of technology implementation in global context. This technology has also brought up a proper relation in between the customer and supplier, leading to the growth of the company, with secured transaction and cutting off all the middlemen and corruption.

ISSUE AND RISK MANAGEMENT

A systematic technique for identifying, evaluating, and dealing with hazards to which an organization is exposed is known as risk management. The application of decision sciences can improve risk management in organizations. During the phase of project completion from the initial stage, there are many risks factors affecting the entire deployment of the system. Therefore, certain plans and execution are required for mitigating and solving the issues. During the phase of completion, the issues were all covered up and were listed in a tabular format, displayed, and discussed along with the impact of all the risks resolved. (Nur, Hakim, and Amrozi 2020)

ISSUES

Risks	Risk name	Occurrence	Impact	Auxiliary Plan
1	Lack of knowledge	Very high	Disaster	Learn and learn more
2	Health problems	Medium	Medium	Take precaution
3	Project Completion and Time Allocation	Medium	Medium	Completion till the capability and keeping the future plans for further extensions
4	Filtering the Contents	Medium	Medium	Review from multiple sources
5	Complications while Implementation	High	High	Seeking for additional supports from seniors and mentors
6	Compatibility of the software to be used	Low	High	Use the dedicated version of tools
7	Gas usage via Ganache	High	High	Implement the necessary techniques and research
8	Error while building up contracts	High	Medium	Regulate the import section of the files
9	Network and connection of project and Deployment	High	Medium	Test the system time to time
10	Research from allocated section	High	High	Allocate and study appropriate

In order to mitigate the risk factors, creation of checkbox of risk management before initiation of development assists the development in a significant process and standard. Companies should use this checklist as general advice and engage with the appropriate internal stakeholders to proactively identify, prioritize, and manage the risks pertinent to their particular project. Guidance on corporate risk management initiatives is not covered under the scope of this module. Topics to be included in the checklist are:

- Data privacy Risk
- Blockchain protocol interoperability
- Security and Integration
- Governance and Control Risks (during deployment)
- Auditability and Asset Management
- Legal and regulatory, Antitrust
- Financial Risks

Furthermore, during the phase of development there were following risks due to integration and 33implementation of blockchain for the supply chain system.

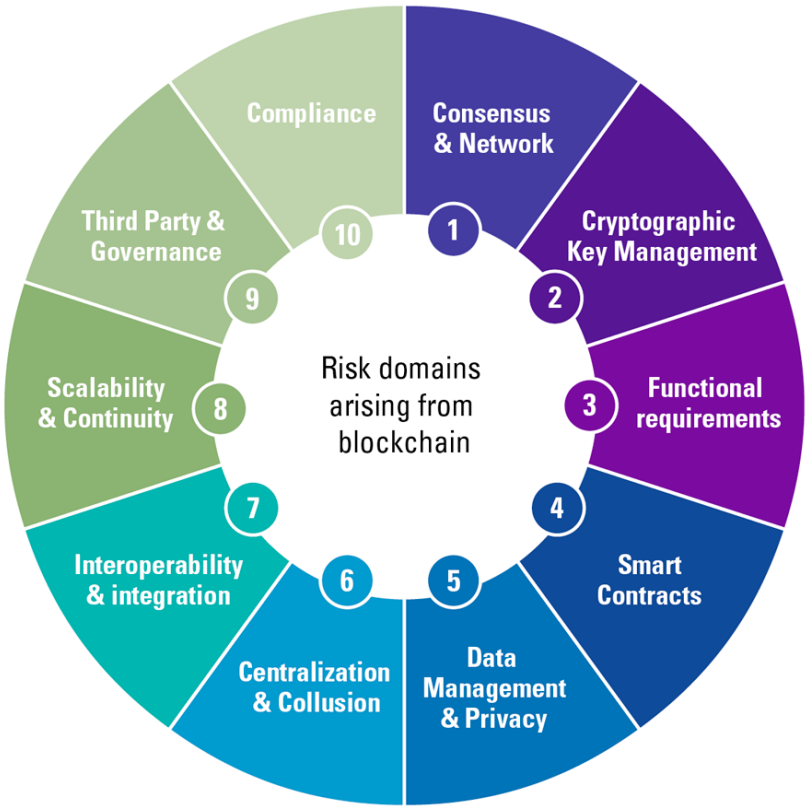


Figure 30 Risk Domains from Blockchain

During the project development, there are multiple risks to be addressed before the deployment. The development itself is complex in terms of deployment and response from the contracts. Following the guidelines of development of smart contract as well as game theory concept, the integrity for data of the supplier and consumer, domains are set.

RECOMMENDATION

There are factors in the blockchain technology that maximum number of companies cannot influence. In order to mitigate the possible risks in the phase of development and report writing, different analysis is completed and one of the important one is PESTEL Analysis. This analysis does not only assist the companies for the determination of the market study and situation, but it also enhances the system by effective use of extensive networks.

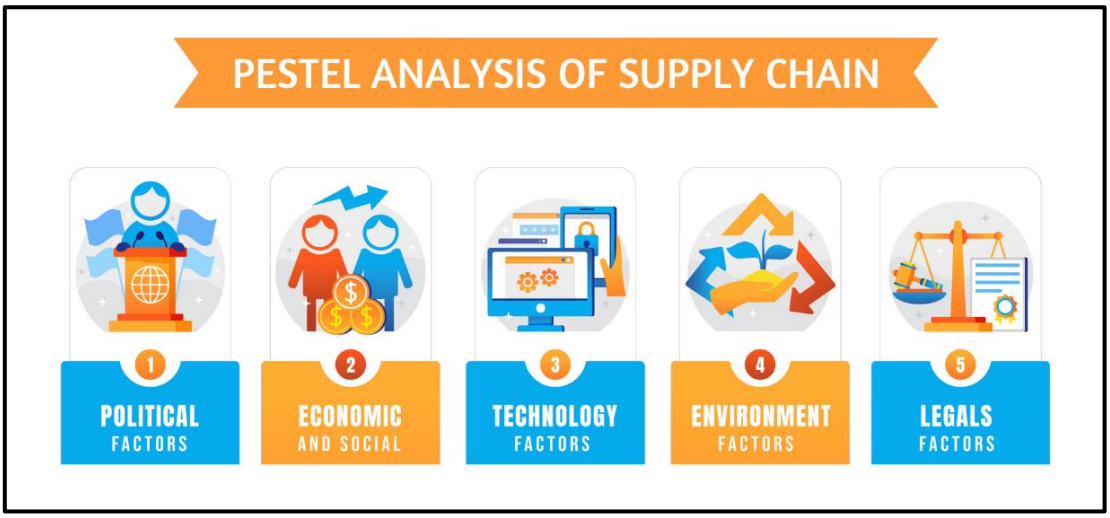


Figure 31 PESTEL Analysis

The traditional practice implementing society will completely take a new turn if the technology is applied for the medication sector. Blockchain implementation will be leading to the significant change in the political system and the policies govern by them. In an addition to regulating the interest rates and state spending, government officials are the policy changers who tend to manage the economic conditions in the part through the tax legislation. In the case of Nepal and blockchain, the government has not implemented the blockchain technology declaring use of blockchain as illegal. (Kyle Peterdy)

In terms of technology and environment setup for the project, there are many complications and errors that need to be addressed in the particular state. The risks should be completely avoided such that there is less error while deployment. The project will consist of a proper environmental setup for all the tools, and applications to be executed as per the requirements. Some devices and system updates can cause errors while project execution and deployment. In case of developing country like Nepal, there is no testing environment for real world scenarios, because the deployment of project in real world is considered to be illegal.

