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Deployment of Smart Contract based Blockchain to Optimise Pharma Supply Chain

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***Abstract*: Blockchain is a system for recording transactions while assuring an immutable and permanent audit trail of the transactions that occur as a part of the network. The system of recording transactions is implemented in such a way that it is highly secure. The Blockchain in simple words can be described as a digital distributed ledger that is duplicated across the network of systems that are a part of the blockchain. Each block consists of a number of transactions, and when a new transaction occurs, it is added to the ledger of every member or participant. This decentralised database is known as Digital ledger technology. The blockchains are recorded with a cryptographic signature called a hash. The features which make the blockchain stand out are its programmability, high security, immutability and its ability to be distributed, anonymous, time-stamped and unanimous. Innovative interactions with Blockchain alongside AI, IoT and augmented reality exhibit a good future scope for the creation of models based on the same. The use of analytics and IoT in sync with smart contracts can make blockchain-based systems intelligent and active. Smart contracts comprise the logic encoded with the blockchain. Together, blockchain and smart contracts can help achieve high security, transparency and autonomy for the transactions that occur in the blockchain between its members, i.e., network nodes. Supply chain and logistics in the pharma industry has been posed with many challenges including the high number of distributors, lack of traceability and delay. Analysis of the pharma industry indicated that the supply chain processes in the industry are complex with various inter-relationships and interdependencies. Blockchain when embedded with smart contracts can bring about an evolution in the pharma industry. Together they would influence and drive the success factors as required by the industry while generating a throughput in terms of structure and capabilities. Blockchain is an example of the concept that can drive supply chain management systems of the pharma industry and can help make/take important decisions in favour of their final customer. However, organisations need to ensure that their technologies and business models are well aligned with the blockchain to achieve the best possible outcome or value-added services from the same. Blockchain must be kept concurrent with the evolving standards for its optimised utilisation.**

***Keywords*: Blockchain, Smart contract, Distributor confidence, Pharma supply chain network.**

1. Introduction

Blockchain is a system of recording information in a systematic manner so as to prevent and make hacking and data breaches close to impossible. The two key features of Blockchain makes it lucrative for the optimisation of the supply chain in the pharmaceutical sector. One major feature is the digital distributed ledger which withholds all data relevant to the supply chain including the transactional data in a safe and encrypted manner. This also enables recording of transactions in the form of multiple copies at different locations, however, only to users with access. The second major feature is reliability, trust and transparency offered by the Blockchain. The blockchain would require the consensus of all members in the network to ensure the credibility of the transaction. Additionally, the blocks are linked to one another with a pointer leading to data in the adjacent block, which makes data tampering impossible. Consensus algorithms and transaction cryptography are implemented across the peer-to-peer distributed network to prevent any data breach or hacking. Each node of the distributed network holds an updated copy of the distributed ledger inclusive of their own information and the transaction history.

Blockchain when implemented with supply chains and integrated with IoT and smart contracts can surely prove to be beneficial. This ideation exists owing to the shift of ownership of goods, as transactions, that takes place across the supply chain, and in the case of the pharma sector, there are a larger number of distributors involved due to the import and export of drugs from different countries across the globe. To keep a track of all transactions and drug transfers in real-time, while preventing fraud and drug replacement during the entire supply chain process, the effective implementation of blockchain is the way ahead. While many sectors have already implemented or are on the verge of it, this paper indicates how blockchain implementation in the supply chain of pharma can be a huge boon for the industry.

2. Research Methodology

The approach taken in this paper is of a systematic mapping study to explore the feasibility of blockchain in the supply chain of pharmaceutical companies. The results of this study would help identify and map research areas related to applications of blockchain. [1] Also, it will also help identify gaps that need to be thought upon for future studies. This approach has been divided into five key steps as presented below in Fig. 1.

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Fig. 1. Research methodology

A. Research Question and Objective

The purpose of this research is to analyze the role of blockchain along with smart contracts in sync with analytics and IoT in the pharma sector to solve the problems associated with its vastly distributed supply chain. These are the questions in general that the study aims to find the answers to.

