Blockchain for End-to-End Supply Chain Transparency

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How blockchain improves traceability, compliance, and security in pharmaceutical and consumer goods industries.

Abstract:

Blockchain is the digital record-keeping technology behind cryptocurrency networks that has been phenomenal. It has been a potential game changer in the financial world. It is also a promising technology in supply chain management as it fosters them through faster and more efficient delivery of products. It also enhances the traceability of the product, aids coordination between the partners, and makes financing more manageable. Blockchain has been phenomenal in supply chain networks, fostering consensus mechanisms, decentralization, reliability of systems and data, and improving overall performance.

Blockchain renders opportunities for supply chains to strengthen their traceability and enhance end-to-end visibility. This level of transparency in blockchain-based supply chains is the need of the hour for the pharmaceutical and consumer goods industries. The modern pharma supply chains are complicated; thus, incorporating blockchain-based smart contracts to monitor the interaction between the participants helps companies stay informed of the sales transactions and ensures prompt payment dispersals. Smart contracts help regulate the interaction by monitoring the status of IoT containers in the pharmaceuticals and consumer goods industry.

Keywords: Blockchain, supply chains, Pharma industry, consumer goods, traceability compliance

Introduction:

The decentralized approach of blockchain technology has resulted in numerous innovations across various industries, including the pharma and the consumer goods industry. The digitalization of the supply chains is an intelligent and value-driven process that yields new revenue and business value for the organizations (Buyukozkan and Gocer, 2018). Digitalized supply chains enhance capabilities and allow companies to decrease their operating costs and improve quality. They can develop new products as per customer needs and gain a strategic advantage over business operations (MacCarthy and Ivanov, 2022). Blockchains can further help supply chains improve end-to-end data transparency, reduce costs and risks, and foster sustainable operations (Saberi et al., 2019). Hence, blockchain is a promising application in the pharmaceutical industry, as it requires efficient and responsive supply chain handling techniques (Al Hawary et al., 2017).

Blockchain technology allows the pharma companies and those players in the consumer goods industry to gain more visibility and control over the processes, connect with their partners easily, gain accurate information, and follow demand patterns quickly. This also mitigates the expiry and spoiling of medicines and consumer care products. Transaction costs are also reduced through reduced processing and lead times, safe delivery of medicines, reduced contracting costs, and upholding the brand's image and reputation (Pournader et al., 2020). This paper aims to analyze

the impact of blockchain technology in enhancing compliance and security in the pharma and consumer goods industry.

Benefits of blockchain technology on the supply chain:

Blockchain technology offers various benefits, which help manage costs, increase transparency, and, in the process, increase efficiencies in the supply chain. There are benefits like less dependence on paperwork, more information on the product lifecycle, and enhanced interoperability. Blockchain technology enhances information distribution throughout the supply chain so that everyone is fully aware of what action is required from them.

a) Increased transparency:

Transparency is the cornerstone of integrity and trust in the pharma industry, as the quality of legitimacy of the medicines touches human lives directly. Blockchain technology renders a game-changing alternative for increasing this transparency throughout the pharmaceutical supply chain. As blockchain technology advances, more players from the pharma and consumer goods industries realize its promise of transforming the manufacturing, distribution, and consumption of products across the sector. (Hasselgren A, Wan PK et al, 2020)