FUTURE WORK

It is crucial to see the difference between today's centralized controlled world and a total decentralization of every part of business transaction as a spectrum, looking ahead and beyond the scope and context of the issues discussed in this book.

It is not simple to fully decentralize the internet and realize the potential of the blockchain. The transformative initiatives conducted by industry leaders and industry consortiums could be seen as an effort to comprehend the dangers associated with transactions, trust, and technology.

Most commonly, industry rivals or startup organizations claim that this is done before fully embracing the decentralized world. The spectrum itself is intriguing, and on both sides of the spectrum, creativity is being nurtured. Understanding industry-specific innovation and adoption trends is crucial because they may point to whether or not blockchain-powered business networks are ready for production. (Anon.h)

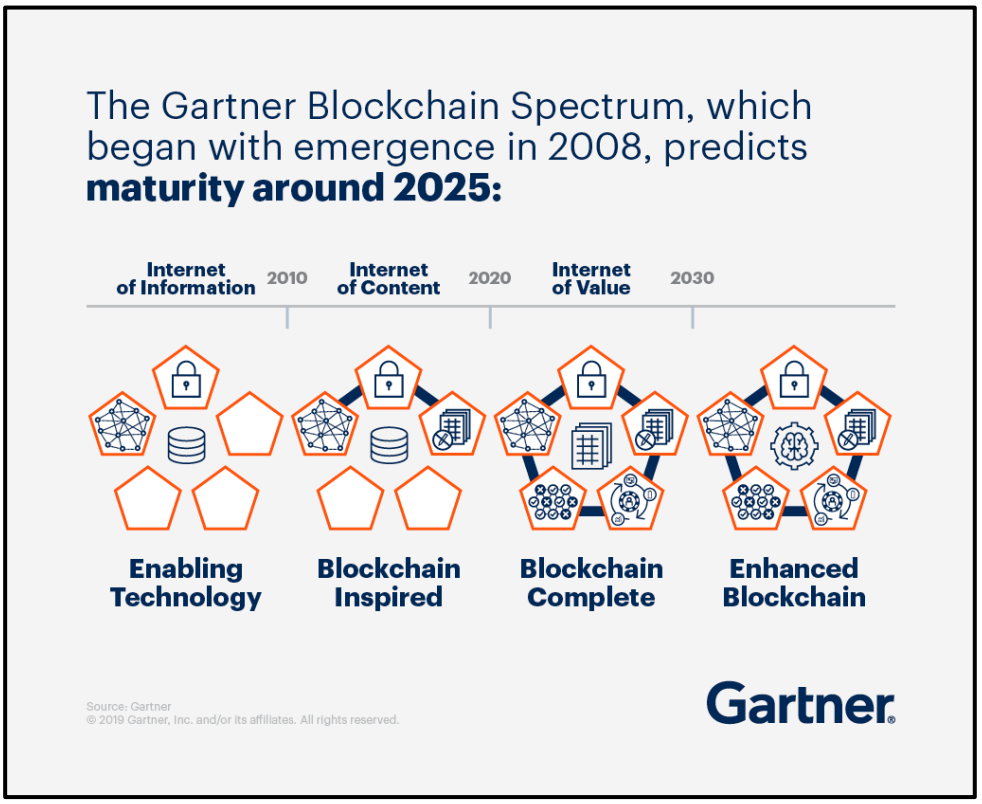


Figure 32 Past and Future prediction of Blockchain

The growth from above table displays how blockchain implementation has and will be enhancing multiple sectors of business and security. For the growth after implementation, the future plan is to integrate a mobile application with all these features along with QR code scanning ability of the application itself instead of the retailer.

CONCLUSION

The solution for a smart anti-counterfeit pharma supply chain is suggested in the study and is based on AI and blockchain technology. All product transferring records are permanently documented in the immutable ledger through the use of smart contracts and product registration and transfer. The integration of smart contracts enables product tracking. Consumers may take part in preserving information flows as well. Due to the proposed system's strong decentralized features, it is far less likely that data would be altered secretly. The Rasa chatbot takes care of better customer service, medication information transparency, and order movement along the supply chain.

Additionally, an event request-response procedure was developed to confirm the legitimacy of the event by confirming the identities of all parties and the signature included in the event. Every occurrence may be documented and kept as a log on the blockchain, where it can be accessed in real time. Finally, a decentralized application (DApp) based on the Truffle framework was created, along with a smart contract deployment, smart contract testing, contract code implementation, and a decentralized web app interaction interface based on a prototype. Data accessibility, tamper-resistance, and defense against man-in-the-middle attacks are the system's distinguishing features.

With the use of blockchain, a distributed Hyperledger can be created without a single central authority. Due to the immutability of every transaction on the blockchain, private information such as customer or drug information cannot be altered. In addition to fostering trust between the different key players in the supply chain, including manufacturers, middlemen like distributors and suppliers, and end users like customers, retailers, and hospitals, blockchain also offers complete transparency. Using an event request-response framework, every product within the chain may be moved between the various authenticated chain entities. With the use of smart contracts, the blockchain is used to store all transactions between the various entities.

