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A Proposed Supply Chain Model of Blockchain Technology-Based in Automotive Component Industry

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Abstract*: The automotive industry has rapidly developed and overrun the market for the last decade. In this context, automotive components or parts are essential factors to manufacture automotive products. Undoubtedly, the supplier that provides the automotive components or inbound logistics becomes a critical party of Supply Chain Management activity. In this frame, the failure of inbound logistics potentially creates a severe implication to the automotive industry in terms of the financial effects, company image to damage the customer. Arguably, the supplier activities encompass the continuity of automotive components delivery, on-time delivery schedule, supplier and customer relationship maintenance, and financial operation. In this point, the problem identifies the distribution of automotive components and stock maintenance. Therefore, this qualitative research is essential to explore a proposed Blockchain Technology model in Supply Chain Management (BlcSCM), especially in the automotive component industry. On that basis, design science research methodology facilitates to create a proposed model, Leavitt Diamond. In this model, the essential factors (people, process, technology, and organization) merges with supply chain management. Finally, it refers to the Blockchain Technology model in Supply Chain Management.

***Keywords*: Blockchain Technology, Blockchain in Supply Chain Management, Design Science Research, Qualitative Research**

I. INTRODUCTION

The contemporary automotive industry develops rapidly; it starkly impacts the automotive components industry, especially in Supply Chain Management(SCM) activities(Ambe, 2014). In this line, the high quality of automotive components should meet the industrial standard. On the other hand, the punctual distribution, inbound logistics activities serve to ensure continues components supplies for the automotive manufacturers. In this stage, another challenge emerges for the automotive SCM, such as counterfeit automotive component problems. Indonesia, as one of the automotive producer countries, recently encounters a similar situation. Besides the rapid development of the automotive industry, it also triggers question regarding the automotive component such as components forgeries (Adam Samudra, 2017)(Andika, 2018). The use of counterfeit automotive part potentially creates a bad image of the company, financial impact to customer safety threat (Panga and Mchopa, 2014). From these lessons, SCM becomes a central concern to develop and new regulation in the automotive area has been launched (Minister of Transportation Regulations No. 33/2018) by the ministry of transportation to increase the safety aspect. In the other hand, another law applied in the automotive industry is Law No.8 1999 regarding consumer protection. Therefore, the automotive component industry, as an essential part of the automotive manufacturer, should meet a high standard of components product.

Early research reported that Blockchain Technology can improve the SCM activities due to Blockchain characteristic, such as transparency, scalability, and interoperability (Guhathakurta, 2018), tamper-proof security, privacy(Dorri *et al.*, 2017), traceability (Kshetri, 2018), trust(Imeri *et al.*, 2019) and applied for IoT, RFID, and sensor to support the industry(Kuhn *et al.*, 2019)(Ghobakhloo, 2018). As this background, this paper attempts to explore a new proposed model of Supply Chain Management named BlcSCM that is constructed based on the Leavitt Diamond Model, Automotive Supply Chain Management, and Blockchain Technology. In this line, the scope is Indonesia automotive industry span. The focus group discussion (FGD) has been conducted with several automotive component industries, distributors, and automotive manufacturers in Indonesia. In the end, figure 1 exhibits the general distribution of automotive components based on the Blockchain and the new proposed model of the BlcSCM, as shown in figure 6.

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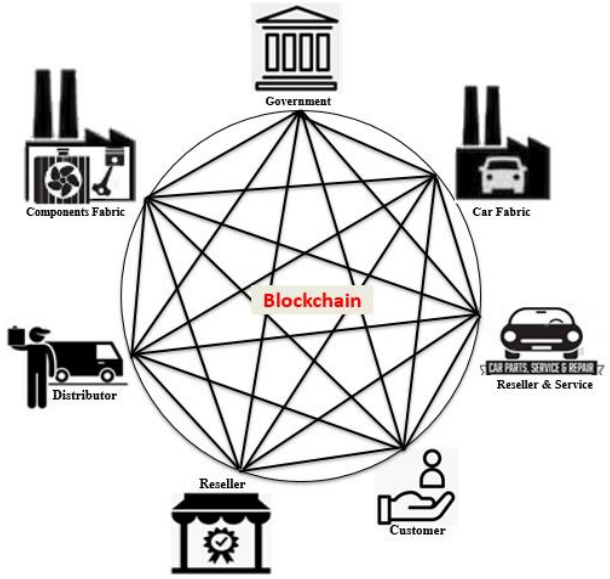

