

Blockchain in Supply Chain: Case Study of Lottemart Ciputat

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Abstract. Current supply chain methods are having difficulties in resolving problems arising from the lack of trust in supply chains. The root reason lies in two challenges brought to the traditional mechanism: self-interests of supply chain members and information asymmetry in production processes. Blockchain is a promising technology to address these problems. The key objective of this paper is to present qualitative analysis for blockchain in supply chain as the decision-making framework to implement this new technology. The analysis method used Val IT business case framework, validated by the expert judgements. The further study needs to be elaborated by either the existing organization that use blockchain or assessment by the organization that will use blockchain to improve their supply chain management.

Introduction

The movement of goods (supply chain) for people around the world is massive. For example, in 2015 the market's global value was \$8.1, and is expected to grow to \$15.5 trillion by 2023, making it one of the largest industries on the planet. In the United States, freight and logistics spend in 2015 totaled \$1.48 trillion, nearly 10% of the country's GDP (Transparency Market Research, 2016).

According to KPMG, many parts of the logistic value chain don't have a full visibility and trusted system to communicate between various members. They use manual processes to keep track of the movement of their goods. For example, some members rely on manual data entry and paper-based proof of delivery (POD) to record the orders. Some PODs are send back through couriers, that will create issue on bad data handling practices. Lack of transparency and bad tracking is both the cause-of and caused-by this manual/paper based data.

In summary, the challenges of current traditional mechanism are:

1. The self-interests of the supply chain members
2. The information asymmetry in the process

Rise in adoption of technologies has reached supply chains industry, summing up substantial research and innovation interest towards developing reliable, auditable and transparent traceability systems. Recently, there are a lot of supply chain enterprises start develop and implement a full integrated system based on transparent blockchain contracts to track the whole flow of supply chain, from the moment from the moment a shipment leaves the factory, to the final delivery on the customer's doorstep. This blockchain technology will help to create a full transparency communication system between parties.

In the consumer goods and retail industry, companies like Unilever and Wal-Mart are exploring the use of blockchain technology to improve their tracking and visibility. With blockchain they are able to enhance the transparency of data because the used of a single source of truth.

Material and Methods

2.1 Supply Chain Traceability

A supply chain is a group of manufacturers or producers and service providers that are working together, creating end to end distribution chain to deliver products and services that are needed by end users (Bozarth & Handfield, 2006). The actors in a retail supply chain are linked collectively through the physical flow of products from manufacturers to end consumers.

Shifting forward, many supply chain manufacturers develop track and trace application to help them on delivery process. It means that tracking each physical product will be done digitally so that it will be more secure and traceable. For example, physical product will be embedded with Internet of Things (IoT) sensor and it will transmit the data about product integrity, temperature, and other evidences.

2.2 Blockchain Technology

Blockchain is declared as a distributed database, where information/data will be stored on the blockchain arrangement and can only be accessed by computers that are affiliated to. One individual file of data is divided into parts, termed blocks. All blocks accept to be accurate by the absolute network, which happens algorithmically. For the action to proceed, the actors/ parties needs to show their 'digital signature', which will be accurate through the blockchain network. Encryption is activated to protect the data.

Blockchain receives a lot of attention due to their characteristics, which the main characteristic is; it reduces the charge for trusted third parties and intermediaries. These characteristics cover the:

1. Creation of data records that are permanent, i.e. cannot be afflicted or deleted
2. Decentralized
3. Peer to Peer (public and private)
4. Ability to analyze the time and origin of every access in the Blockchain
5. Access by all participants to all data in the Blockchain
6. Guaranteed accomplishing of smart contracts (programs) that automatically execute already a set of agreed conditions are met

In this work, we explore the potential of smart contract; an emerging blockchain based decentralized technology that provides a new paradigm for trusted and transparent computing. By replacing the central server with a carefully designed smart contract, we construct a decentralized privacy preserving search scheme where the data owner can receive correct search results with assurance and without worrying about potential wrong doings of a malicious server.

Smart Contracts are applications with a state stored in the blockchain. They can facilitate, verify, and enforce the process of a contract. Each smart contract, identified by a special address, consists of script code, a currency balance, and storage space in the form of a key/value store. Once created and deployed, the contract's code cannot be modified forever even by its creator.