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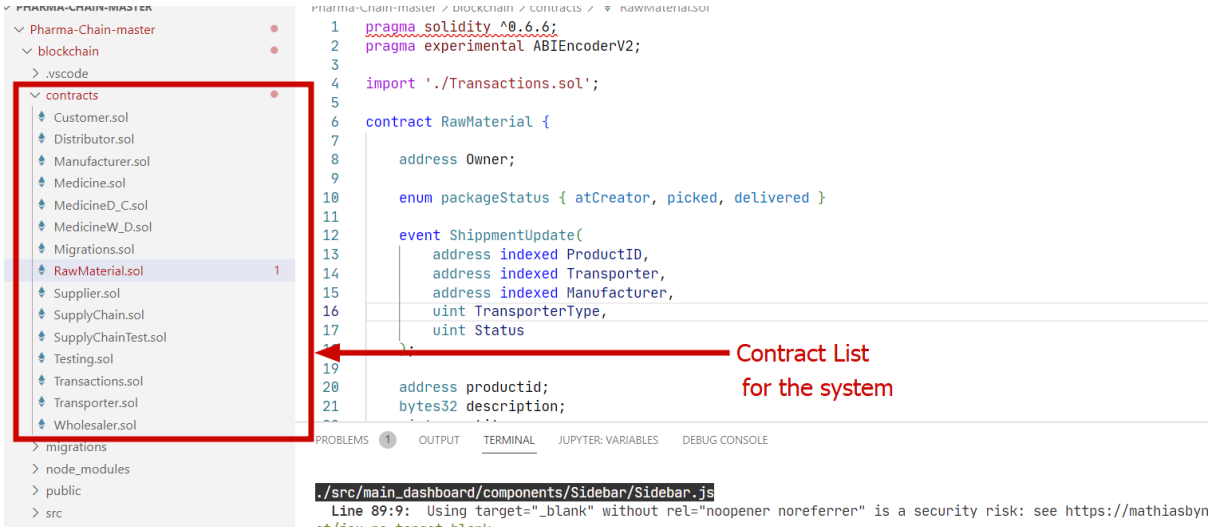
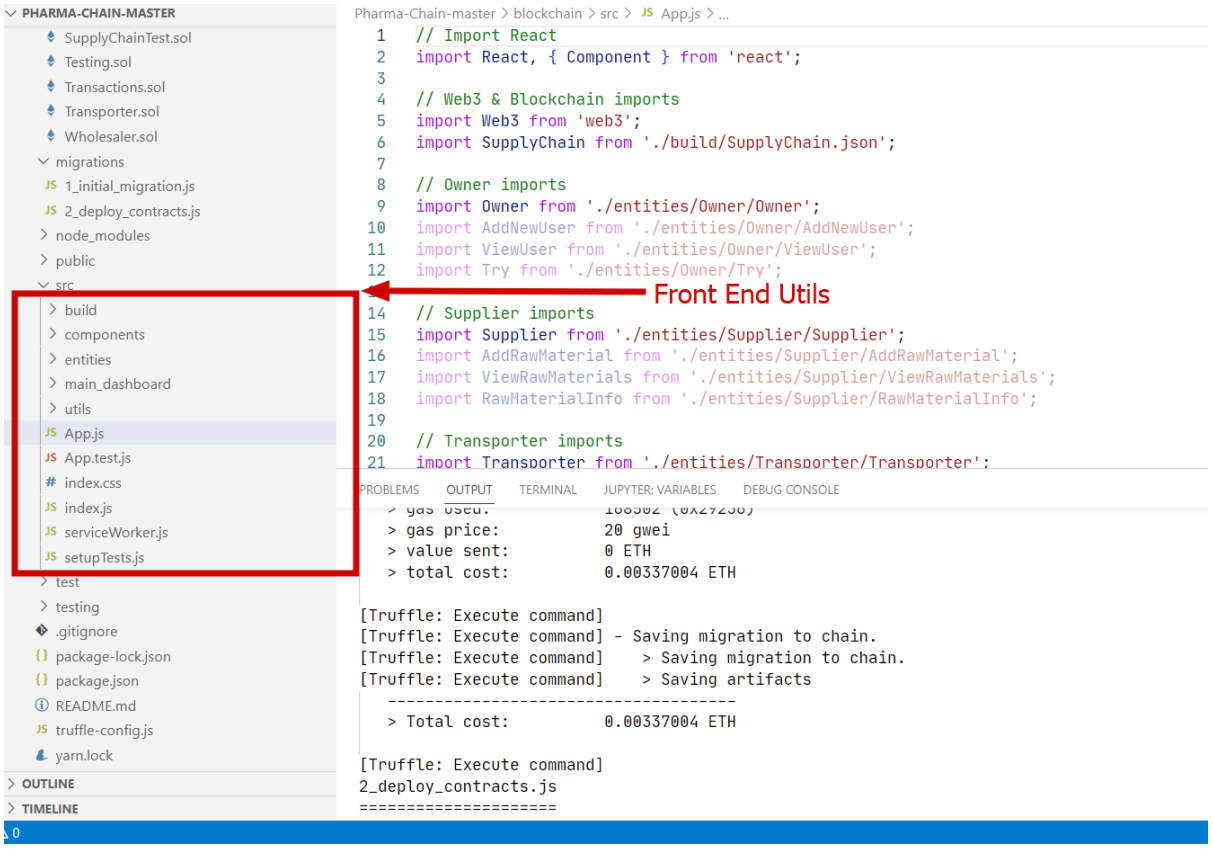
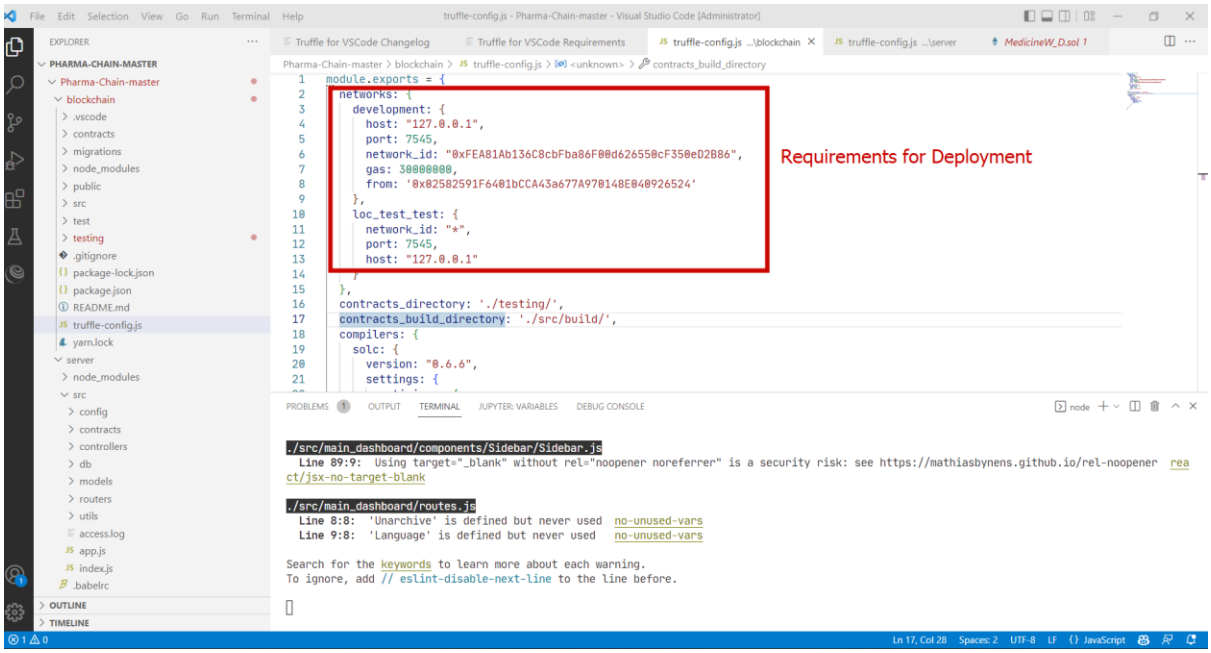
APPENDIX