Figure 1. Automotive Components Distribution with Blockchain

II. LITERATURE REVIEW

In this section, it explains some relevant and essential literature, such as open problem identified from the literature, Supply Chain Management, Blockchain Technology, Leavitt Diamond Model, and Design Science Research.

A. Open Problems

The rapid development of the automotive industry contemporary seizes advantages for automotive component industries. However, the alterations directly impact supply chain processes such as on-time distribution, components availability in the market, continuity of components for car manufacturers (Ambe, 2014), and components forgery. In this part, automotive components are an essential part of the automotive industry. The failure to meet with the standard potentially cause financial problems for the company, industry image, and loss of life(Bates *et al.*, 2006). Therefore, many researchers attempted to explore new Blockchain technology to bring advantages to the industry.

B. Supply Chain Management (SCM)

SCM is a system that manages all flow of information, services, and material from raw materials through warehouse and factory to the customer. In other words, SCM is the control and management of the fund; all materials and information on the logistic process originated from raw material, fabrication, delivery of finished goods to end customers (Ambe, 2014).

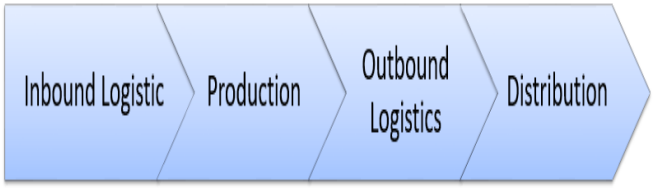

Figure 2. SCM

C. Blockchain Technology

The new technology Blockchain is coined by a person or a group named Satoshi Nakamoto in 2008. In the beginning, blockchain is initially introduced in January 2009 for cryptocurrency named BitCoin (Nakamoto, 2008). The development of Blockchain Technology offers another feature called Smart Contract by a cryptographer named Nick Szabo(Swan, 2015). In this stage, Blockchain Technology turns into a new phase that will be used beyond cryptocurrency ever since, such as an enterprise system, supply chain management(Surjandy *et al.*, 2019), and customer relationship management. With this in mind, Blockchain presents the advantages for industry such as tamperproof security, distribution, sharing, open, immutable, transparency, reliability and accuracy(Liu *et al.*, 2020)

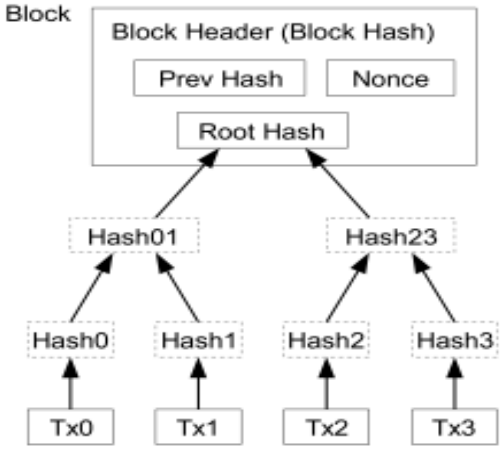

Figure 3. Blockchain

D. Leavitt Diamond

There are four prominent success factors in the industry. The elements consist of people or actors, task or process, technology, and structure or organization(J.Leavitt, 1962). Figure 4, commonly renowned as the Leavitt Diamond model, represents the salient components in this framework. This model will facilitate the outset of the BlcSCM Model.

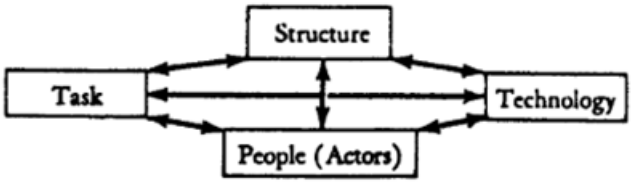

Figure 4. Leavitt Diamond Model

E. Design Science Research (DSR) Methodology

The Design Science Research (DSR) is a research methodology commonly used in information systems research(Peffers *et al.*, 2007). In this frame, DSR facilitated this research and served to bring the inline improvement from early experimentation.