1. Does blockchain help improve the efficiency of the supply chain in the pharmaceutical sector?
2. Can inter-system operability along with blockchain and smart contracts enhance the productivity of the supply chain?
3. Would blockchain help detect counterfeit of drugs by racketeer and inappropriate handling of drugs by distributors?

B. Conducting the search

This stage involved searching for and discovering all scientific papers relevant to the research topic of smart contracts. For our research, we chose the phrase "blockchain" as the primary keyword for finding papers. We chose this word because we wanted to limit the scope of our research to only blockchain-related work. We chose scientific databases to perform our search after determining the keyword for the search process. IEEE Explore, ACM Digital Library, ScienceDirect, Springer, Ebsco, and Scopus were the titles we chose. Only high-quality papers from conferences, journals, seminars, symposiums, and books were considered.

C. Screening for relevant papers

This stage involves searching for related papers as per our research questions. We started by removing papers that were unrelated to our research based on their names. If we couldn't make up our minds about a paper, we'd look at the abstract. Each paper was also screened using exclusion criteria. Excluded papers: (a) non-English papers, (b) papers without full text available, (c) redundant papers. [1]

D. Keywording using abstracts

This phase includes using the key-wording technique mentioned to identify all related articles. We started by reading each paper's abstract to determine the most relevant keywords and main contribution. The keywords were then used to categorize the papers into different groups. We read all of the papers after classifying them and made any necessary improvements to the classification. [1]

3. Literature Review

- Reserve Bank of India has been closely monitoring the opportunities of blockchain technology in the banking sector which has been indicated in the paper titled “Application of Blockchain technology in Banking and financial sector of India.” [3]
- Deloitte IoT provides an insight that suggests that, as a part of the Skill India programme, the government hopes to spend ₹436 crores over a period of 3 years for emerging technology and train over 4 lakh individuals in technology such as Blockchain, Internet of Things (IoT) and Artificial Intelligence (AI). [4]
- The leading technologies which are governing Industry 4.0 are Internet of Things, Artificial Intelligence, cloud intelligence and Data Analytics as indicated in Fig. 2.

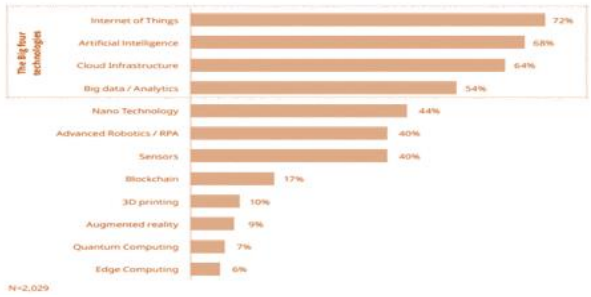

Fig. 2. Technologies with the potential to disrupt industries

- Spend Edge estimates that Blockchain will register an incremental spend of $27.68 billion with a CAGR of 67.12% during the 5-year forecast period of 2021-2025. [5]
- Frost and Sullivan, 2019 suggest that Blockchain tech vendors have raised funding up to $808.38 million in the healthcare industry. The estimated impact of blockchain in the drug and supply chain industry is predicted at $600 million by the year 2022 as indicated in Fig. 3. [6]

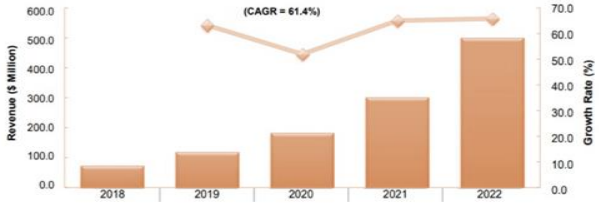

Fig. 3. Revenue forecast scenario of DLT in the healthcare sector

- IBM report indicates $203 billion losses in health systems during the year 2020. The systems which are currently in an implementation like the Electronic Health Record (EHR) system are inclusive of more than 700 vendors who find it difficult to converse and stay on the same page. With over 41 million patient records breached in the year 2019, a single hacking incident affected over 21 million records. 70% of the leading health and life sciences executives surveyed incomplete, fake and forged information as a major hindrance to decision making in the health and pharmaceutical sector. With the advent of blockchain along with data sharing and Distributed Ledger Technology (DLT), 950,000 lives could be saved in a cost-effective manner generating up to $93 billion worth of savings. [7]
- The report on Blockchain in healthcare start-ups in India by Tracxn for the year 2020, indicates that the technology is being extensively deployed in India based healthcare start-

ups such as Plenum data, Shivom, NHCT, Vitraya, UHID, MedBlocks and Rolyte that provide data security, data integration and management solutions based upon Blockchain and IoT. [8]