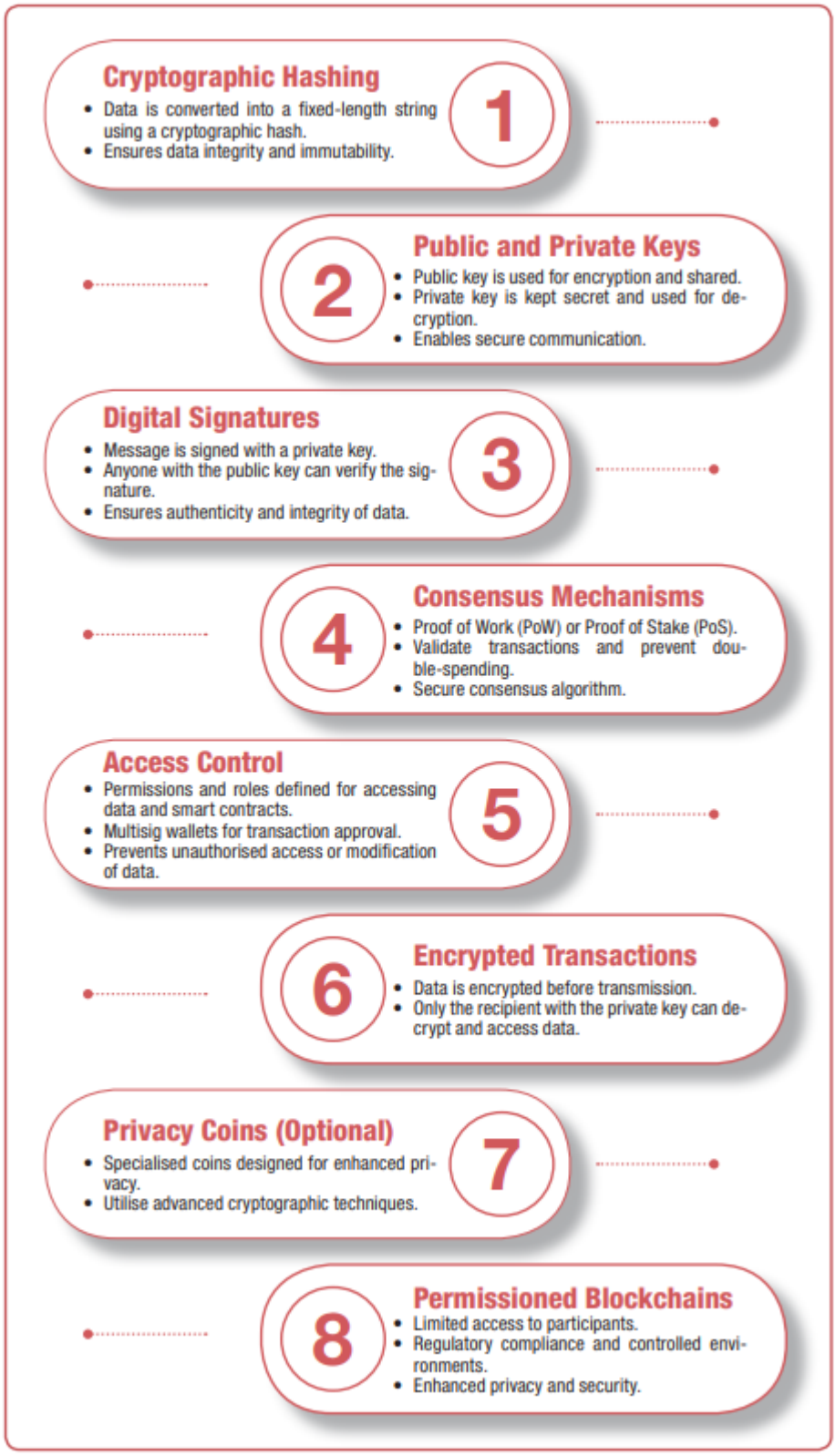
b) Distributed ledger system:

This is the heart of the blockchain movement towards traceability and compliance in various industries. The blockchain ledger is distributed over various nodes and is thus not vulnerable to manipulation or single-point failures. As every transaction is verified and recorded, it is impossible to tamper with data without consensus. This indicates that manufacturers, regulators, distributors, healthcare practitioners, and even end users can track the journey of pharmaceutical and consumer care products with complete confidence in the integrity of the system. (Kuo TT, Kim HE et al, 2017)

c) Tracking and verifying the supply chain:

The ability of blockchain technology to offer end-to-end traceability is one of the significant applications of blockchain technology in the pharmaceutical sector. Every batch of the medication will be branded with a digital signature that records critical information such as the origin of raw materials, quality control checks, and distribution paths using smart contracts and unique identifiers. As a result, the stakeholders in the pharma supply chain can now obtain a detailed record of the product's journey. For instance, the pharmacist can scan a QR code on drug packaging and get a complete history of the drug’s production and distribution.

