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The Benefit and Challenge of Blockchain Technology for Tracing Automotive Component: a simulation test

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Abstract*: Supply Chain Management System (SCMS) poses as one of the essential aspects for distributing component, especially in contemporary Automotive Industries. In this line, the tracing process of the automotive part is one of the critical features required in this industry, such as for automotive product improvement and its forensic. Early research reported that the tracing component feature is prone to component counterfeit that could cause financial loss and even loss of life. The recent studies emphasized that new development technology, commonly renowned as Blockchain is believed to have the ability to perform tracing automotive component and minimize the counterfeit. However, the feature of Blockchain technology is to track automotive component found in the literature mostly. In this frame, the biggest challenge is to obtain the evidence of Blockchain Technology implementation for automotive part component tracking. Therefore, this report paper is a part of design science research stages striving to perform the simulation test by using business process simulation method of Blockchain implementation for tracing automotive components. The focus group discussion involved a manufacturer automotive component, several distributors of automotive components, and two of the big three car manufacturers in the country. The purpose is to understand a comprehensive supply chain management process in the area of automotive component distribution. During the test by using simulation test model, revealed several advantages and challenges. Ultimately, Blockchain technology is potentially implemented for tracing automotive component and the merging combination system between SCMS and Blockchain Technology that contributes to developing new robust SCMS.

***Keywords*: Blockchain, Blockchain Tracing Component, Blockchain in Supply Chain Management Systems.**

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I. INTRODUCTION

Supply Chain Management System (SCMS) is one of the essential aspects of tracing the distributed component. In this point, the feature to track automotive part plays a significant role as a crucial element for forensic and for automotive product development. The early research reported that tracking automotive part mitigated automotive component counterfeit that caused financially and harmed the lives. With this viewpoint, a myriad of studies has been conducted mostly in the literary form that stated Blockchain technology might be used for tracing component [1]-[5]. In this spectrum, this study tries to implement Blockchain technology to track automotive part by using Business Process Simulation (BPS) method. The research is commenced with a forum group discussion (FGD) of an automotive component manufacturer company, several distributors of automotive component company, and two of big automobile manufacturer companies in the country. The FGD team consists of company director, sales, marketing division, purchasing department, logistics and distribution division, assembly department, supply chain management division, information technology division, finance department, and human resources division. The result of FGD refers to an automotive component business process model. It also depicts that the company is recently facing automotive component stock manipulation and nonstandard automotive component received by the customer. Importantly, this stage of the simulation test process will follow current business process distribution model without the alteration of the business process made. Figure 1 represents the detail of the research design. On the other side, the companies have not granted permission to share information (component label name format) of the automotive component due to trade secretiveness. Therefore, the component identity will be an assumption. The study successfully performed the simulation test and showed that Blockchain could be used for tracing automotive component. The other essential result of the simulation test indicated that Blockchain technology serves to monitor and control the distribution [6] and the availability of inventory and stock. It convinced that the automotive component forgery is possible to reduce by using Blockchain technology due to the immutable and secure characteristic of Blockchain [4][5] and the peer-to-peer transaction has been applied during the simulation test.

The research is initiated with the literature review and followed by the research methodology, the result, discussion, and the conclusion eventually.

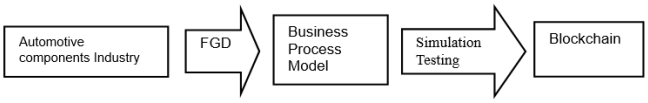

Figure 1 Research Design

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II. LITERATURE REVIEW

A. Supply Chain Management System

The Supply Chain Management System is a system used for managing the supply chain process to ensure the integrated operation of information among several businesses, such as raw component material suppliers, automotive component suppliers, automotive manufacturer, automotive component distributions until the automotive component received by customer [7].