Therefore, we use smart contract to create a fair reciprocal mechanism, where the data owner receives correct search results as long as he honestly pays the money, and the worker earns the money as long as he faithfully follows the protocol.

2.3 Case Studies of Previous Blockchain Implementation in Supply Chain

By the end 2016, Walmart was doing two blockchain trial projects, supported by IBM. The first project is to track products from Latin America to US, and the second one is moving meat from Chinese farms to stores (Popper & Lohr, 2017). Currently, Walmart spends several days to track the movement of pork products. However with the help of Blockchain, it only requires a few minutes. In Blockcain, Walmart can track details about the farm, factory, batch number, storage temperature and shipping. In addition, Walmart filed a patent application for this blockchain technology in May 2017.

In April 2017, the world's largest defense contracting firm, Lockheed Martin teamed up with Virginia-based GuardTime Federal announced plans to integrate blockchain into its supply chain risk management (Higgins, 2017b).

Maersk is the world's largest and busiest carrier company. It was reported that Maersk main problem is the tons of paperworks that they need to manage. For every container, it has its own paperwork (Popper & Lohr, 2017). Maersk creates a blockchain software with the help of IBM to help replacing the current paperwork. The goal is when customs authorities signed off on a document, they could immediately upload a copy of it with a digital signature. All the parties involved, such as government authorities will be notified whether that order has been completed. With blockchain, all the parties are confident that no one can alter the data.

In 2017, Intel built a blockchain system to track the movement of seafood supply chain, from a fisherman to a fishmonger, to a seafood restaurant. By combining blockchain and IoT, they were also able to record the temperature data and fishmonger's record.

2.4 Val IT

The IT Governance Institue (ITGI) released Val IT in March 2006. Second version of it Val IT 2.0 was released in 2008 (P Voon, 2009). Val IT is recognized as the first comprehensive framework to support enterprise from the point of view of IT governance, with a focus on value. Val IT's overall goal is to enable enterprises manage their investment in IT changes environment in a right way to get optimal result, by having a highest value benefit, in the most affordable cost, and in an acceptable level of risk (ITGI, 2008).

Method

The authors formed a research framework as follows:

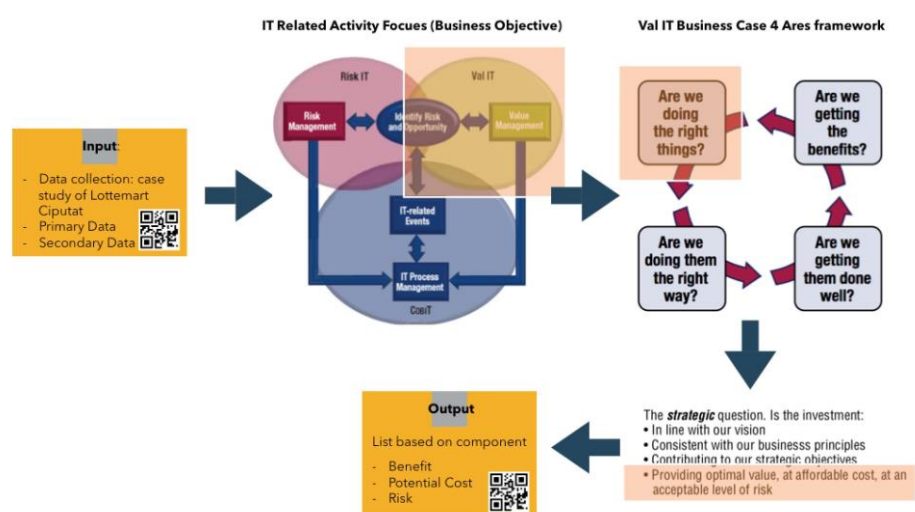


Figure 1. Method of analysis framework using Val IT (adapted from the ITGI, 2006).

In this paper, we will use Val IT framework as the analysis method. By doing analysis using Val IT, we hope that this paper may help stakeholders to make business decision easier after they understand the value and how it is created.