Figure 1: Flowchart on how privacy and security are ensured in blockchain technology.



d) Blockchain strengthens regulatory compliance:

The pharmaceutical sector relies on strict regulatory compliance to ensure the safety and efficacy of its products. Businesses should follow a plethora of regulations to ensure the safety and effectiveness of their products. Integrating blockchain technology has the potential to streamline their compliance processes. Smart contracts help automate compliance and regulatory processes, and such automation mitigates administrative load for the pharma industry, as well as reduces human error. (Kiester L, Turp C, 2022).

e) Financial benefits:

The use of blockchain technology has a significant effect on companies' cost savings. Some of the recent studies have revealed the figures as in the below points:

- A study by IBM says that the blockchain can help cut the costs of businesses by $200 billion annually.
- World Economic Forum study found that the usage of blockchain in the supply chain helps reduce the risk of fake products by 50%.
- The success of the blockchain has led the United Nations to explore its usage in the food movement and ensuring food safety.

f) Facilitates trust in clinical trials:

Clinical trials frame the foundation for drug development and provide the evidence to support the safety and efficacy of the new medicines. Data integrity and transparency in clinical trials have always been concerns for the industry players. Blockchain technology can completely transform this important stage of drug development (Naughton DB, 2019). Blockchains record every step of the clinical trial, and the immutability of blockchains ensures trial data is not modified and validated independently, adding to the integrity of the results.

Steps involved in the process of implementing blockchain technology in the supply chain of the pharma industry

On the basis of the generic principle and research development by authors (Vu, Ghadge, and Bourlakis 2021), the implementation of blockchains in the pharmaceutical supply chain can be classified into broadly three stages.

Figure 3: Steps involved in the implementation of blockchain in pharmaceutical supply chain

1. Initiation stage:

The initiation stage encompasses understanding the blockchain and its potential benefits, as well as the rationale behind its adoption (Pichlak 2015). The external environment and the technology initiatives drive the need for blockchain adoption. Tseng et al. (2018) suggest an open surveillance net by risk benchmark to watch medication movement in the pharma supply chain. The government and the other participants should inspect the transaction information and protect the authenticity of the drugs.

2. Adoption decision stage:

Moving from the adoption stage to this stage requires financial, strategic, and technological evaluation (Picklak 2015). Inter-organizational resources are evaluated in this stage, and the resources should be allocated to support the

adaptation of technology. Top management consent and stakeholder consent are paramount at this stage. The long-term benefits of blockchain incorporation, such as high data security, improved supply chain, and combating counter-fitted drugs, will persuade large players to join the implementation surge (Holbl et al., 2018). Blockchains offer interoperable interfaces with the systems and information on drug movement, and they are thus much more advanced than the ERP systems of pharma producers.