B. Blockchain & Multichain

Recently, Blockchain is a new technology that was introduced by Satoshi Nakamoto [8] and found in 2008. At first, Blockchain Technology was utilized for cryptocurrency or financial transaction in 2009 and then used by Bitcoin for almost a decade [9]. The development of Blockchain Technology since the first version [10] to the last release 3.0 has been undeniably evolving, especially the development of Smart Contract, enhancement of Blockchain feature and the ability to support enterprise systems such as Supply Chain Management System [10]. In this vein, multichain is a cryptocurrency Blockchain technology system [11] selected in this study because of the characteristics of Multichain Blockchain system cater to the automotive component company requirement, such as private and authorized Blockchain. In this line, there is no modification of Multichain used for the testing. The structure of Multichain Blockchain is depicted in Figure 2. It shows that in one node comprises of several addresses and some assets. However, assets can be attached to a single address or multiple addresses. The address is an entity, and the form is 32 hex character (or commonly known as the pseudo name in Blockchain) or can be represented as a named of the customer, manufacturer, distributor or reseller in this study. Assets name is an entity usually used for the name of the coin of cryptocurrency; however, assets name is used to represent that component named.

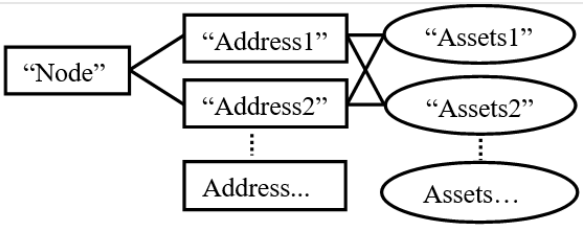

Figure 2 Multichain Structure

Model or strategy used in this study is a one-on-one mapping model between company operation entities and Blockchain addresses, and an automotive component map with an asset in Blockchain. The key aspect found is an asset should be unique label/name otherwise the model will not function as required.

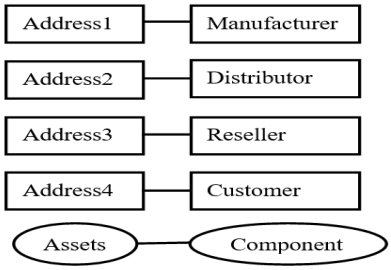

Figure 3 One to One Mapping

C. Design Science Research (DSR)

Design Science Research represents the stages of the research process; Design Science Research is commonly used for information system research [12]. This study follows the DSR stages that are commenced with Forum Group Discussion (FGD) in an automotive component manufacturer, distributor of automotive component, and automotive car manufacturer as a customer. On that basis, it continues to develop a model and validation process. However, this stage functions as an essential step to ensure the Blockchain Technology System has the capability for tracing automotive part prior to the model produced.

D. Business Process Simulation

The Business Process Simulation (BPS) is one of the essential methods in Business Process Management. BPS method is used to enhance of business process and develop the new business model. It reflects that the development is implemented by using computer application systems. This method can be applied in this study. The benefits offered by BPS is a low cost required to compare then using production system, closed to the real business process, and the outcome can be considered for future development stages[13][14].

III. RESEARCH METHODOLOGY

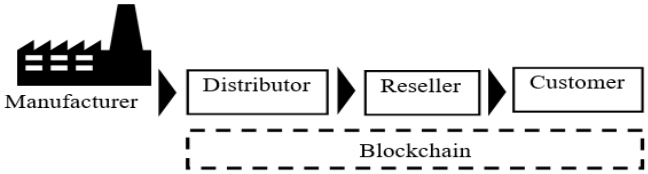

Figure 4 Process Distribution Model

Figure 3 explained the business process of automotive components distribution, starting with the manufacturer as a producer of components; however, the manufacturer is not allowed to do the product distribution based on government regulation in Indonesia. Therefore, the product should be directly distributed to the leading distributor then distributed to the reseller, and finally to the customer.

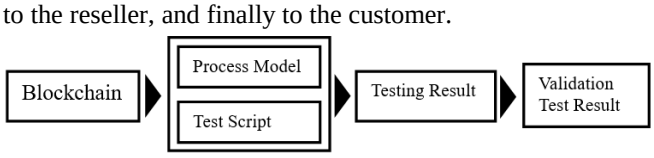

Figure 5 Simulation Test Model

Figure 4 exhibits the research simulation testing stage model in this study. The testing script will be generated based on the business process model (FGD Result).

The testing script will be implemented into the Blockchain application and review the result of the test eventually.