- Adoption of analytics in the supply chain of pharma can address the current discrepancies in the industry. The implementation of BDA in the SCOR model can help improve upon the decision-making process while nullifying the chances of fraud in the drug supply chain. [9]
- With the increased amount of data generated as indicated by Fig. 4 through the multiple users involved, predictive data analytics can help achieve meaningful inferences. [9]

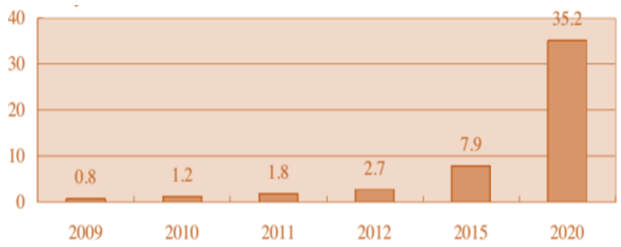

Fig. 4. Data volume predicted in zettabytes

- Capgemini report indicates that only 3% of the organisations are deploying blockchain at scale. Blockchain adoption maturity is set to reach its peak in the year 2025 and transform business processes.
- Organisations have been increasingly ready and willing to increase their investment in blockchain owing to the pacesetters as indicated in Fig. 5.

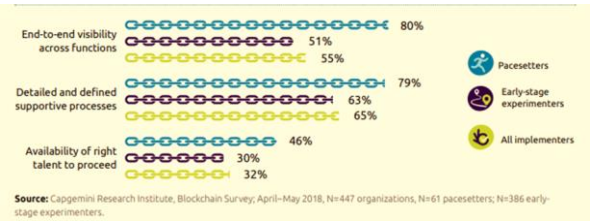

Fig. 5. Blockchain adaptability survey

4. Pharma Supply Chain

The primary components of a supply chain in a pharmaceutical industry include:

1. Primary manufacturing including contractor sites
2. Secondary manufacturing
3. Distribution centers and market warehouses
4. Wholesalers, Retailers and Stockists
5. Pharmacies and hospitals

Fig. 6 indicates a snapshot of the generic pharma supply chain process followed by the pharmaceutical companies. Primary manufacturing is associated with the production of Active Pharmaceutical Ingredient (API). This process involves the chemical synthesis and separation for building up of molecular compounds, or product recovery followed by purification in case of biochemical processes. [11] Post this, these ingredients are acquired in the raw material procurement stage. The pharma company then carries out chemical and microbial testing to ensure the safety of the ingredients procured. As a part of secondary manufacturing, the various drugs are manufactured under the subcategories of parenteral, oral and topical drugs. Item-based packaging is done with each batch having a unique alphanumeric code given by the pharma company. Post the drug testing process, the drugs are stored at the company warehouse from which they are shipped either domestically or internationally. The drugs then reach the distributors and market warehouses, post which is picked up by the drug wholesalers and are supplied to the hospitals and pharma stores through which the patients purchase their prescribed medication. [11], [12]