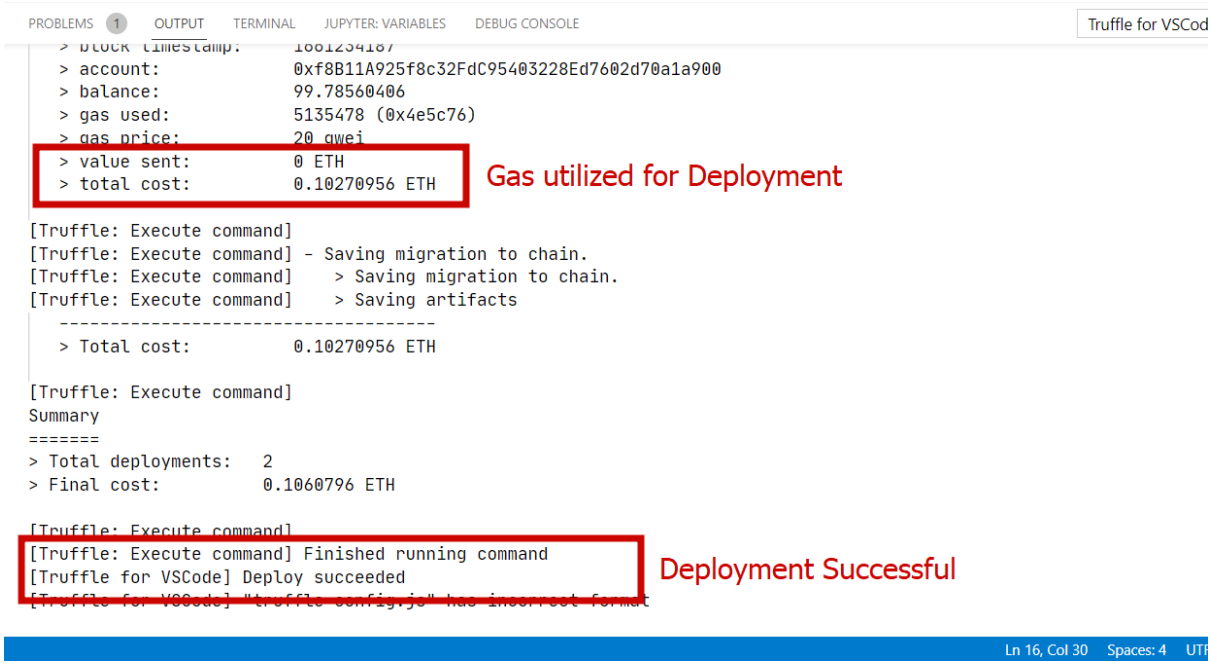
```
Pharma-Chain-master > server > truffle-config.js > <unknown> > contracts_build_directory
1  const path = require("path");
2
3  module.exports = {
4      contracts_build_directory: path.join(__dirname, "C:\Users\bipin\OneDrive - Coventry University\Desktop\course\Semest
5      networks: {
6          development: {
7              port: 7545
8          }
9      }
10 };
```