III. METHODOLOGY

In this section, it explains steps to develop the model of supply chain management based on Blockchain technology in automotive component industy. Figure ..shown the research methodology performed in this research.

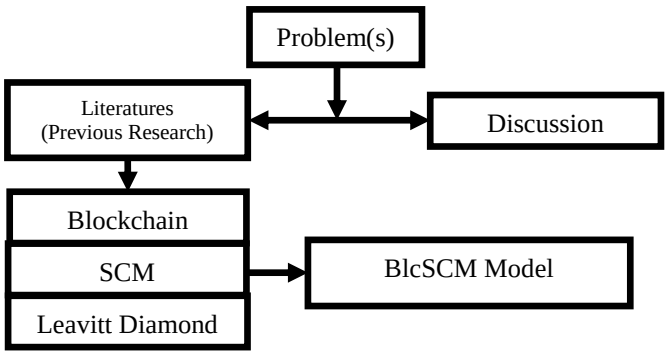

Figure 5. Research Design Steps

IV. RESULT AND DISCUSSION

This section explains the proposed model of Blockchain Technology in Supply Chain Management (BlcSCM) for automotive components industry. In conclusion exhibit at Table I.

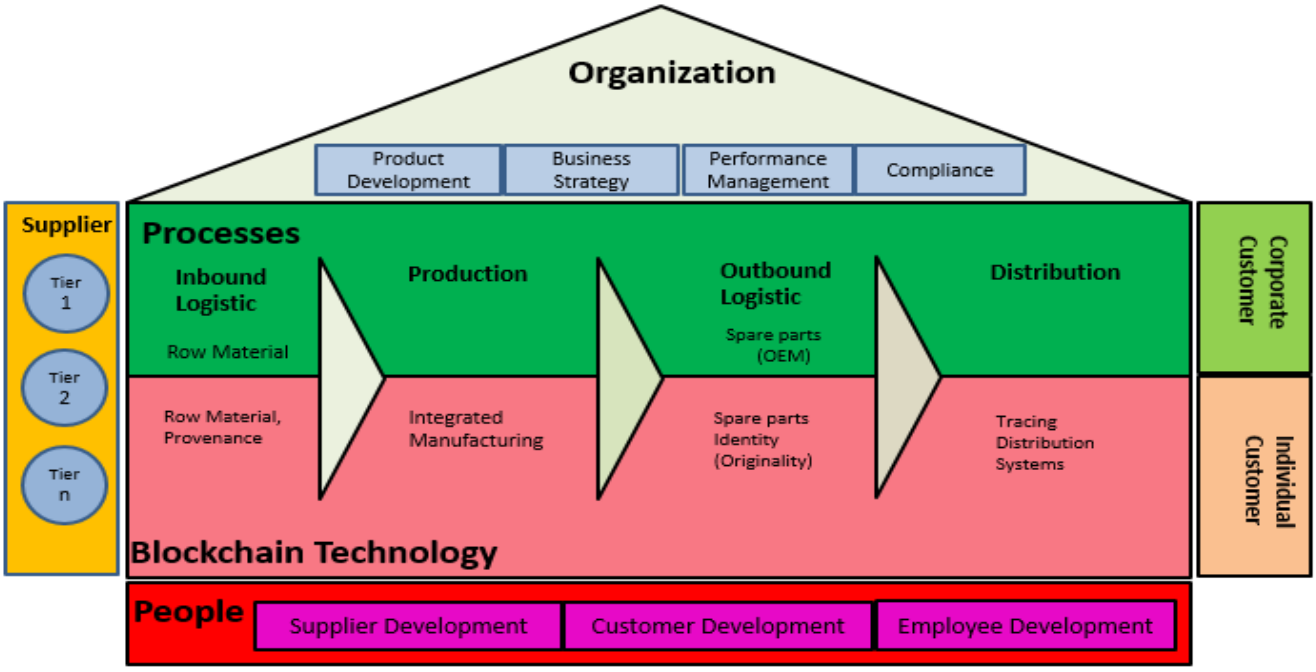

Figure 6. BlcSCM Model

Table- I: Blockchain implication

No	Blockchain at	Impact to	Description
A	Organization	Product Development	Intellectual Property
B	Organization	Compliance	Comply to Rule
C	Organization	Performance Management	Monitoring
D	Process & Technology	Inbound Logistics	Provenance, Tracing
E	Process & Technology	Production	Tamper-proof, Doubtless
F	Process & Technology	Outbound Logistics	Product Identity
G	Process & Technology	Distribution	Locating and Monitoring
H	People	People Development	Tracing Skill Backup Person

For the detail explanation of each poin as follow:

A. Blockchain at Organization Aspect for Product Development

Product development is one of the primary activity stages before new product design develops. Blockchain Technology facilitates essential aspect in product development such as for the protection of intellectual property product design(Holland and Stjepandi, 2018). Furthermore, Blockchain ensures the right formula or material used for the component(Banerjee, 2018).

B. Blockchain at Organization Aspect for Compliance

Blockchain Technology facilitates all processes in supply chain management that comply with the regulation, distribution, and shared-Blockchain characteristics. These ensure compliance in any activities of industry(Yeoh, 2017). In this set, compliance in this industry includes ensuring the product follows the ISO 26262 – Functional Safety in Minister of Transportation Regulations No.33 in 2018 and Act No. 8 in 1999. In this corridor, blockchain technology with traceability characteristics ensures the raw material used and product design meet with industrial standards (Banerjee, 2018).

C. Blockchain at Organizational Aspect for Performance Management.

In this part, blockchain demonstrated performance management based on the angle of the organization. Blockchain Technology with trusted, validated, distributed, open, and reliable characteristics are applied for data management. It could be used for monitoring and performance management(White, 2017).