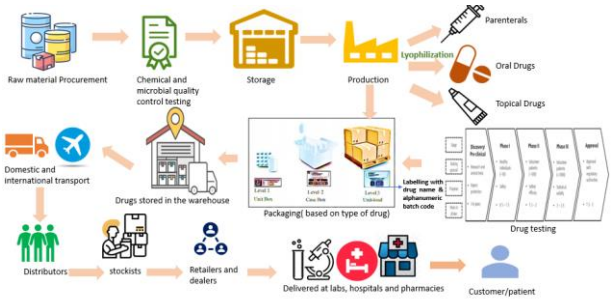

Fig. 6. Pharma supply chain

5. Problems Associated with Pharma Supply Chain

- Lack of transparency: Consumers and even drug distributors are unsure about the quality and testing of the drug. The pharma companies have remained suspicious about the supply chain processes and origin of the drug in the case of imported drugs.
- Distribution issues: The presence of multiple intermediaries and distributors in the supply chain makes reachability a major issue. Also, monitoring the temperature of drugs throughout their journey remains ambiguous.
- Increased delay and tracking issues: The material from its intermediary stage must pass its quality control check before being further transported, which can cause additional delays. There is also a need to prevent cross-contamination of products for changeovers which can result in longer downtimes.
- Demand and inventory management: The demand is forecasted upon historical data and market intelligence. Inaccurate demand forecasts can lead to increased inventory and distribution related issues owing to the vastly spread supply chain of the pharma industry.
- Difficulty in order processing: Unexpected interruptions like power cut, strike, lack of the presence of optimized distribution mechanisms hinders the processing of orders. Distance and miscommunication issues may also arise while translating orders.
- Interoperability of systems: Usage of different technical standards, procedures, and processes during manufacturing and distribution makes the process all the more complex. There is no centralized system which creates a lot of chaos.
- Protecting and Sharing data: Since there is a large amount of data that is recorded as the drug moves through the supply chain. It has to be confidential and encrypted. There is a lack

of a common system that can carry out the storage and maintain its authenticity and security.

- Verification of transaction and identity: There is no option to verify the identity of various distributors involved and keep track of the transactions carried out with them. [11], [13]
- Reverse logistics: In case of any drug discrepancy from the procurement stage to the endpoint delivery stage, many pharma companies lack in terms of the design and implementation of a reverse logistics process.

6. Blockchain based Pharma Supply Chain

The three-tier implementation is as follows:

A. Implementation of Tier 1

Blockchain alone cannot be the best optimised solution. It must be equipped with Enterprise Resource Planning (ERP) solutions and IoT for efficiency in monitoring the supply chain processes. Blockchain being independent ensures interoperability and compatibility with other systems. Blockchain hence acts as a global supply chain management system because of its interoperability, easy access, transparency and encryption. Many drugs can now be tracked with IoT sensors which can help reduce the scope of error and aid in increased automation and authenticity. Fig. 8 gives deep insight into the supply chain network and information tracking process along with IoT sensors for the measurement of various parameters such as quality, temperature, barcode check, etc. This tier gives a clear flow of the blockchain-based supply chain of pharmaceuticals from the procurement and manufacture of drugs up to the patients with temperature and quality checks, processing and packaging. Sales contracts are authenticated with digital signatures for transaction approval which abides the regulations and validations. This tier also includes the web apps used for the optimized implementation of the blockchain as indicated in Fig. 7.

Fig. 7. Scan alphanumeric batch code

B. Implementation of Tier 2

This tier indicates the usage of a hybrid ledger. While this incorporates two kinds of ledgers, the public ledger is accessible by everyone and carries consolidated tracking information for all the shipments along with the hash value (of the block) of private transactions. The private ledger however can be accessed only by stakeholders and network nodes who have been involved in any particular transaction and contains information pertaining to the private transaction. The model helps mitigate the fear of stakeholders regarding privacy concerns and data security. [14] The private ledger can help protect sensitive data by restricting complete data access through selective permits. This enables the protection of personal and encrypted data. The proposed hybrid model retains the distributed ledger property of the blockchain where each node retains a copy of the ledger.

A consensus algorithm is incorporated for the purpose of security and transparency within the blockchain network. [15] Any transaction would require the consensus of a majority of participants for it to be approved and added as a new block. This would help establish governance through an established consortium. Each node in the network constitutes the stakeholders or the main players in the SCM. The hybrid model however allows access while ensuring data security for internal and external supply chain partners inclusive of third-party data authentication and monitoring service providers.