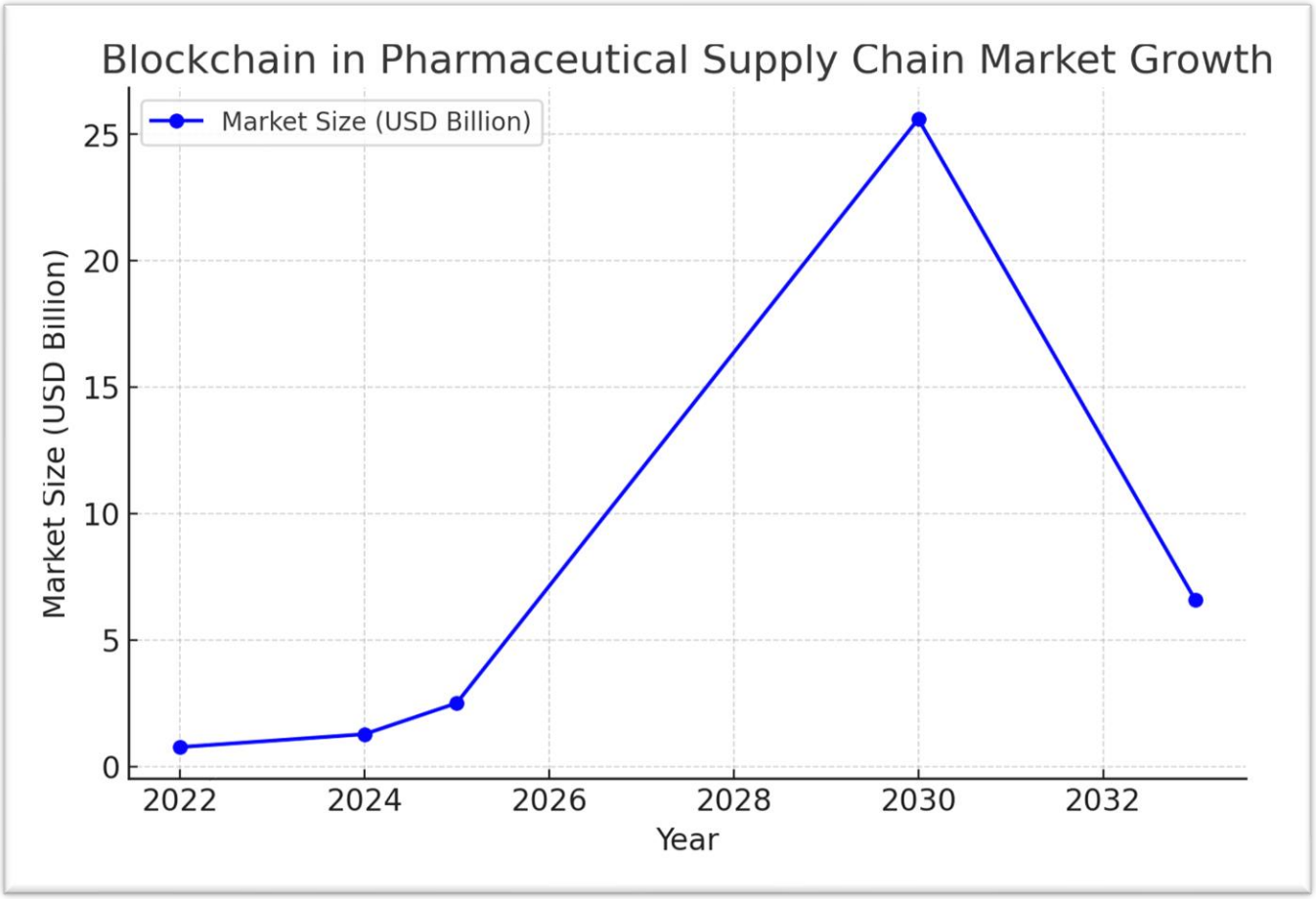
3. Implementation stage:

It is practical to perform a pilot study with few supply chain participants and test the feasibility of blockchain (Von Hoek 2019) to obtain valuable and meaningful insights. Mediledgers can be followed to track the drugs at the package level. With the success of pilot projects, scaling up the products at the supply chain level should be instituted. The pharmaceutical market is projected to yield at least 1.6 billion dollars in 2025, contributing to the implementation of blockchains.

Market growth of blockchain in the pharmaceutical supply chains

The pharmaceutical blockchain market is expected to grow substantially in the coming years. In 2023, this market is valued at nearly USD 0.98 billion and is predicted to reach USD 5.15 billion by 2032, reflecting a CAGR of 19.90% (Market Research Future, 2024). This growth is primarily due to the increasing adoption of blockchain solutions in streamlining operations for better data security and traceability in pharmaceutical supply chains.

Figure 2: Market growth of blockchain technology in the pharmaceutical supply chains



The integration of blockchain technology into the pharmaceutical supply chains has been achieving remarkable growth, as there is a need for enhanced security, efficiency, and transparency in the industry. The following are a few key ways in which the pharmaceutical supply chain is being transformed through the combination of blockchain and data analytics.

1. Traceability and Transparency:

An immutable ledger allows real-time visibility for tracking pharmaceutical products from manufacturing through to ultimate consumers. Such visibility can prevent counterfeits from entering the supply chain (IBM, 2023).