In addition, in order to answer the research question and to design an effective design that solves the problem at hand within the corporate and regulatory context, we follow Val IT framework, using one of four fundamental IT governance related question: Are we doing the right things? This identifies the risk of error or lack of clarity in the desired business outcomes in a changing environment, as follows:

Below are the outputs of the paper:

1. How business outcome will be measured? And all initiatives required achieving expected outcome? We will show the business canvas for the new technology
2. List of cost component
3. Key risks: identify risk

Table 1. List of expert and topic discussion

Interviewee	Company	Profession	Topic
Irwan Hariawan	Lottemart Wholesale Indonesia	Customer Excellence Manager	1. Current and propose changes of flow processing 2. Current issues on fields
Siti Hardianti	Lottemart Wholesale Indonesia	Supply Chain Associate	1. Provide data regarding calculation of delivery order 2. Propose changes of flow processing
Ginanjjar Fahrul	Ritase.com	Head of Backend Dev	Propose system architecture
Indri Suprapti	Ritase.com	Finance Manager	Current reconciliation and charging mechanism
Andik Susilo	Microsoft Indonesia	Microsoft MVP on infrastructure	Migration planning and risk
Pandu Sastrowardoyo	Blockchain Zoo	Co-Founder	Blockchain implementation, architecture, and cost component

Results and Discussion

Current process of Ritase x Lottemart Wholesale supply chain will be used as a case study. Based on blockchain and IoT, a system for traceability is proposed, in which the logistics data is shared among Lotte, Ritase, transporter, driver, and customer.

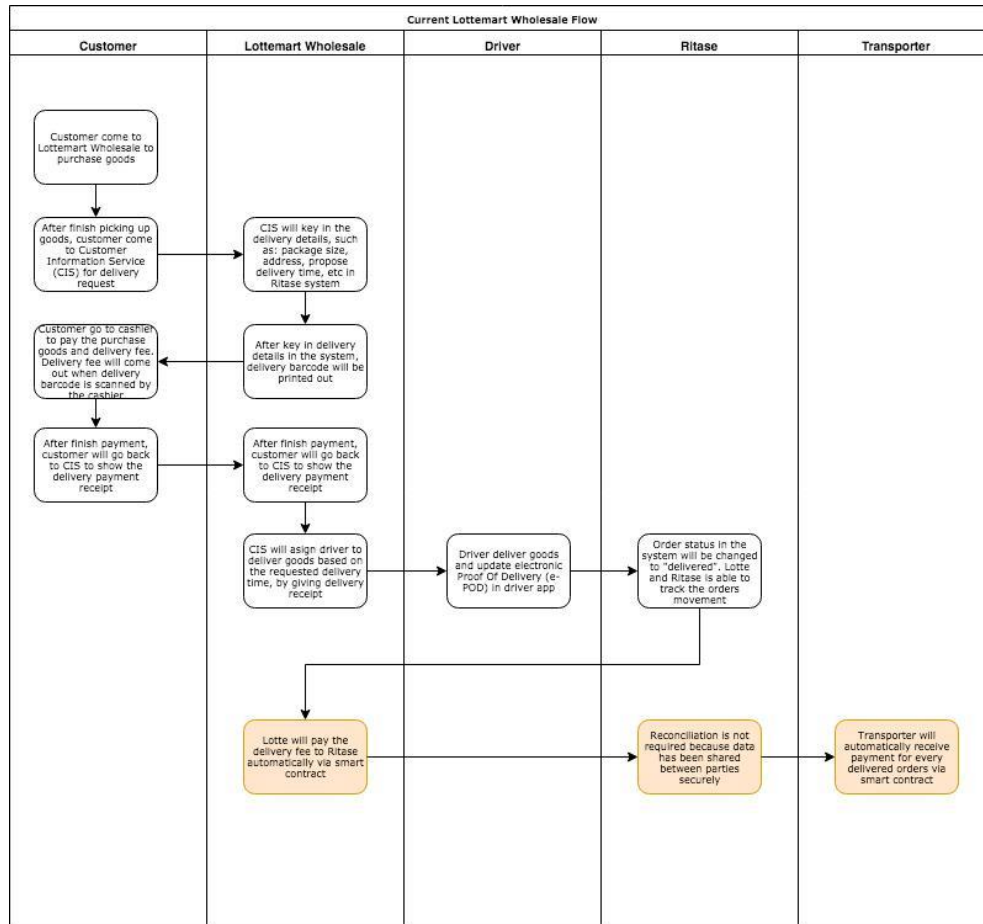


Figure 2. Target Lottemart Wholesale x Ritase logistic flow

The current and target system architecture of supply chain management system using blockchain technology (Chen, 2017), validated by expert judgement, will be described in figure 3.