C. Implementation of Tier 3

Efficient storage of data on the cloud. Demand planning and tracking with a user-friendly mobile interface. Analytical tools such as fraud detection, demand planning and automation need to be incorporated into the system for data security and privacy of the various participants, network nodes, or stakeholders. The usage of the blockchain is also dependent upon the interface design such as dashboards, mobile or web apps, etc. The nodes of the network as a part of the blockchain, place their data through the application interface. The application interface thus enables data linking, data querying and service verification. [16]

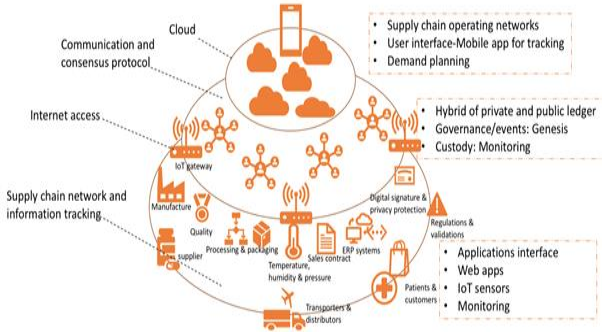

Fig. 8. Blockchain based pharma supply chain

7. Implementation of IoT and Smart Contracts in Pharma Supply chain

A. Use of IoT and Smart Contracts

The main objective of IoT is to connect the physical and the digital world. In this case, it acts as an interface and supports blockchain or aids in its implementation. Utilizing the capabilities of IoT sensors can help implement the peer-to-peer marketplace in a more optimized manner. Blockchains along with smart contracts enable the connected devices to act as intelligent agents which identify themselves in the network and also carry out micro-transactions in sync with the business rules

or smart contracts which cannot be modified.

Smart contracts can be self-executed based upon a pre-defined or a prescribed event. Smart contracts and smart devices would aid in the autonomy of the operations and supply chain management, enabling machine-to-machine interactions and coordination with other systems. In simple words, smart contracts also enable the members of the network to build terms, conditions and logic into a digital contract. This would enable the network members to check upon the legitimacy of the drug and prevent fraud through the detection of fraudulent distributors and vendors. The Fig. 9 indicates the deployment of blockchain along with the IoT and smart contracts for increased optimization. [17]

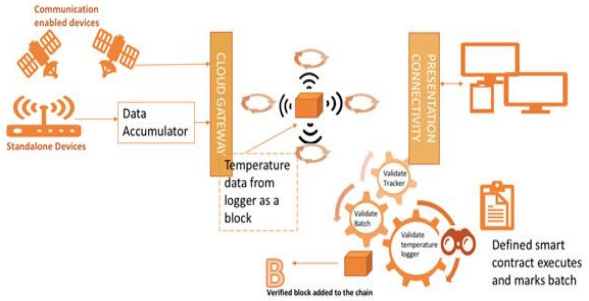

Fig. 9. Deployment of IoT and smart contracts

B. Predictive analytics and smart contracts to prevent drug discrepancies

The implementation of Blockchain along with smart contracts and predictive analytics has been implemented in our model to bring more efficiency to the blockchain while eliminating the chances of drug discrepancies, i.e., the end customer and the manufacturer are assured about drug safety throughout the supply chain journey. Once the drug is dispatched with its package and batch ID to the distributor, the distributor stores it in his warehouse where the temperature and humidity are continuously monitored by the IoT sensors whose values are stored in real time on the blockchain. Every drug must be stored within the permissible temperature and humidity range as prescribed by the pharma company.

For the purpose of the same, we have come up with the distributor confidence variable. For every transaction that occurs between the pharma company and the distributor with a varied number of drug units each time, the number of hours the temperature breach or humidity breach caused by the distributor is recorded on the blockchain and a smart contract initiating the reverse logistics process is executed if the temperature or humidity levels are crossed beyond the permissible limits which affects the drug potency. If this value is beyond the permissible limits, his distributor rating is decremented. However, on every successful transaction, his distributor rating is incremented. In the case that the distributor crosses the permissible limit thrice, with respect to not maintaining the prescribed temperature, humidity or storing the drug for an additional number of days, the distributor confidence is set to 0. This will help us in eliminating the faulty distributors in our pharma supply chain while ensuring the drug safety and predicting any case of drug discrepancy before it reaches the end customer. Drug safety is of topmost priority to the pharma company. Any inappropriate or faulty drug could not only ruin their brand image but would also have a lawsuit filed against them. The use of predictive analytics in sync with smart contracts will help us predict any discrepancy beforehand and identify the faulty distributors.

