BLOCKCHAIN TECHNOLOGY FOR PHARMACEUTICAL DRUG DISTRIBUTION IN INDONESIA: A PROPOSED MODEL

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ABSTRACT. *The distribution process is an essential part of boosting the profitability of a company. Distribution process carried out the process of acquisition, purchase, storage, distribution, transport, repackaging, re-labeling, documentation, and record-keeping practices. The problems that occur in the validation process of each distribution process in each party involved are not well registered and integrated with each other, so in the complex drug distribution environment, the monitoring process becomes a necessity every time more urgent and primary to reduce theft, prevent counterfeiting, and improve efficiency, synchronization, visibility, and safety. Providing good tracking of goods gives consumers greater interest in the consumption of goods that meet certain ecological and ethical standards and thus requires the quality of the goods consumed. In this thought, it aims to discuss the best blockchain models for the drug distribution process. This research is qualitative research. As a result, the model was introduced as a potential blockchain model and could be applied in pharmaceutical companies in Indonesia.*
Keywords: Blockchain technology, Distribution drug, Pharmaceutical

1. **Introduction.** Current technological developments will foster technological improvements in the digital age, and this occurs in the distribution process that uses technology for the process of data and information exchange. Distribution is the main driver of profitability in a company since it has a direct impact on logistics costs and customer experience [1]. Distribution is an important activity in the integrated management of the product supply chain. Distribution is one of the processes that occur in all industries, including the pharmaceutical industry. Distribution process carried out the process of acquisition, purchase, storage, distribution, transport, repackaging, re-labeling, documentation, and record-keeping practices. In distribution, some people and entities are generally responsible for handling, storing and distributing these products [1,2]. One of the distribution processes in the pharmaceutical industry distributes drugs from the pharmaceutical industries to wholesalers, large merchants to hospitals or pharmacies, from pharmacies to final consumers (patients or the public) [3].

In this distribution process, the data must be integrated with each other. With this, you can be closer to the concept of blockchain if we think about distributed data, data integration, more secure platforms, accounting books, databases, storage, data exchange and connection of parts with real, unhandled data and ultimately trustworthy [4]. Blockchain is a new technology that was originally introduced by a person or group of people called

Satoshi Nakamoto in 2008 [5]. Blockchain is a distributed database that contains information about all transactions that use peer-to-peer networks, hashing timestamp transactions, in chains with markle trees that use hash-based proof of work that is carried out consensually and digitally recorded in "blocks" and then linked cryptographically and chronologically in "chains" using a set of mathematical or encryption algorithms [5,6], thus forming records that cannot be changed [5,7]. The encryption technique guarantees the user's ability to change only the part of the block he accesses, using private keys and codes. Encryption also allows you to synchronize copies of the blockchain that are distributed among the network bases stored in the ledger.
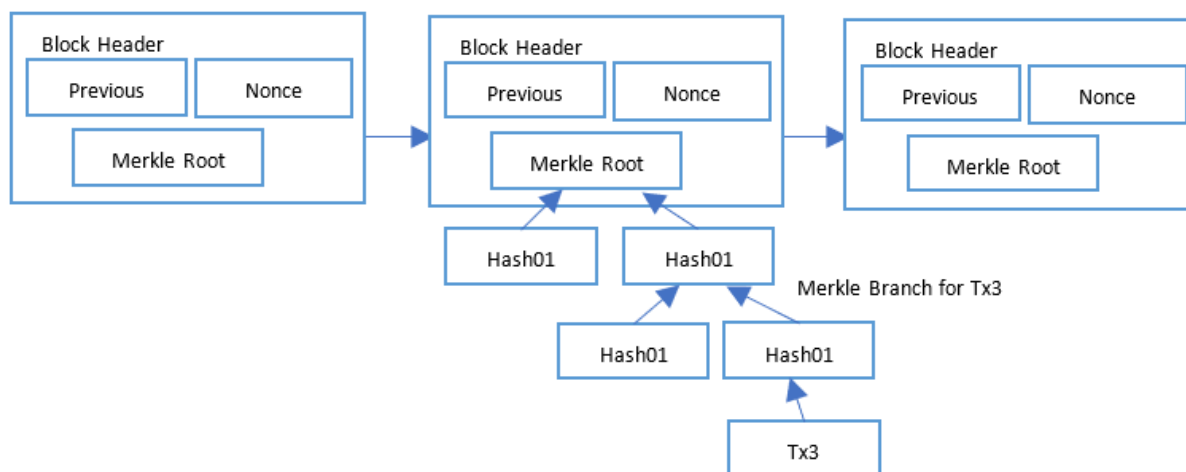