The Blockchain experiment environment is delineated as follows:

- Server O/S : Ubuntu
- Node name : beeBlockTesting
- Version : 2.0.2
- Protocol : 20010
- Database : SQLite
- Node Address : beeBlockTesting@nnn.nnn.163.25:2881
- Language : JSON, C++, Python

Business process simulation testing scenario is presented as follows:

Firstly, the distributor received ten pieces of component 1237-7777-O001-B001 (unique component label) from the manufacturer. Following that, the distributor delivers the six pieces parts of component 1237-7777-O001-B001 to the reseller, and the customer buys six pieces of component 1237-7777-O001-B001 as the last process.

The testing will not review the Multichain Blockchain application, mining process, hashing process, the scalability of the system, messages, infrastructure, security, and the database of Multichain. In this point of entry, there is no integration test between production system and the simulation test system.

From the simulation testing scenario, it will be translated into the Blockchain script following one on one mapping model. Table 1 described the details of each step and the simulation.

Table 1 Transcript Simulation Test

No	Business Process	Blockchain Script
		Create "Address" in Blockchain node that represent as: a. Manufacturer (1NYUNSwpYYcNYp7XZ4hs92xiuPaGT7Urz2PyJK) b. Distributor (1PFGax4RLui9MtJEieeE563M7b7h1fF4Qs7fPG) c. Reseller (1CLPrurrAJKbDjR61QckEVoR2qq2LQ3RjbEydE) d. Customer (153Q7He9aEDxo3Vme9rSK4bGeqod1FWqYQB7NY)
1	Distributor received ten stock of 1237-7777-O001-B001 from manufacturer 1237-7777-O001-B001 (as component label name) 1237-7777 (component code) O001 (country of origin) B001 (production batch no)	Issue 10 assets named "1237-7777-O001-B001" from Manufacturer (1NYUNSwpYYcNYp7XZ4hs92xiuPaGT7Urz2PyJK) to Distributor (1PFGax4Rlui9MtJEieeE563M7b7h1fF4Qs7fPG)
2	Deliver 6 stock of 1237-7777-O001-B001 from distributor to reseller	Send 6 assets named "1237-7777-O001-B001" from Distributor (1PFGax4Rlui9MtJEieeE563M7b7h1fF4Qs7fPG) to Reseller (1CLPrurrAJKbDjR61QckEVoR2qq2LQ3RjbEydE)
3	A customer buys six components 1237-7777-O001-B001 .	Send 6 assets named "1237-7777-O001-B001" from Reseller (1CLPrurrAJKbDjR61QckEVoR2qq2LQ3RjbEydE) to Customer (153Q7He9aEDxo3Vme9rSK4bGeqod1FWqYQB7NY)

Table 1 exhibits the mapping from the current business process into the Multichain Blockchain application system. Figure 4 reflects the Blockchain script of new assets issues. In this token, it proofs that cryptocurrency Blockchain applications can be used to issue the automotive component stock.

Issue 10 raw units of new asset
New Issuance Metadata:
Asset Name 1237-7777-O001-B001
JSON Data {"Origin": "001", "ProdBatchNo": "001"}
Open to follow-on issuance True
Quantity Multiple 1

Figure 6 Asset Issue Log

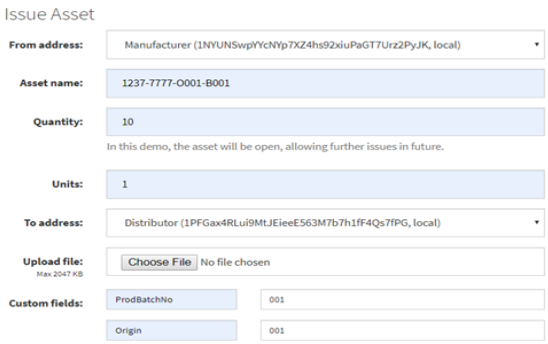

Figure 7 Screen Capture Issuing Asset

Figure 4 explains the log of JSON script to create an asset in Blockchain with asset name is 1237-7777-O001-B001 (asset name in this study represents the component code name) with ten boxes (10 raw units) of components). The process of issuing an asset in Multichain Blockchain can be seen in Figure 5.