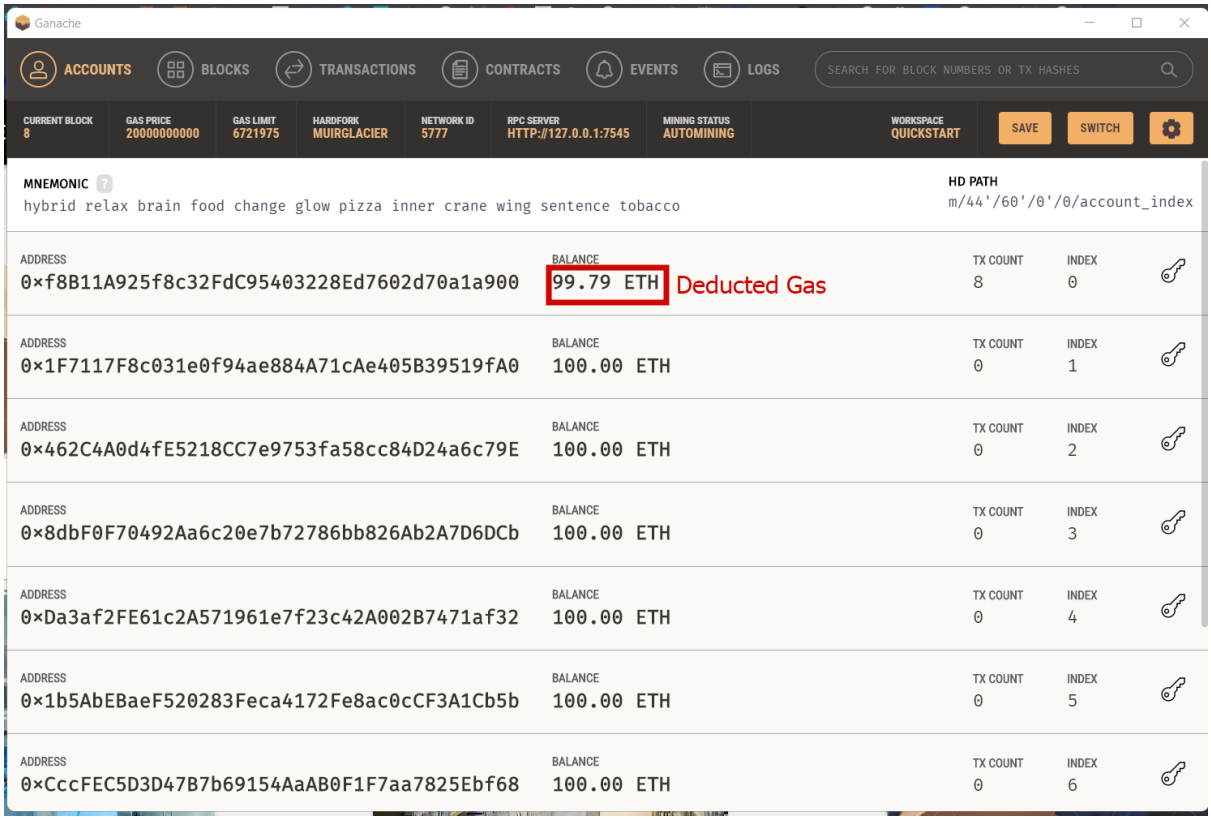
Build Directory for Contract

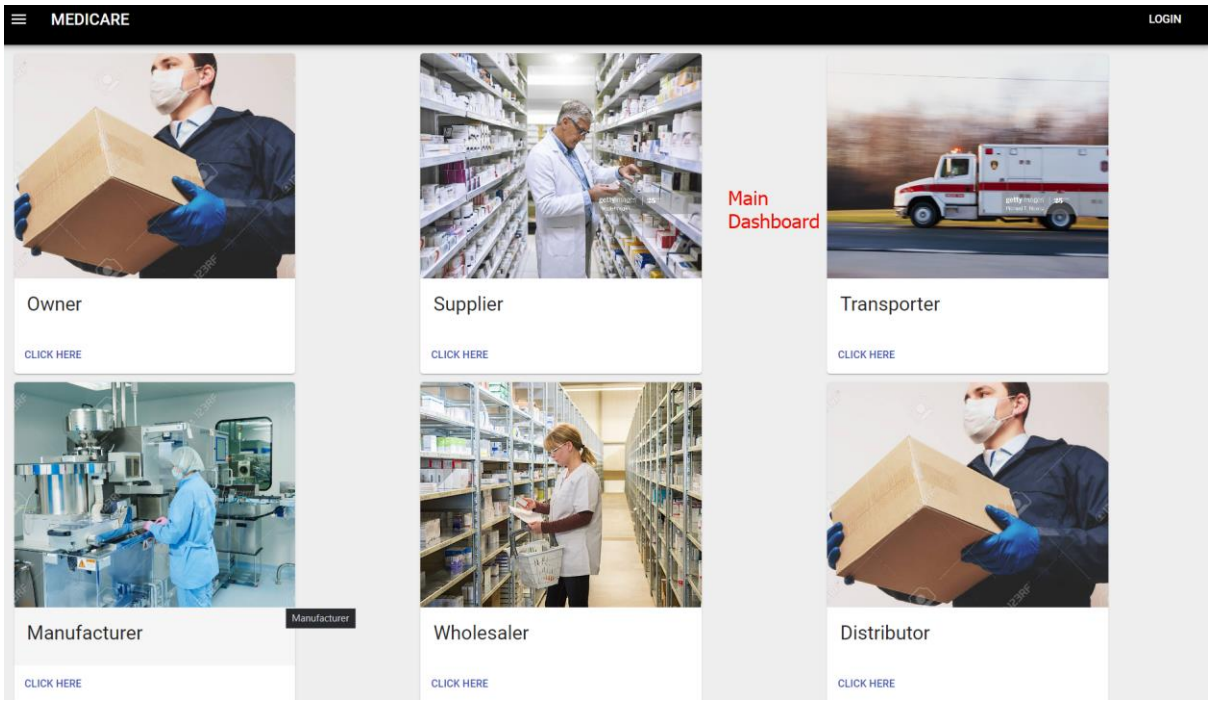


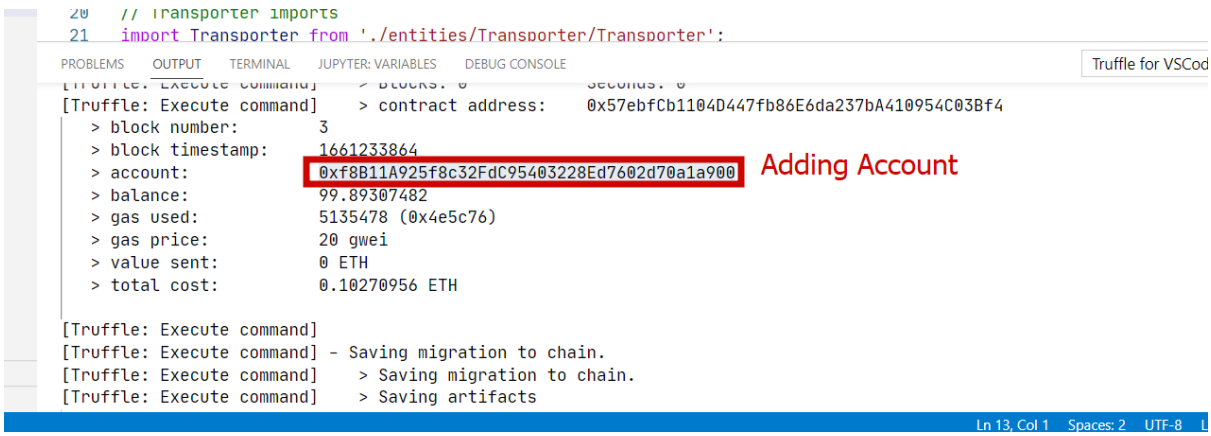


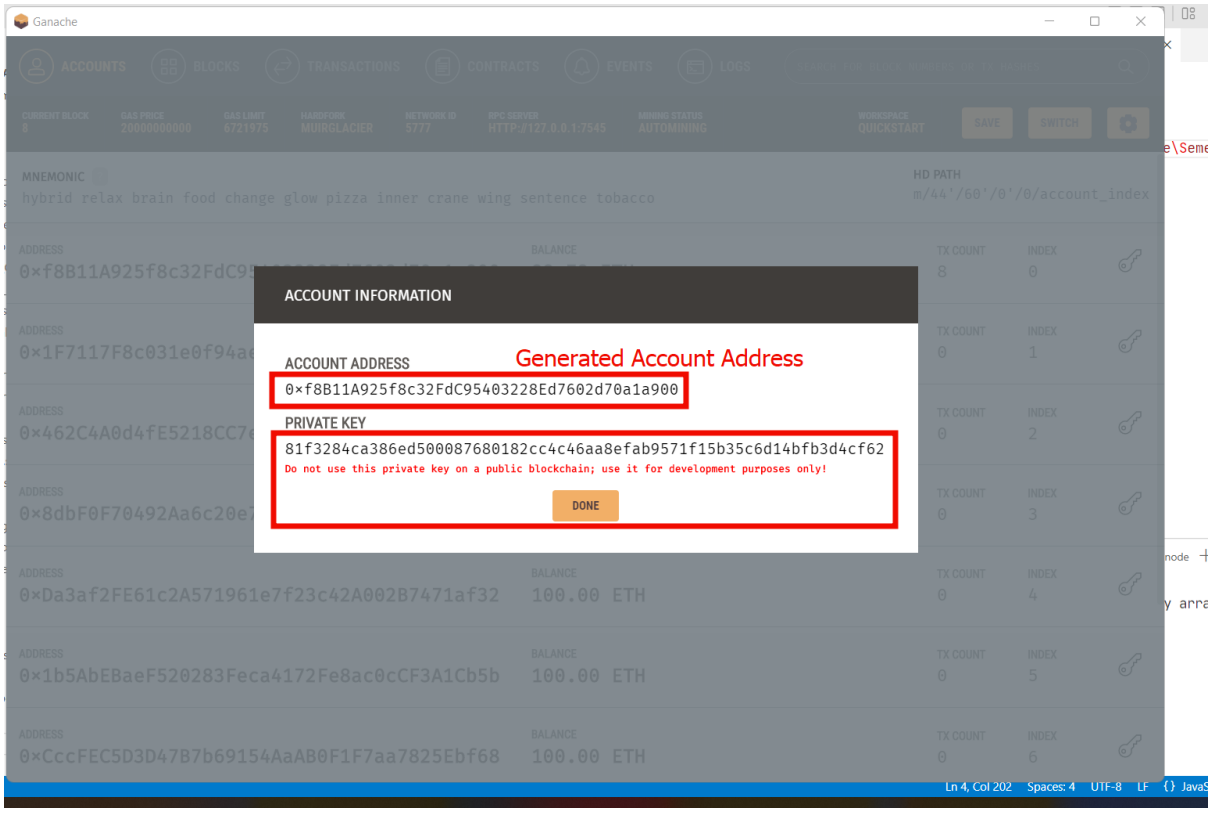

Requirements for Deployment

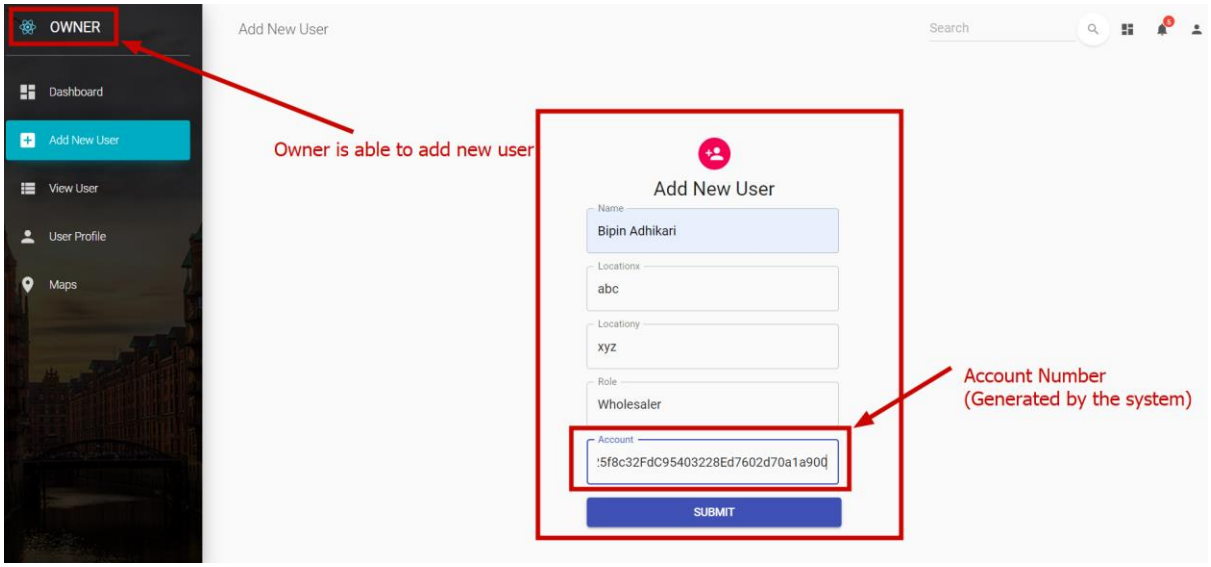

> account: 0xf8B11A925f8c32FdC95403228Ed7602d70a1a900
> balance: 99.78560406
> gas used: 5135478 (0x4e5c76)
> gas price: 20 gwei
> value sent: 0 ETH
> total cost: 0.10270956 ETH
Gas utilized for Deployment
[Truffle: Execute command]
[Truffle: Execute command] - Saving migration to chain.
[Truffle: Execute command] > Saving migration to chain.
[Truffle: Execute command] > Saving artifacts
> Total cost: 0.10270956 ETH
[Truffle: Execute command]
Summary
> Total deployments: 2
> Final cost: 0.1060796 ETH
[Truffle: Execute command] Finished running command
[Truffle for VSCode] Deploy succeeded
Deployment Successful

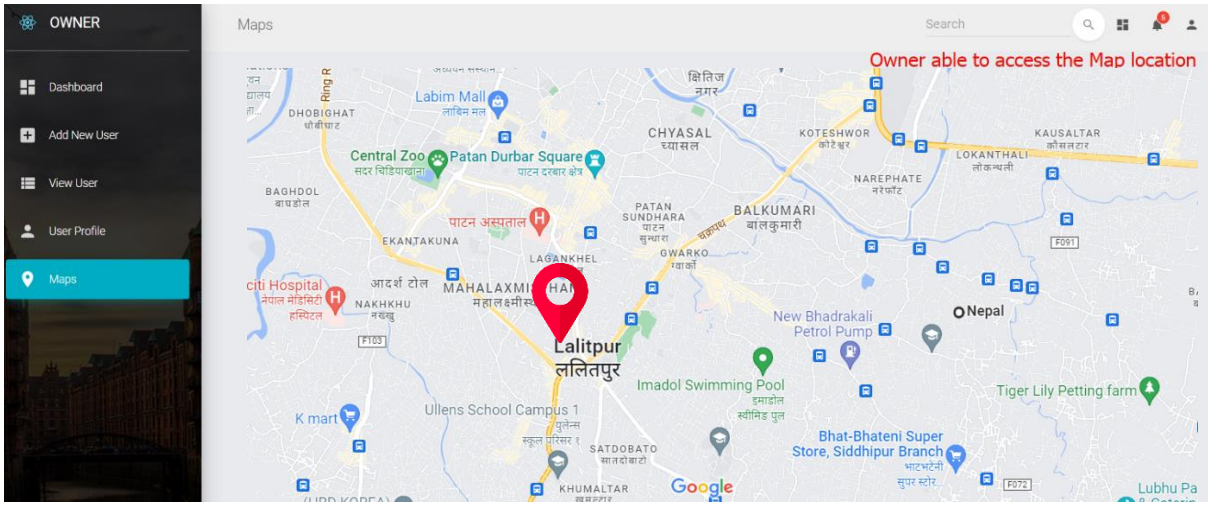

Ganache
ACCOUNTS
BLOCKS
TRANSACTIONS
CONTRACTS
EVENTS