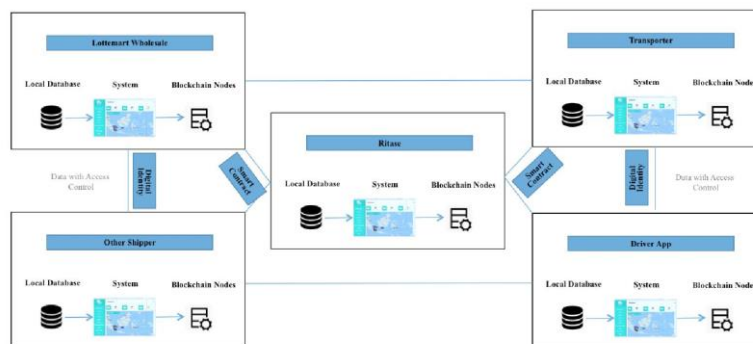


Figure 3. Proposed blockchain system architecture

Blockchain technology offers the possibility to make complete remittance information available to all the parties involved in transactions, reducing the time and manual effort involved in payment reconciliation to minutes instead of days. A corporate supplier could create its own Permissioned Blockchain where it and its buyers can store and retrieve relevant remittance information. The blockchain nodes can be authorized to allow companies within a supply chain to download relevant information to seamlessly match with the payment statement information received from the Bank.

By speeding up the reconciliation process, corporates will gain better visibility and control over their cash positions within their supply chain. They will avoid lengthy invoice disputes, reduce collection queues and be able to review credit lines more efficiently and those are benefits, which are difficult to ignore.

4.1 Key Benefit

In addition, the urgency to implement a new system in current business process is due to the different delivery fee for every supply chain parties in every month.

Month	Lottmart Ciputat	Ritase	Transporter
January Batch 1	IDR 13,057,000	IDR 10,281,600	IDR 11,125,000
January Batch 2	IDR 16,778,000	IDR 12,170,700	IDR 14,990,400
February Batch 1	IDR 14,088,000	IDR 10,926,900	IDR 12,850,200
February Batch 2	IDR 10,079,000	IDR 7,742,700	IDR 8,069,400
March Batch 1	IDR 13,624,000	IDR 9,909,000	IDR 12,370,500
March Batch 2	IDR 12,246,722	IDR 8,790,300	IDR 11,924,100
Summary For 3 months	IDR 79,872,722	IDR 59,821,200	IDR 71,330,400
Average Summary per month	IDR 26,624,241	IDR 19,940,400	IDR 23,776,800

Figure 4. Reconciliation result between supply chain parties

The business model canvas is required to determine value proposition of blockchain based smart contract in supply chain logistic. The following as below for the business model canvas of blockchain based smart contract.