FIGURE 1. Blockchain [5]

In its development, blockchain technology began to clarify its influence by providing benefits in economic, political, humanitarian, legal and other systems [8]. Blockchain has the potential to change technological development and even has the ability to reconfigure all aspects of society and its operations [7]. The concept of a blockchain with an open book that is distributed, verified stakeholders (government and industry) will validate all drug distribution transactions and documents to make the data more accurate and reliable. The concept of blockchain is very acceptable to support the collaboration that occurs between stakeholders in sectors close to the industry because of the values provided by blockchain as "unchanged", "validated", "shared" and "open" [9]. Blockchain is close to what we call an identity, each party needs a valid identity and recognition/approval from government, industry and other related sectors. In supply chain management, especially distribution in the pharmaceutical industry, there is a complexity of distribution in the participation of stakeholders, including government institutions, hospitals, clinics, drug manufacturers, drug distributors, pharmaceutical chains, retailers, research organizations [10]. The process of distribution to consumers should be able to guarantee or guarantee that medicines are well received, of high quality and according to needs [11-13]. Blockchain technology will help pharmaceutical companies minimize their knowledge of operational results in the development of medicines for the process of distributing medicines to final consumers [14].

In the system in Indonesia, the distribution process has aspects that must be complied with or carried out in accordance with the guidelines for a good distribution of drug (C-DOB) based on the Head of BPOM Regulation number HK 03.1.34.11.12.7542 in 2012, which include quality management, organization, management and personnel, buildings and equipment, operations, self-inspection, complaints of drugs and/or materials for returned drugs, suspected falsification and withdrawal, transportation, contract facilities and documentation [15,16]. This guideline must be carried out by all parties in the drug

distribution chain. Indonesia in realizing the vision and mission of national industrial development to improve public health, the pharmaceutical industry has several problems that occur in the distribution of medicines, among others: data of drugs not yet administered registered in BPOM ($+/-$ 20,000 types) and data from uncontrolled distributors available ($+/-$ 2821 PBF) [17], BPOM in 2013 received 71 drug circulation findings with a value of Rp. 5.67 thousand million, in 2014 the findings reached 3,656 items with a value of Rp. 31.6 billion, in 2015 up to 3,671 items with a value of Rp. 20.8 billion, and in 2016 the February-March 2016 period found up to 4,441 items with values that reached Rp. 49.8 billion [18]. This problem is because the handling of drug data has not been done well; there are still many distribution systems through unofficial distributors or those not listed in BPOM [19]. Another violation that occurs in the sale of medicines is the sale of counterfeit medicines and expired drugs in the pharmacy, the sale of drugs that contain narcotics, psychotropics and hard drugs that are not by the rules determined by the government [20].

The problems that occur due to the system are not integrated and the lack of a systematic follow-up/follow-up process in the process of distribution of complex medicines that results in not recognizing the data of medicines and the uncontrolled distribution of medicines in the market [21,22]. The validation process of each distribution process in each party involved is not registered and is well integrated with each other, so that in a complex environment of drug distribution, the monitoring process becomes an increasingly urgent and primary need to be able to increase the theft reduction, prevent counterfeiting and increase efficiency, synchronization, visibility and security [23,24]. Providing good tracking of goods gives consumers greater interest in the consumption of goods that meet certain ecological and ethical standards and thus requires the quality of the goods consumed.
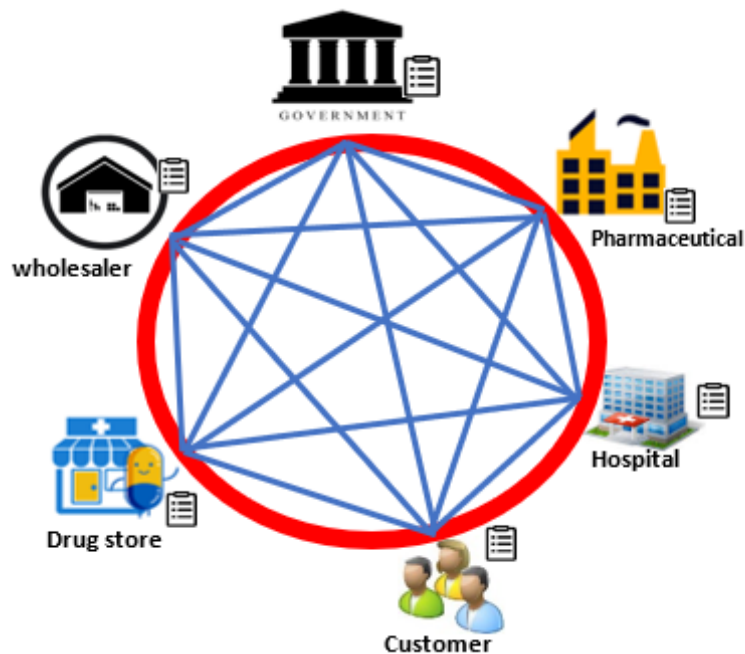

