

# A Secure Healthcare System using Blockchain Technology

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**Abstract** - Requirements from consumers and governments to produce more sustainable products have increased during recent years. Even if products are certified, one cannot make sure companies meet these requirements, since no chain of events can verify this exists. The transportation industry lacks certification and information on whether a product is transported in a sustainable way. The health industry, on the other hand, has integrated the use of certifications widely. However, the industry also requires traceability through the entire supply chain. In this research, the authors study how traceability issues can be solved from the perspective of a fourth party logistics firm and how the transparency could be increased. Scholars argue that one way of solving traceability issues, and at the same time achieve transparency, could be to use the blockchain technology; a technology which stores data in chronological order, impossible to manipulate afterwards. Therefore, the blockchain technology has been tested on a product's flow, from loading at a supplier, through a cross-docking terminal and a central warehouse, to receiving at a client's store. By integrating a blockchain to a smartphone application, enabling scanning of QR codes through the camera, and linking the information from the QR code to the blockchain, digital footprints between the parties could be created at each transaction. To be able to implement the technology and successfully use it, three main challenges have to be overcome: cooperation between the involved parties, motivation for the user of the smartphone application, and system integration between the different IT-systems. The conclusions from the research are that the usage of blockchain technology is advantageous in order to achieve traceability. In addition, the technology enables all involved parties to check the product's entire history as well as its current location. Further, the technology creates transparency for all participants. Due to the irreversible technique of storing data, the blockchain technology creates a unique level of credibility, which contributes to a more sustainable industry. The information on the blockchain enables companies to strengthen the relationships with current customers and to attract new ones.

**Key Words:** Blockchain, Traceability, Transparency, Supply Chain, QR Code

## 1. INTRODUCTION

World Health Organization (WHO) defined counterfeit medicine as "one which is deliberately and fraudulently mislabeled with respect to identity and/or source"[1]-[3]. Counterfeiting of various products creates problem to different manufacturing industries and it causes serious threat to pharmaceuticals products. This threatens the

public health and also causes revenue loss to the legitimate manufacturing organizations. The International Chamber of Commerce of Geneva reported that the annual sales of counterfeit products in the world amounts to U.S.\$ 650 billion [4].

There are various techniques which has been already used for tracing counterfeit drugs in medical supply chain. Authors in [6], proposed usage of Smart-Track which contains bar code or RFID code on medicine bottles for verifying its legitimacy. Similarly, Data-Matrix tracking system has been proposed in [7], where each medicine contains a Data-Matrix. This matrix includes Manufacturer ID, Product ID, unique ID of the package, the authentication code and optional meta -data. The author has also mentioned the CVR(central verification register) which will store the hash value of the details included by Data-Matrix. On purchase scanned Data-Matrix (which includes hash value) is verified with CVR of the manufacturer.

Authors in [8] has proposed a NFC (Near Field Communication) tags for validating the authenticity of drugs. It contains three different phases such as (1) Product registration (2) Product authentication by Key value (3) NFC (Near Field Communication) tag. A key exchange technique has been proposed to verify the details of the medicine from its NFC tag [8].

None of the above methods use the automatic verification of product authenticity, and manufacturer legitimacy. When it comes to preventing counterfeit drugs in the drug supply chain, blockchain technology stands out as a way to ensure an immutable chain of transaction ledger, tracking each step of the supply chain at the individual drug level [5].

## 1.1 Background

The aim of this study is to contribute to two different areas. Firstly, the field of tracking and tracing of goods, primarily in the medical industry. This by exploring how block chain technology could be applicable in the distribution part of a supply chain. Due to the increased demand of transparency from different stakeholders, our second intention of the study is to suggest a tool for managing transparency in the field of logistics by using blockchain technology.

## 1.2 Purpose

The purpose of the research is to study the real-world problem i.e. the traceability issues for the cooperative fourth

party logistic (4PL) company. The company has a mismatch of the physical and digital flow, and the research intend to study if the blockchain technology is applicable to deal with this issue and thus obtain transparency.

lower layers that companies should give their full attention, since the pertaining parties often experience bad and unhealthy working conditions along with low salaries (Svensson, 2009), which causes unsustainability in the industry.

The sustainability awareness, not only from social aspects but also environmental, has grown during the last decade to become an important part of supply chain management (Gualandris, Klassen, Vachon, & Kalchschmidt, 2015). Nowadays, stakeholders interest in what a firm do in terms of sustainable practices (Gonzalez-Benito, Lannelongue, & Queiruga, 2011; Gray, 2013) and consumers demand more sustainable and transparent products (Trienekens, Wognum, Beulens, & van der Vorst, 2012). One technology that has been given much attention during the last few years, which can offer both traceability and transparency, is the blockchain technology (YliHuumo, Ko, Choi, Park, & Smolander, 2016). A technology that initially was invented to support the digital currency of Bitcoin (Nakamoto, 2008). The blockchain technology stores data in blocks, in chronological order, and due to a mathematical trapdoor (Brennan & Lunn, 2016), the data stored in the blocks is impossible to alter or remove (Nakamoto, 2008; Fanning & Centers, 2016). Copies of the chain of blocks, hence the term blockchain, and thereby the information, are distributed among the participants in the network (Tsai, Blower, Zhu, Yu, & Ieee, 2016).