Once the drug is dispatched from the distributor warehouse, the barcode is scanned and recorded, post which a smart contract is executed. If this barcode does not match with the prescribed bar code, an immediate reverse logistics process takes place. This helps the pharma company in planning a more efficient reverse logistics process while minimizing the cost. Additionally, the drug tracking is carried out in real time through the implementation of Global Positioning System (GPS) as indicated in Fig. 10 along with the implementation of shortest path algorithm, enabling the drug to reach faster. When the prescribed route is not followed, the stakeholders are notified of the same. The entire process is indicated in Fig. 11.

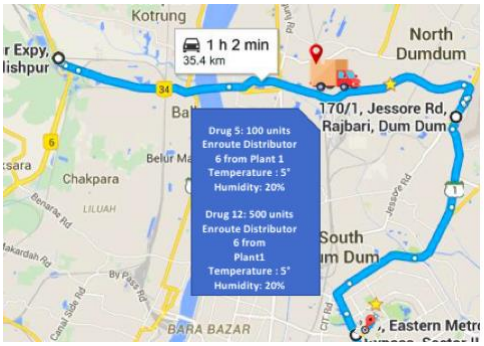

Fig. 10. Real-time location tracking

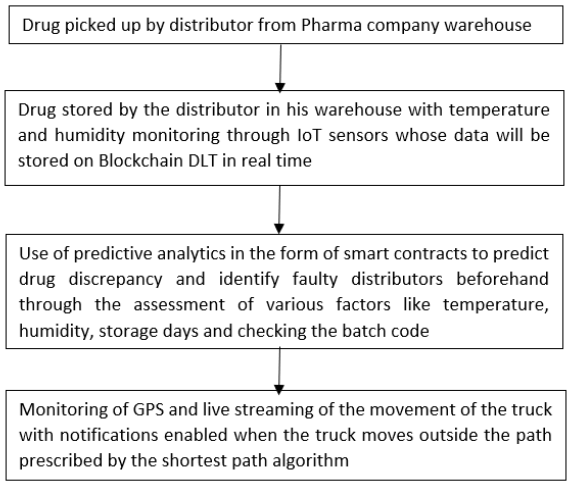

Fig. 11. Process execution

C. An example case of distributor confidence

Based on the insights derived from the pharma companies like Cipla and Dr. Reddy's on their supply chain processes and the data they withhold regarding the same, we created a synthetic dataset for the evaluation of various parameters. In order to prevent drug discrepancy, it is very important to partner with a trustworthy distributor. For the purpose of the same, the distributor confidence variable was introduced. The variable is assessed upon the maintenance of various factors such as

humidity, temperature, batch code check and number of storage days. Our dataset comprises of 20 distributors, 20 drugs, dispatch dates, storage days, permissible temperature values, hours of temperature and humidity breach, batch code number and real-time location. In order to obtain the distributor confidence value, we used the previous distributor confidence values and incremented or decremented them by a multiplier for every successful and unsuccessful transaction carried out by that particular distributor. The flowchart of the same is as indicated in Fig. 12. To ensure drug safety, it is important to know the distributor confidence value before we hand over batches of the pharma company's drug to the distributor. Additionally, this would help us predict the efficacy of a particular distributor on his current transaction.