LOGS
SEARCH FOR BLOCK NUMBERS OR TX HASHES
CURRENT BLOCK 8
GAS PRICE 20000000000
GAS LIMIT 6721975
HARDFORK MUIRGLACIER
NETWORK ID 5777
RPC SERVER HTTP://127.0.0.1:7545
MINING STATUS AUTOMINING
WORKSPACE QUICKSTART
SAVE
SWITCH
MNEMONIC
hybrid relax brain food change glow pizza inner crane wing sentence tobacco
HD PATH
m/44'/60'/0'/0/account_index
ADDRESS 0×f8B11A925f8c32FdC95403228Ed7602d70a1a900
BALANCE 99.79 ETH
Deducted Gas
TX COUNT 8
INDEX 0
ADDRESS 0×1F7117F8c031e0f94ae884A71cAe405B39519fA0
BALANCE 100.00 ETH
TX COUNT 0
INDEX 1
ADDRESS 0×462C4A0d4fE5218CC7e9753fa58cc84D24a6c79E
BALANCE 100.00 ETH
TX COUNT 0
INDEX 2
ADDRESS 0×8dbF0F70492Aa6c20e7b72786bb826Ab2A7D6DCb
BALANCE 100.00 ETH
TX COUNT 0
INDEX 3
ADDRESS 0×Da3af2FE61c2A571961e7f23c42A002B7471af32
BALANCE 100.00 ETH
TX COUNT 0
INDEX 4
ADDRESS 0×1b5AbEBaeF520283Feca4172Fe8ac0cCF3A1Cb5b
BALANCE 100.00 ETH
TX COUNT 0
INDEX 5
ADDRESS 0×CccFEC5D3D47B7b69154AaAB0F1F7aa7825Ebf68
BALANCE 100.00 ETH
TX COUNT 0
INDEX 6