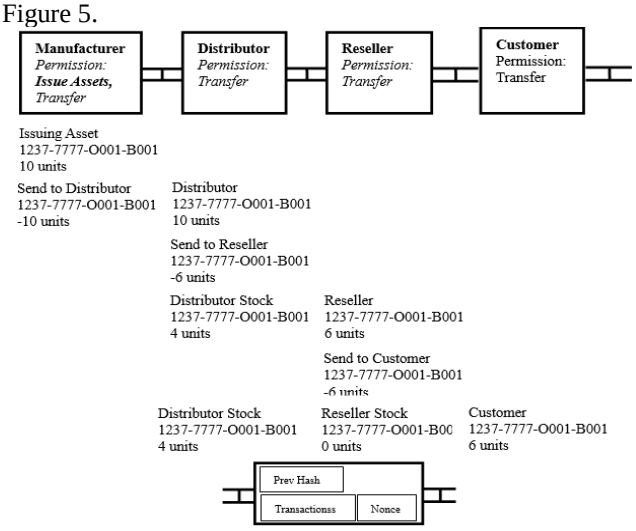

Figure 8 Blockchain Tracing Component

Figure 6 depicts the ability of Blockchain to trace the movement of the component in each level of the entity and the feature possibly implemented. It sheds light on the essential nature of blockchain technology which is immutable, transparent, distributed, and peer-to-peer. Attempt by adding asset stock might not be happen in distributor, reseller and customer level because of no permission of issuing asset are granted.

IV. Result and Discussion

In this study, using one on one mapping model where:

- Asset (asset name) represent as a component (component label name),
- Address can be used to describe a department (a person that responsible for the department),
- Manufacturer's name (a person that is responsible to deliver that component to the distributor),
- Distributor's name (a person that is responsible as a distributor)
- Reseller's name (a person that is responsible as a reseller)
- Customer's name (a person that use the component).

In this case, it is an applicable method for Blockchain to tracking the automotive component. Figure 7 represents the last status of the simulation test that explained the stock.

The validation process of simulation test result has been performed by using FGD with the domain experts such as component automotive industry, automotive car manufacturer, and Blockchain industrial partner.

```
Label    Distributor
Address 1PFGax4RLui9MtJEieeE563M7b7h1fF4Qs7fPG
1237-7777-O001-B001    4

Label    Reseller
Address 1CLPrurrAJKbDjR61QckEVoR2qq2LQ3RjbEydE
1237-7777-O001-B001    0

Label    Customer
Address 153Q7He9aEDxo3Vme9rSK4bGeqod1FWqYQB7NY
1237-7777-O001-B001    6
```

Figure 9 Last Stock Log Captured

A. Benefits Obtained

The benefit attained during the review of the test consists of the utilization of the Blockchain to support Supply Chain Management, especially for tracing automotive component. At the same time, it also can be used to monitor and control of stock availability in each level of distribution (distributor, reseller, Peer-to-Peer transaction), and to solve the forgery of component because the total stock of each asset cannot be manipulated (immutable data).

B. Challenges Encountered

The challenges encountered during the review of the test comprises of the problem that has been detected while issuing the asset name (component label name). With the current component label, it is arduous to issue the asset in the Blockchain because the asset name should be unique. Therefore, the asset name (component label name) is combined with the production batch no (1237-7777-O001-B001) where the production batch is fixed (unique) even though the product name is identical. Recently, the component label name consists of the label name and the country origin only.

V. Research Limitation, Implication, Conclusion and Future Research

The limitation of the study is due to lack of permission from the industry to share the essential information because of trade secrecy. The Multichain implemented "as-is" application system to discern the original Blockchain Technology used; however, the flexibility of application might cause the adjustment so that the aim of the study can be fulfilled.

The conclusion, "as-is" Multichain Blockchain system and application can be used for tracing automotive component. It signifies that Blockchain technology is applicable for inventory recording system, monitoring and controlling of inventory in the future and reduce spread of forgery components. However, the development of Blockchain application system should be initiated for future growth and the simulation indicate that business process reengineering required for automotive component process.

The future research might improve the infrastructure of Blockchain rather than directly input to using Multichain admin feature. It could modify the support such as the implementation of the API connection so the off-chain smart contract might be applied, and the development of Blockchain is in the range of the real business process.

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Surjandy is a PhD student at Bina Nusantara University. Blockchain Technology in Supply Chain Management System is my dissertation topic. My master and bachelor's degree from Bina Nusantara University majoring in management and management information systems. Recently, I am Lecturer in Bina Nusantara University