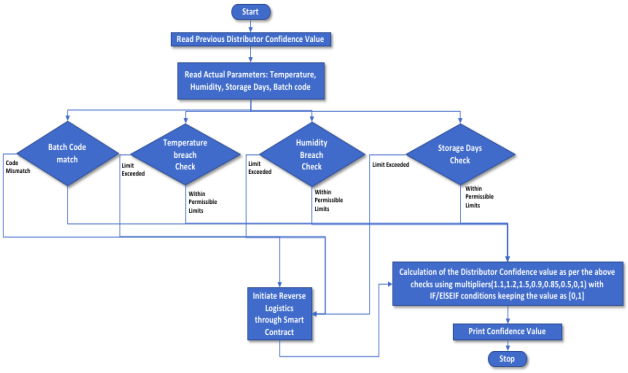

Fig. 12. Distributor confidence flowchart

D. Data Driven Insights

Post the real time increment and decrement of the distributor confidence variable through multiplying them by quantitative factors from the range of 1.5 to 0 (based on the nature of breach and hours of breach or route deviation), the shift in distributor values were observed for a range of transactions that were carried out. In our proposed model, the data obtained through IoT sensors is stored on the blockchain and assessed for any possible discrepancy using if-else conditions. After consecutive iterations and the multiplication by the factors in real time, the graph denoted in Fig. 13 indicates the trend of values for distributor 1. Fig. 14 indicates the varying distributor values across a period of 2 years. Distributor 4 and distributor 5 are promising choices when the pharma company is dealing with a sensitive drug as they have executed an increased number of successful transactions and have improved their ratings over months while Distributor 10 and distributor 15 have shown negative growth and cannot be trusted with critical drugs. The chance of drug discrepancy when drug is handed over to these distributors is very low. When any condition is violated, the distributor confidence is immediately incremented and decremented and in case of a major discrepancy which can lower the potency of the drug, a smart contract is executed for the purpose of reverse logistics by issuing various work orders. This enables us to predict the faulty drug before-hand and before reaching the customer. Additionally, we can predict the drug reliability when it is with a particular distributor.

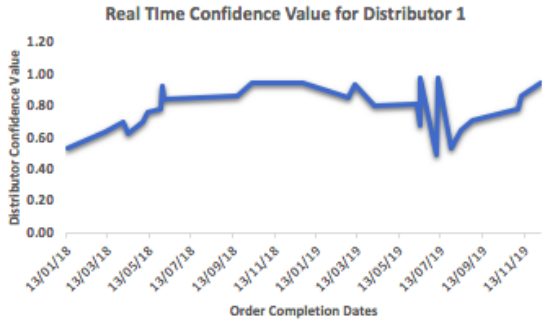

Fig. 13. Real time distributor confidence value on his transaction date

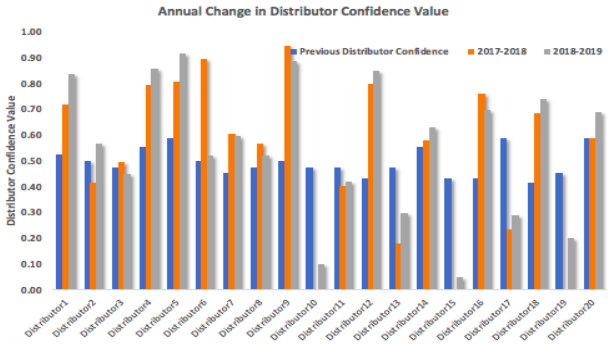

Fig. 14. Year on Year(YoY) change in distributor confidence values

8. Results and Conclusion

The present supply chain in the pharma industry is plagued by multiple problems in varied domains such as lack of transparency, distribution issues, tracking, demand and inventory management, order processing issues, data security and sharing, data and identity verification, drugs counterfeiting. Many organizations have already implemented ERP systems towards upgrading their IT infrastructure. The potential of blockchain along with the deployment of smart contracts in solving a few problems among the ones mentioned has been researched upon, which found blockchain to be an innovative step towards problem-solving. [13] Also, in the sector a lot of parameters are considered that need to be tracked and monitored such as humidity, temperature, pressure and other crucial parameters thus mandating the utilization of IoT sensors, software and other technologies. This becomes one of the pillars on which the successful application of blockchain in various cases relies upon. [6], [10].