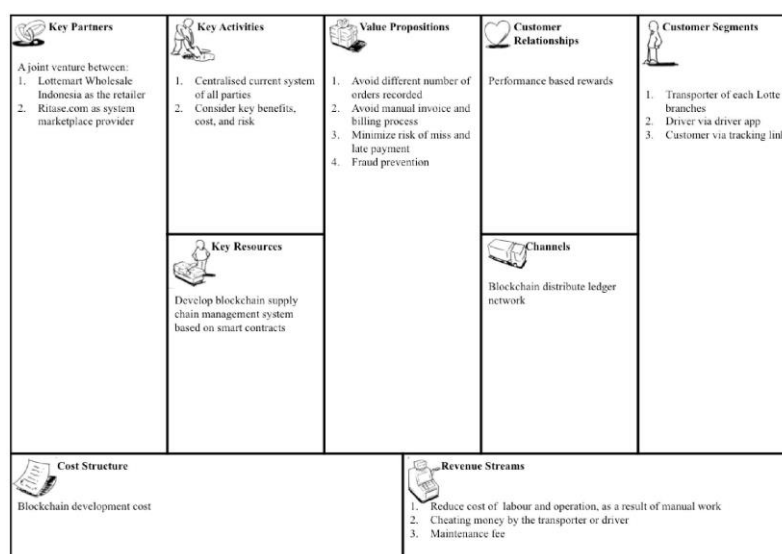


Figure 5. Business model canvas on blockchain for supply chain

Table 2. Proposed key benefit of blockchain in supply chain

Key Benefit	Description	References
Decentralized Management	Improved care data sharing and analysis without ceding control: Blockchain is by design a decentralized (ie, a peer-to-peer, non-intermediated) architecture. Each institution can keep full control of their own computational resources (while collaborating with other institutions for data sharing and analysis).	Decovny, S. (2017)
Immutable Audit Trail	Unchangeable log of clinical research protocols: "Use of blockchain technology has recently been shown to provide an immutable ledger of every step in a clinical research protocol, and this could easily be adapted to basic and experimental model science. All participants in the peer-to-peer research network have access to all of the time stamped, continuously updated data. It is essentially tamper proof since any change, such as to the prespecified data analysis, would have to be made in every computer within the distributed network."	Ahram, T. <i>et al.</i> (2017)
Data Provenance	Ensure original manufacturer and ownership transferring in supply chain: "Using Blockchain, the origin of the product and its components are detected, and any transfer of ownership in each case is made clear and available to everyone. Forged, poor quality or stolen goods can be tracked and identified."	Caro, M. P., Ali, M. S., Vecchio, M., & Giaffreda, R. (2018)
Robustness/Availability	- Improved robustness for supply chain: "In the existing solutions, there is still a central authority that can be compromised and documents that can be faked. - Superior data availability: "Blockchain would ensure continuous availability and access to real-time data. Real-time access to data would improve coordination in emergency situations. "	Francisco, K., & Swanson, D. (2018)
Security/Privacy	Secured and privacy data sharing: "confident that the blockchain will hold them securely."	Disterer, G. (2013). Sattarova Feruza, Y., & Kim, T. H. (2007)

4.2 Cost Component

When companies make decisions about the IT investment, one of the most common questions they ask is “how much does it cost?” This paper explains about the cost component of implementing this technology, instead of giving the exact price because the specification of each company might be different depends on the services they use.

Table 3. Proposed cost component of blockchain in supply chain

Cost Component	Description	References
Blockchain Platform	Depending upon the consensus mechanism, select the most suitable platform. Free and Open Source platform is available, eg: 1. Big Chain DB 2. Hyperledger 3. Openchain 4. etc Or use blockchain solution provider	Luxembourg, D. (2017).
Nodes	- Permissioned or permission-less - Number of nodes -Nodes will run on the cloud, on premise, or both -Hardware configuration issues like processors, memory, and disk size -Base operating systems (usually Ubuntu, Red Hat, or Windows)	Luxembourg, D. (2017).
APIs	Some blockchain platform come with pre-made API or not. Major of APIs categories: - Audit functions -Data authentication through digital signatures or hashes - Smart contracts -Smart asset lifecycle management: payment, exchange	Deloitte. (2016)
Admin and User Interface	- Front end and programming languages (Javascript, Python, Nodejs, etc) - External database (MySQL, MongoDB, etc) - Servers (web servers, FTP servers, mail servers)	Deloitte. (2016)
Integration	AI, Machine Learning, IOT, etc.	Fintech, P., & Conference, Q. (2018)

4.3 Risk

Table 4. Proposed risk of blockchain in supply chain

Risk	Description	References
DowntimeRelatedwith Business Continuity	When doing migration from old to new technology or one database to another database, one of the risk that is hard to avoid is there will always be a downtime, while we want to keep the credibility of our data.	Zwißler, F., & Hermann, M. (2007)
Data Migration	When there is miss procedure on data transfer, it will cause longer downtime or the data will not be credible anymore.	Zwißler, F., & Hermann, M. (2007)
Performance Degradation	New environment will be different with the previous technology, and will affect the performance of the system. We need to do the tuning again.	Fintech, P., & Conference, Q. (2018)
Scalability Inflexible	In blockchain, to scale up or scale down, we need to tweak the hardware.	Fintech, P., & Conference, Q. (2018)

Conclusion and Future Work

We introduced blockchain technology in supply chain, which provides decentralized management, an immutable audit trail, data provenance, robustness/availability, and security/privacy. We identified benefits compared to traditional distributed databases for supply chain management system, and provided qualitative analysis, such as cost component and risk factors of the blockchain supply chain management system.

However, cautionary tales exist. There are still challenges with the scalability and performance of the technology, with complexity, with governance, etc. Now, it's up to each enterprise whether it is worth to implement this technology and whether this is the right time with the valuable information and understanding given. These challenges can be addressed through careful application design and implementation. We expect many new applications to emerge soon.

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