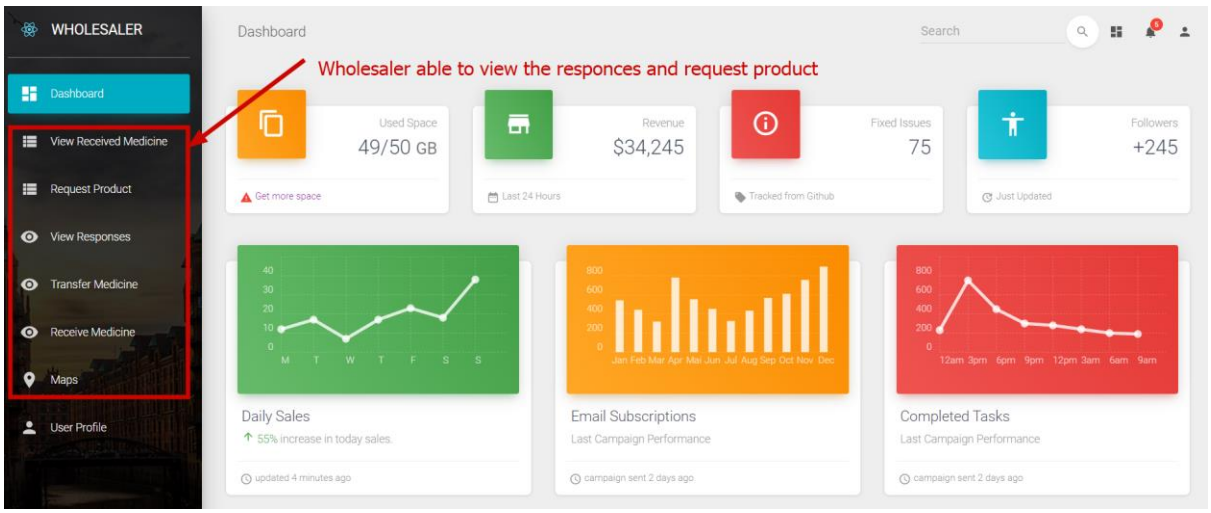

MEDICARE
LOGIN
Owner
CLICK HERE
Supplier
CLICK HERE
Main Dashboard
Transporter
CLICK HERE
Manufacturer
CLICK HERE
Manufacturer
Wholesaler
CLICK HERE
Distributor
CLICK HERE

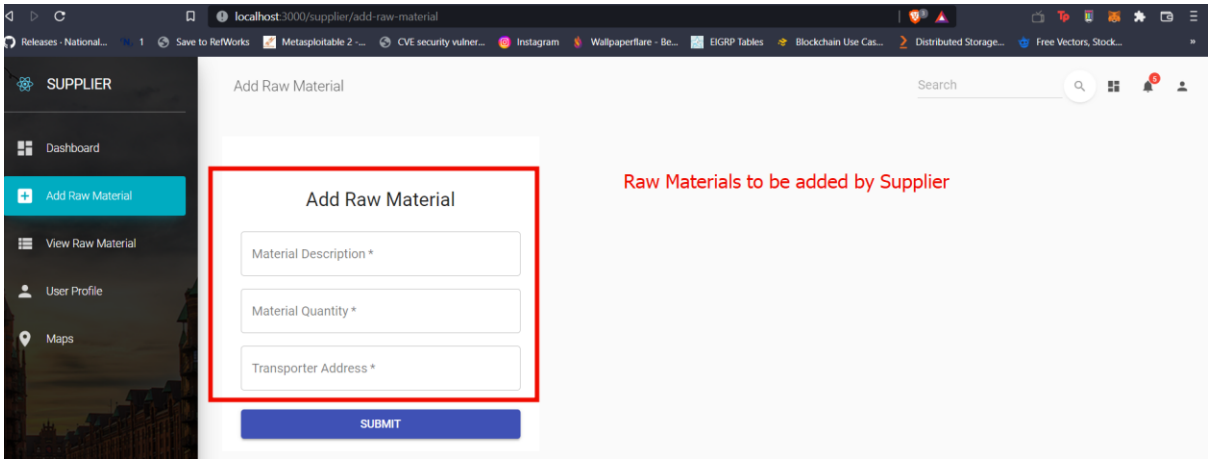

// Transporter imports
import Transporter from './entities/Transporter/Transporter';
PROBLEMS
OUTPUT
TERMINAL
JUPYTER: VARIABLES
DEBUG CONSOLE
Truffle for VSCod
[Truffle: Execute command] > contract address: 0x57ebfCb1104D447fb86E6da237bA410954C03Bf4
> block number: 3
> block timestamp: 1661233864
> account: 0xf8B11A925f8c32FdC95403228Ed7602d70a1a900
Adding Account
> balance: 99.89307482
> gas used: 5135478 (0x4e5c76)
> gas price: 20 gwei
> value sent: 0 ETH
> total cost: 0.10270956 ETH
[Truffle: Execute command]
[Truffle: Execute command] - Saving migration to chain.
[Truffle: Execute command] > Saving migration to chain.
[Truffle: Execute command] > Saving artifacts
Ln 13, Col 1
Spaces: 2
UTF-8


Ganache
ACCOUNTS
BLOCKS
TRANSACTIONS
CONTRACTS
EVENTS
LOGS
MNEMONIC
hybrid relax brain food change glow pizza inner crane wing sentence tobacco
HD PATH
m/44'/60'/0'/0/account_index
ACCOUNT INFORMATION
ACCOUNT ADDRESS
Generated Account Address
0xf8B11A925f8c32FdC95403228Ed7602d70a1a900
PRIVATE KEY
81f3284ca386ed500087680182cc4c46aa8efab9571f15b35c6d14bfb3d4cf62
Do not use this private key on a public blockchain; use it for development purposes only!
DONE
0xDa3af2FE61c2A571961e7f23c42A002B7471af32 100.00 ETH
0x1b5AbEBaeF520283Feca4172Fe8ac0cCF3A1Cb5b 100.00 ETH
0xCccFEC5D3D47B7b69154AaAB0F1F7aa7825Ebf68 100.00 ETH
Ln 4, Col 202
Spaces: 4
UTF-8
LF


OWNER
Add New User
Search
Dashboard
Add New User
View User
User Profile
Maps
Owner is able to add new user
Add New User
Name
Bipin Adhikari
Locationx
abc
Locationy
xyz
Role
Wholesaler
Account
:5f8c32FdC95403228Ed7602d70a1a90(
SUBMIT
Account Number
(Generated by the system)


OWNER
Maps
Search
Dashboard
Add New User
View User
User Profile
Maps
Owner able to access the Map location
Labim Mall
DHOBIGHAT
Central Zoo
Patan Durbar Square
CHYASAL
KOTESHWOR
KAUSALTAR
LOKANTHALI
NAREPHATE
BAGHDOL
पाटन अस्पताल
PATAN SUNDHARA
BALKUMARI
EKANTAKUNA
LAGANKHEL
GWARKO
citi Hospital
NAKHKHU
MAHALAXMI
Lalitpur
ललितपुर
New Bhadrakali Petrol Pump
Nepal
Imadol Swimming Pool
Tiger Lily Petting farm
K mart
Ullens School Campus 1
SATDOBATO
Bhat-Bhateni Super Store, Siddhipur Branch
KHUMALTAR
Google