2. Secured Data:

Blockchain's decentralized and cryptographic infrastructure protects sensitive pharmaceutical data from unauthorized access and cyber threats, therefore making them also compliant and protecting patient data (IBM, 2023).

3. Compliance and Reporting:

An auditable and tamper-proof transaction record is provided by blockchain, enabling compliance with regulations like the Drug Supply Chain Security Act (DSCSA) of the pharmaceutical companies. Compliance reports are thus made efficient while errors in documentation are minimized (U.S. FDA, 2023).

4. Optimization of Supply Chain:

Integration of big data analysis with blockchain allows real-time performance insight into supply chains. This will be of great help to pharmaceutical companies in identifying inefficiencies and optimizing inventory. Therefore, this integration helps in reducing operational costs and improving the accuracy of forecasts (Market Research Future, 2024).

5. Prevention from Counterfeit Drugs:

Blockchain gives proof-of-proof authentication of pharmaceuticals, making supply routes and drug origins clear and traceable, thus bringing counterfeit medicine accessibility risk much lower to the patient (National Institutes of Health, 2023).

Recommendations

- Blockchain in the pharmaceutical and consumer goods industry can be extended to the initiation of smart contracts that help automate crucial procedures on the basis of a governed preset code. Such enhanced transparency can boost stakeholder trust and eventually improve end-user safety.
- The decentralized nature of blockchain fosters peer-to-peer contacts to reshape the pharmaceutical value chain, especially in the distribution process. This also reduces reliance on middlemen and fosters an efficient supply chain.
- Integrating blockchain applications in the pharma industry thus mutes the possibilities of a central authority and provides the drug supply chain with an unmatched level of security and transparency.
- According to WHO, about 10% of pharmaceutical products are counterfeit, putting human lives in danger (Uddin et al., 2022). To address this, it is recommended that the Medledger system be implemented, powered by blockchain technology, to initiate smart contracts and chain codes.
- Blockchain technology should be used to improve transparency in clinical trials and enhance their integrity. It also serves as a tool to improve the accuracy and completeness of data in clinical trials.

Conclusion:

Blockchain technology has immense potential to transform the pharmaceutical and consumer care goods supply chain by rendering solutions that enhance the security, transparency, and efficiency of logistics. With the integration of decentralized apps and smart contracts, it will be possible to automate the crucial operations in the pharma industry and maintain its integrity. Blockchain technology will form the future of the pharma industry and will be marked by security, transparency, and a consumer-centric design. It has the potential to affect the global health sector in different ways, focusing on various fronts: counterfeit medicines, regulatory compliance, and integrity of supply chains.

References

- Pareek, A., Sharma, S., & Verma, A. (2024). *Blockchain technology in pharmaceutical supply chains: A transaction cost perspective*. Scripta Medica.
- ScienceDirect. (2023). *Blockchain for supply chain transparency*. Pareek, A., & Sharma, S. (2023). *Blockchain technology in pharmaceutical supply chains: A transaction cost perspective*. ResearchGate.
- Author Unknown. (2022). *Blockchain for supply chain transparency*. Retrieved from file:///C:/Users/pc/Downloads/10-1108_MSCRA-10-2022-0023.pdf
- Qualifyze. (n.d.). *The role of blockchain technology in pharma*. Retrieved from ScienceDirect. (2024). *Blockchain for supply chain transparency*. Retrieved from
- ResearchGate. (2022). *Blockchain for supply chain transparency*. Retrieved from
- Author Unknown. (n.d.). *Blockchain for supply chain transparency*. Retrieved from file:///C:/Users/pc/Downloads/BlockchainforSupplyChainTransparency_Final%20(1).pdf
- Harvard Business Review. (2020). *Building a transparent supply chain*. Retrieved from ScienceDirect. (2022).
- *Blockchain supply chain innovation*. Retrieved from Deloitte. (n.d.).
- *Blockchain supply chain innovation*. Retrieved from ResearchGate. (2024).