Our research thus proves that the implementation of blockchain along with IoT and smart contracts will not only improve the efficiency of the blockchain, but will also ensure that there are negligible chances of drug discrepancy through continuous monitoring and mapping of various factors such as temperature, humidity, location, number of storage days, etc. We have analysed the monitoring of the distributor confidence variable for a set of distributors, the study can be expanded further to 'n' number of distributors involved in the pharma supply chain which can aid in identifying the trustworthiness of a particular distributor based on predictive analytics through the assessment of his confidence interval on his previous transactions and predict the value on his current transaction.

Our study would also help in the elimination of faulty distributors by setting their value to 0 on repeated faults made by them.

9. Limitations

The limitations of this study include the high cost of implementation across the supply chain process which would involve upgradation of technologies and provision of sensors for the multiple distributors involved. Thus, there might be some issues with regard to scalability of the same. The network nodes involved with the blockchain must be active participants to approve a particular transaction, since the transaction is approved when majority of the parties involved provide consensus, it is important for majority of the parties involved to remain active throughout the process. In our proposed design however, they would just have to approve the notification and check the status of the drug in its supply chain through the mobile application. Another possible drawback encountered could be the failure of one of the IoT sensors, this would result in inaccurate data recording. To combat the same, we recommend renewal of the sensors 6 months before they fail.

10. Future Scope

Our study can be expanded further in order to keep track of drug inventory in real time through the blockchain data comprising of the number of units of a particular drug dispatched each day. Through analysis on the various drugs and the assessment of their demand supply mapping along with the application of predictive analytics can help us identify the drugs which are fast moving and have a high market demand and those which have a low market demand. This can help us minimize inventory. Additionally, the barcode scanner which can be accessed through the distributor phone can also have the face recognition feature through which we can re-check that the drug is with the designated distributor.

References

[1] Blockchain-Based Smart Contracts: A systematic Mapping Study, Maher Alharby and Aad van Moorsel, Dinaharan Nagamalai et al. (Eds): AIS, CSIT, IPPR, IPDCA, 2017, in press.
[2] SUN rises from RANBAXY: Supply Chain Strategy of an Indian Pharmaceutical Company, Sushmera Manikandan and Balan Sundarakani, 2018, in press.
[3] Whitepaper on Application of Blockchain technology in Banking and financial sector of India, An IDRBT Publication, January, 2017, in press.
[4] Internet of things: Rise of the connected world Report, Deloitte, 2021.
[5] Global Blockchain Technology Market Procurement Intelligence Report, SpendEdge, 2021.
[6] Report: Global Blockchain Technology Market in the Healthcare Industry, Frost & Sullivan, 2019.
[7] Blockchain Interoperability smart Project Report, IBM et al., 2020.
[8] Blockchain in healthcare start-ups in India Report, Tracxn, 2020.
[9] Big Data Analytics Adoption in Pharmaceutical Supply Chain Management and its Impact on SCOR Process: A qualitative Study of the Australian Pharmaceutical Industry, Maryam Ziaee, unpublished.
[10] Does Blockchain hold the key to a new age of supply chain transperancy and trust, Capgemini.
[11] Michael Wang and Ferry Jie, Managing supply chain uncertainty and risk in the pharmaceutical industry, Monash University, Melbourne, Australia, 2019, in press.
[12] Kah Seng Lee, Factors Impacting Pharmaceutical Prices and Affordability: Narrative Review, University of Cyberjaya, 2020, in press.
[13] Rajesh Kr. Singh et al., Strategic issues in pharmaceutical supply chains: a review, International Journal of Pharmaceutical and Healthcare Marketing, 2016, in press.
[14] Khizar Abbas et al., A Blockchain and Machine Learning-Based Drug Supply Chain Management and Recommendation System for Smart Pharmaceutical Industry, Department of Computer Engineering, Jeju National University, Jejusi, 2020, in press.
[15] Disa Lee Choun and Jim Nasr, Evaluating How Blockchain Can Transform the Pharmaceutical and Health Care Industries, 2018, unpublished.
[16] Swetha Agarwal, Blockchain technology in Supply Chain and Logistics, 2014, in press.
[17] Shruti Srivastava et al., Traceability and Transparency in Supply Chain Management System of Pharmaceutical Goods Through Block Chain, 2019, in press.