WHOLESALER
Dashboard
Search
Wholesaler able to view the responces and request product
Dashboard
View Received Medicine
Request Product
View Responses
Transfer Medicine
Receive Medicine
Maps
User Profile
Used Space
49/50 GB
Get more space
Revenue
$34,245
Last 24 Hours
Fixed Issues
75
Tracked from Github
Followers
+245
Just Updated
Daily Sales
55% increase in today sales.
updated 4 minutes ago
Email Subscriptions
Last Campaign Performance
campaign sent 2 days ago
Completed Tasks
Last Campaign Performance
campaign sent 2 days ago


localhost:3000/supplier/add-raw-material
SUPPLIER
Add Raw Material
Search
Dashboard
Add Raw Material
View Raw Material
User Profile
Maps
Add Raw Material
Material Description *
Material Quantity *
Transporter Address *
SUBMIT
Raw Materials to be added by Supplier


PHARMA-CHAIN-MASTER
truffle-config.js
yarn.lock
server
node_modules
src
config
contracts
Medicine.json
MedicineD_C.json
MedicineW_D.json
Migrations.json
RawMaterial.json
SupplyChain.json
Transactions.json
controllers
db
init.js
models
routers
utils
access.log
app.js
index.js
.babelrc
.gitignore
package-lock.json
package.json
truffle-config.js
Check the access log of the system
::1 - - [02/Apr/2021:17:33:23 +0000] "POST /api/medicine/save-details HTTP/1.1" 201 34 "-" "PostmanRuntime/7.26.8"
::1 - - [02/Apr/2021:17:34:37 +0000] "OPTIONS /api/medicine/save-details HTTP/1.1" 204 0 "http://localhost:3000/" "Mozil
::1 - - [02/Apr/2021:17:34:37 +0000] "POST /api/medicine/save-details HTTP/1.1" 201 34 "http://localhost:3000/" "Mozilla
::1 - - [02/Apr/2021:17:35:52 +0000] "POST /api/medicine/save-details HTTP/1.1" 201 34 "-" "PostmanRuntime/7.26.8"
::1 - - [02/Apr/2021:17:37:08 +0000] "OPTIONS /api/medicine/save-details HTTP/1.1" 204 0 "http://localhost:3000/" "Mozil
::1 - - [02/Apr/2021:17:37:08 +0000] "POST /api/medicine/save-details HTTP/1.1" 201 34 "http://localhost:3000/" "Mozilla
::1 - - [03/Apr/2021:08:08:42 +0000] "OPTIONS /api/medicine/save-details HTTP/1.1" 204 0 "http://localhost:3000/" "Mozil
::1 - - [03/Apr/2021:08:08:43 +0000] "POST /api/medicine/save-details HTTP/1.1" 201 34 "http://localhost:3000/" "Mozilla
::1 - - [03/Apr/2021:08:08:43 +0000] "OPTIONS /api/raw-material/save-details HTTP/1.1" 204 0 "http://localhost:3000/" "M
::1 - - [03/Apr/2021:08:08:44 +0000] "POST /api/raw-material/save-details HTTP/1.1" 201 34 "http://localhost:3000/" "Moz
::1 - - [03/Apr/2021:08:11:39 +0000] "OPTIONS /api/medicine/save-details HTTP/1.1" 204 0 "http://localhost:3000/" "Mozil
::1 - - [03/Apr/2021:08:11:40 +0000] "POST /api/medicine/save-details HTTP/1.1" 201 34 "http://localhost:3000/" "Mozilla
::1 - - [03/Apr/2021:08:11:40 +0000] "OPTIONS /api/raw-material/save-details HTTP/1.1" 204 0 "http://localhost:3000/" "M
::1 - - [03/Apr/2021:08:11:40 +0000] "POST /api/raw-material/save-details HTTP/1.1" 201 34 "http://localhost:3000/" "Moz
::1 - - [03/Apr/2021:08:13:14 +0000] "OPTIONS /api/medicine/save-details HTTP/1.1" 204 0 "http://localhost:3000/" "Mozil
::1 - - [03/Apr/2021:08:13:14 +0000] "POST /api/medicine/save-details HTTP/1.1" 201 34 "http://localhost:3000/" "Mozilla
::1 - - [03/Apr/2021:08:13:14 +0000] "OPTIONS /api/raw-material/save-details HTTP/1.1" 204 0 "http://localhost:3000/" "M
::1 - - [03/Apr/2021:08:13:14 +0000] "POST /api/raw-material/save-details HTTP/1.1" 201 34 "http://localhost:3000/" "Moz
::1 - - [04/Apr/2021:08:42:20 +0000] "OPTIONS /api/medicine/save-details HTTP/1.1" 204 0 "http://localhost:3000/" "Mozil
::1 - - [04/Apr/2021:08:42:21 +0000] "POST /api/medicine/save-details HTTP/1.1" 201 34 "http://localhost:3000/" "Mozilla
::1 - - [04/Apr/2021:08:42:21 +0000] "OPTIONS /api/raw-material/save-details HTTP/1.1" 204 0 "http://localhost:3000/" "M
::1 - - [04/Apr/2021:08:42:21 +0000] "POST /api/raw-material/save-details HTTP/1.1" 201 34 "http://localhost:3000/" "Moz
::1 - - [04/Apr/2021:08:42:21 +0000] "OPTIONS /api/transaction/save-details HTTP/1.1" 204 0 "http://localhost:3000/" "Mo
::1 - - [04/Apr/2021:08:43:17 +0000] "OPTIONS /api/medicine/save-details HTTP/1.1" 204 0 "http://localhost:3000/" "Mozil
::1 - - [04/Apr/2021:08:43:18 +0000] "POST /api/medicine/save-details HTTP/1.1" 201 34 "http://localhost:3000/" "Mozilla
::1 - - [04/Apr/2021:08:43:18 +0000] "OPTIONS /api/raw-material/save-details HTTP/1.1" 204 0 "http://localhost:3000/" "M
::1 - - [04/Apr/2021:08:43:19 +0000] "POST /api/raw-material/save-details HTTP/1.1" 201 34 "http://localhost:3000/" "Moz
::1 - - [04/Apr/2021:08:43:19 +0000] "OPTIONS /api/transaction/save-details HTTP/1.1" 204 0 "http://localhost:3000/" "Mo
::1 - - [04/Apr/2021:08:43:56 +0000] "OPTIONS /api/medicine/save-details HTTP/1.1" 204 0 "http://localhost:3000/" "Mozil
::1 - - [04/Apr/2021:08:43:57 +0000] "POST /api/medicine/save-details HTTP/1.1" 201 34 "http://localhost:3000/" "Mozilla
::1 - - [04/Apr/2021:08:43:57 +0000] "OPTIONS /api/raw-material/save-details HTTP/1.1" 204 0 "http://localhost:3000/" "M
::1 - - [04/Apr/2021:08:43:57 +0000] "POST /api/raw-material/save-details HTTP/1.1" 201 34 "http://localhost:3000/" "Moz