FIGURE 2. Pharmacy distribution model with blockchain

This research proposes the process of identifying the drug distribution process that occurs with each party involved in the network by validating the transactions that occur. The transactions are carried out from the pharmaceutical industry that produces medicines, then requests medicines from the wholesalers, then to hospitals or pharmacies, at the hands of the final consumers who need it. Based on the background, blockchain represents a framework that can be used for drug distribution problems to cope with

the circulation of counterfeit or illegal drugs. In this study, using the qualitative one to answer the question "How can the blockchain framework be implemented to eradicate the circulation of counterfeit or illegal drugs in Indonesia?". In addition, the purpose of this study can contribute to responding to problems that occur due to integrated data, data transparency and validated data to provide certainty about the reliability of drug distribution data in order to minimize information incorrect that irresponsible parties may use incorrectly. With the application of the blockchain concept, it is considered appropriate and good to meet each of your needs in the drug distribution transaction process.

2. **Research Methodology.** In this case, the research steps carried out to develop a model of drug distribution model in the pharmaceutical industry were explained. The following is the research methodology performed in this study in Figure 3.
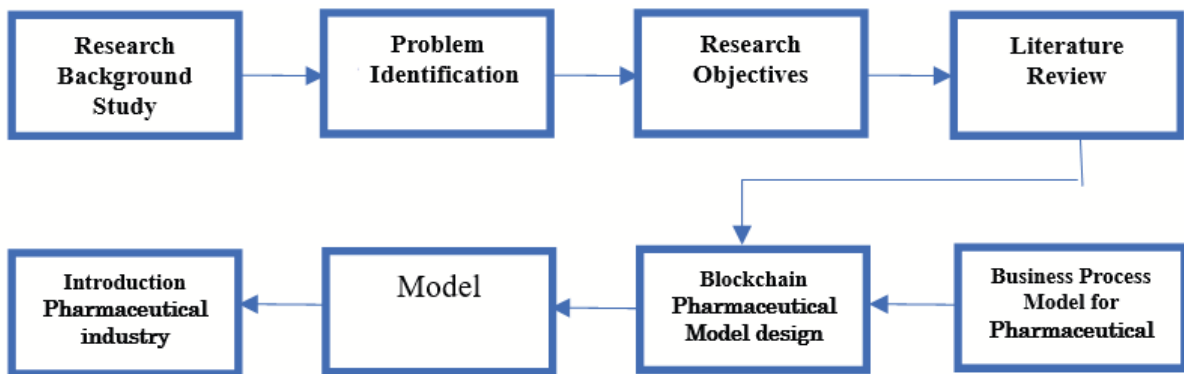

FIGURE 3. Research methodology

2.1. **Research background study.** The initial process is carried out, the researchers look for phenomena from the problems that occur in the distribution process with the problem that the drug data has not been administered in BPOM and the distributor data is not well managed [17], the discovery of the distribution of illegal drugs in the drug distribution chain [18]. There are still many distribution systems through unofficial or unregistered distributors, violations in the sale of drugs that have expired in pharmacies [19], and the sale of medicines that are not in accordance with the rules established by the government [20]. This problem has become the need for researchers to find a model framework that has not yet been applied.

2.2. **Problem identification.** This study identifies the problems that occur when obtaining large quantities of illegal or false drugs in the drug distribution process. Counterfeit or illegal drugs are a form of action that is very harmful to those interested in distribution because it makes the product sell less and even reduces consumer confidence in the product. Where it was expected that the role of all stakeholders could stop the process. In this study the process of finding methods, frameworks, and ideas for verifying drugs that can be verified and improved according to instructions in the drug distribution process is carried out.