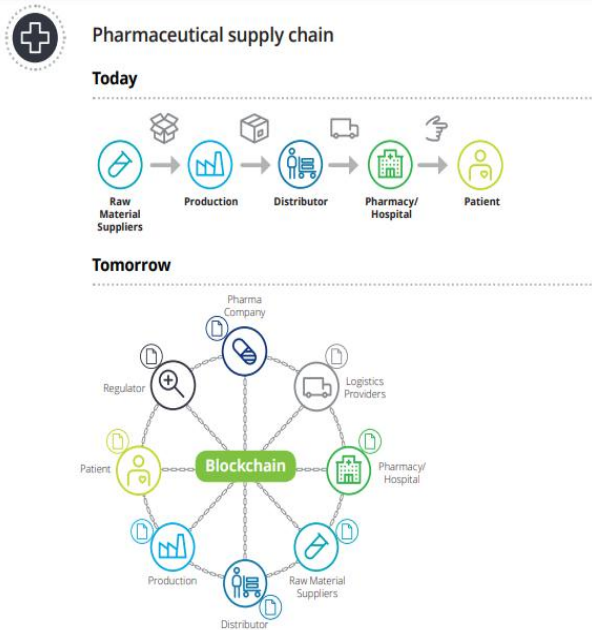


Fig: - Supply Chain

### 1.3 Technology

Blockchain is a technology having decentralized and distributed ledger. It has a blocks which contains a set of transactions that are chained together using a cryptographic hash. Blockchain is mostly known as the underlying technology of bitcoin. In blockchain a peer-to-peer network of computers is used to validate transactions. Blockchain is basically a data structure which is used to create and share distributed ledger of transactions among a network of computers. It is allowed in blockchain for user to make and verify transactions immediately without a central authority.

### 2. Literature Review

The supply chain network consists of numerous parties; suppliers, intermediates, third party logistic (3PL), fourth party logistic (4PL) and customers (Mehmann & Teuteberg, 2016). A 4PL is a non-asset based integrator who manage clients' supply chains to create business value (Win, 2008). More actors within the chain create vast and complex supply chains. One part of the complexity is the truck transportation, which is the most common used way of transports (Caputo, Fratocchi, & Pelagagge, 2006). The transport industry consists of hauliers from whom a buyer bought the transport service, who in turn can use subcontractors to accomplish the transport (Sternberg, Germann, & Klaas-Wissing, 2013). The subcontractors might use additional subcontractors, resulting in multiple layers and leads to difficulties in terms of controlling the transport segment and its parties. It is to those

### 3. System Architecture

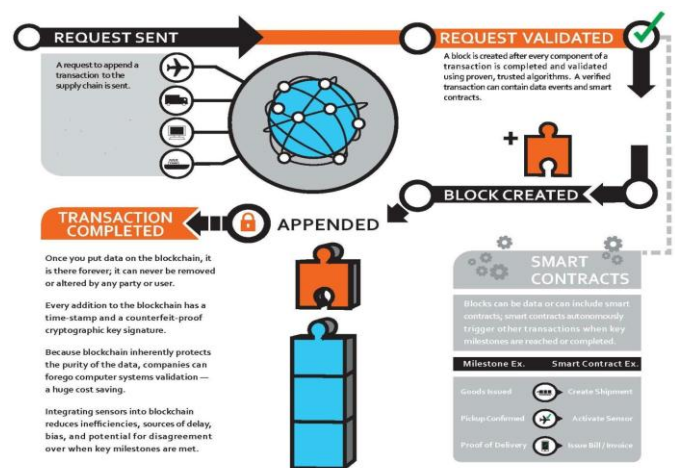


Chart: System Architecture

The data stored inside each block depends on the type of blockchain. In the Bitcoin blockchain structure, the data about the receiver, sender, and the amount of coins is maintained by block.

A hash function is present in every block of blockchain. A hash is like a fingerprint which has long record consisting of some digits and letters. Hash of each block is generated with the help of a cryptographic hash algorithm (SHA 256). Consequently, this helps to identify each block in a

blockchain structure easily. The moment a block is created, it automatically attaches a hash, while any changes made in a block affect the change of a hash too. Simply stated, hashes help to detect any changes in blocks.

The final element within the block is the hash from a previous block. Because of this a chain of blocks is created and is the main element behind blockchain architecture's security. Any corrupt attempts provoke the blocks to change. All the following blocks then carry incorrect information and render the whole blockchain system invalid

#### 4. FUTURE SCOPE

With the increasing popularity towards the technology, blockchain is being adopted by various fields like Finance, Healthcare, Travel and Tourism, Logistics, Real Estate and many more.

We can use blockchain concept in many field to detect the duplicate products.

In future we can use blockchain in Blockchain in Digital Advertising, Blockchain in Cyber Security, and the Blockchain in Forecasting.

#### 4. CONCLUSION

Blockchain is an attractive solution to supporting supply chain. Much like the Internet and search engines have provided a way to search and acquire data that resides in many places, blockchain promises to do the same in a secure environment for business transactions and consumer and patient interactions. The proposed system represent blockchain based secure infrastructure for supply chain among valid participants.

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