2.3. **Research objectives.** This study explains the purpose of this study specifically and solves the problems that occur. The purpose of this study is to build a distribution model to provide open data and information that can be audited, valid and reliable so that the proven portfolio and medication credentials are original and useful medications using this blockchain technology model.

2.4. **Literature review.** A literature review was conducted to help researchers obtain a review of the literature that is appropriate and supports this research. The review of the literature in this study focuses on the implementation of blockchain in the pharmaceutical industry, so it is the basis of the models built for the pharmaceutical industry.

2.5. **Business process model for pharmaceutical.** The development of business processes is carried out, the researcher investigates and proposes a process model that is compatible with the pharmaceutical industry. Then, the researcher decided on the best solution to design models. The business process model for the pharmaceutical industry was obtained from the four largest pharmaceutical companies in Indonesia involved in the survey to reflect the general business model.

2.6. **Blockchain pharmaceutical model design.** At this stage, draw the entire process in the drug distribution process using blockchain identifying each entity involved in each block.

2.7. **Model for distribution drug in pharmaceutical industry.** The model will describe the framework of each thing showing the integration of data so that each interested party can interact with each other. Within this framework, the general transaction process of all parties can be recorded appropriately and indelibly so that the data is always valid and verified for each transaction block. The data may also be used by other parties that have been verified following their respective interests. So that the drug distribution transaction process that leaves the drug factory to the final consumer can be appropriately registered and validated. The drug distribution process carried out in the pharmacy includes the process of receiving orders, acquiring orders, making shipping invoices, sending goods. This process is carried out between the pharmaceutical industry to wholesalers and wholesalers to retailers (hospitals or pharmacies) that are controlled by aspects of CDOB [16], that has been established by the government and the final process for consumers to obtain the necessary medications in drug stores or health services. The application of blockchain technology is the most critical part of this process, where each party can make transactions between peers to be validated and integrated so that each party can access the data according to the interests of the example. Consumers can guarantee that the purchased medication is the correct medication, reasonable, quality, and following the provisions of the doctor.

2.8. **Introduction to pharmaceutical industries.** Based on the research, confirming that the model designed can be applied in all pharmaceutical industries in Indonesia. In the validation of the model made by respondents, that is the pharmaceutical industry that has the highest level of sales in Indonesia, there are four companies selected. In carrying out this socialization, it is expected that this model can be generalized throughout the pharmaceutical industry in Indonesia.

3. **Result and Discussion.** We describe the process in a business process value chain that is at the center of the drug distribution process in the pharmaceutical industry. This value chain describes the entire process that directs the use of the blockchain concept.

The distribution process of the pharmaceutical drug business model with blockchain illustrates the integration of the transaction processes in each stakeholder that occurs within the blockchain technology supported by the CDOB aspects. That can be shown in Figure 4. Due to this base, blockchain is very suitable to be applied in the industrial sector, especially in the distribution process, so that the interested parties can keep track of the drug distribution transactions. The blockchain model developed records and integrates all drug distribution activities from collaboration between government, industry, pharmaceutical wholesalers, community service facilities (hospitals, pharmacies) and end consumers. Based on what is needed in the pharmaceutical world, this research creates
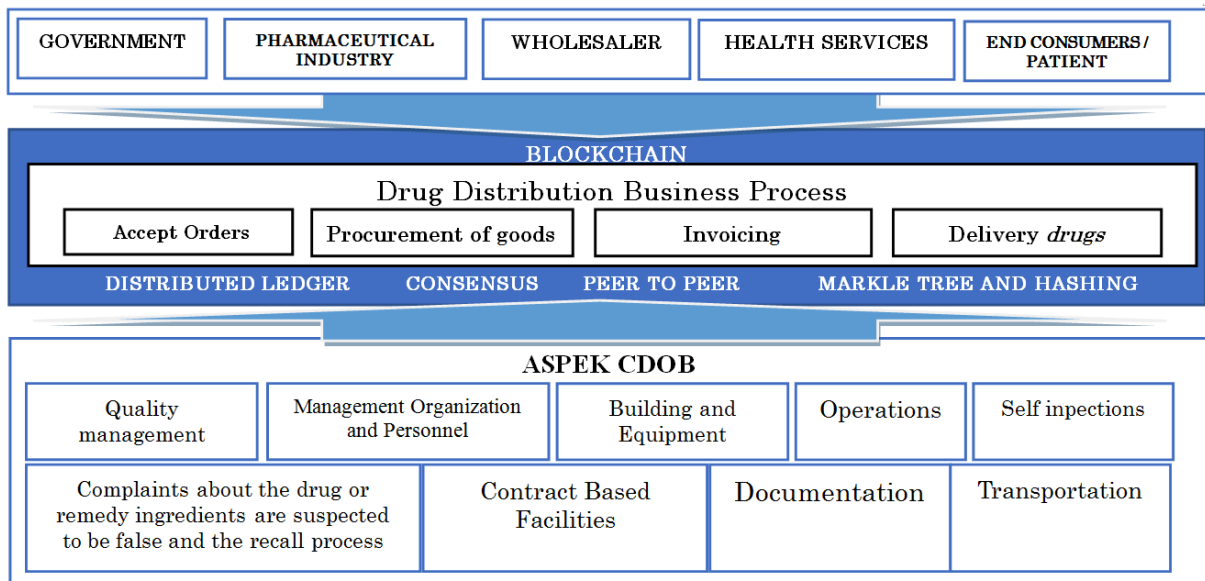
FIGURE 4. Business model distribution of pharmaceutical drugs with blockchain in Indonesia
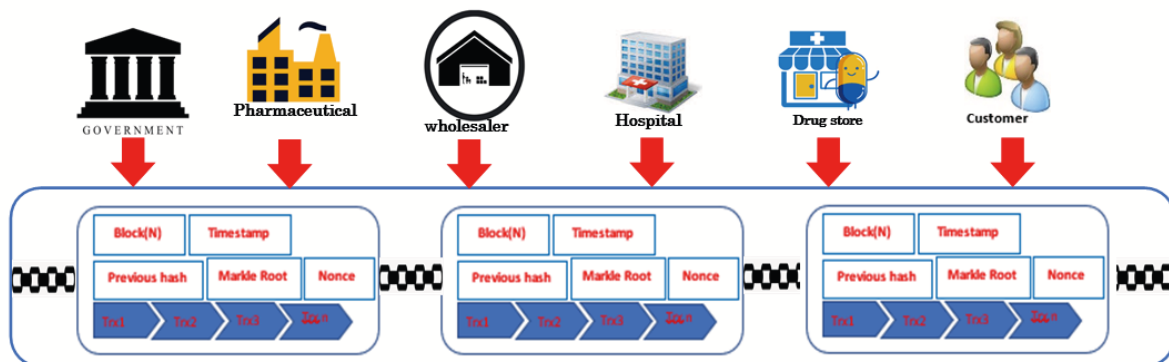

FIGURE 5. Transaction model distribution of pharmaceutical drugs with blockchain

a new blockchain model for the distribution process of the pharmaceutical industry in Indonesia. The processing of the transaction will be in the form of blocks related to each other occuring in the validation process by the participants in the network so that the data becomes more reliable. This can be seen in Figure 5.

4. **Conclusion.** Model is designed based on the core business processes of the largest pharmaceutical companies in Indonesia. In this model, the integration of data, validated data and centralized information carried by blockchain technology is illustrated. In this case, interested stakeholders can access the same data and the data can be validated in real time, which provides a condition for data that is kept updated, validated, verified, accurate and can be tracked well.

In the application of this blockchain, a solution is provided to the problem of the circulation of counterfeit drugs, which is a common problem that occurs in various parts of the world. This happens by not validating information, integrating the information to provide an opportunity for evil parties who are not interested in spreading fake drugs. For this reason, this research proposes an model that is based on blockchain technology that offers data integration, data tracking. All this is reflected in this very important and good concept for the pharmaceutical industry to maintain the quality of the drugs that are in circulation and support the government in the eradication and control of the

distribution of medicines to consumers. With this, you can provide a healthy and good life for the community.

This research has implications for this model that can help interested parties (government, pharmaceutical wholesalers, pharmacies, hospitals) to obtain integrated data, validated data according to their individual needs. This model can also help strengthen the government in controlling the distribution process that occurs in the pharmaceutical market. The pharmaceutical industry can see the process of drug transactions that occur in the distribution process. Consumers can verify data on medications purchased at a pharmacy or hospital. In the future, blockchain technology should be designed in a detailed model for each process that takes place and a prototype is implemented to provide evidence of the integration of data between stakeholders regarding the distribution of medicines.

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