D. Blockchain Technology and Process Aspects for Inbound Logistic.

Blockchain Technology expedites monitoring and controlling of inbound logistic, the distributed, and peer to peer that offer advantages in the process such as source traceability (provenance), delivery row material monitoring or tracing to ensure continuity of row material and on-time delivery (Kim and Laskowski, 2018) (Neisse, Steri and Nai-Fovino, 2017). In other inbound logistics activity, such as in procurement and ordering activities of row material Blockchain Technology, it contributed well in this urgency (Banerjee, 2018),

E. Blockchain Technology and Process Aspect for Production.

Production activities are essential processes in SCM, and in this process where transformation from raw material to finished good happened, Blockchain Technology can be applied in this stage such as for handling production machine or Cyber-Physical System (CPS), Internet of Things (IoT), RFID, Sensor(Ghobakhloo, 2018) to ensure the continuity of machine work. Doubtless, Tamper-proof of Blockchain Technology is to ensure the machine works as the design and arrangement (Xu *et al.*, 2016).

F. Blockchain Technology and Process Aspects for Outbound Logistic.

The outbound logistics is the subsequent process following the manufacturing process that described the preparation process before delivery or distribution of the product. Blockchain Technology will be used for the recording of product identity to ensure the originality or standard quality of the product. In this phase, it captures the salient feature to ensure the product originality or counterfeited components (Sylim *et al.*, 2018)

G. Blockchain Technology and Process Aspects for Distribution

The distribution process describes a process of the delivery product from the manufacturer to the customer. In this level, Blockchain Technology can be used for tracing and tracking of distribution process(Banerjee, 2018). The capability of locating and monitoring product distribution ensured the original automotive components well received by the customer, and it assured the quality of the end product(Tian, 2017).

H. Blockchain Technology for People Development.

Blockchain Technology impacts on people directly, such as for customer privacy(Kshetri, 2017), and people skill development-training(Devecchi *et al.*, 2017). Moreover, it also ensures the continuity of raw material supply for supplier and customer in the way of handling or setting up the product. In this case, Blockchain Technology traced people (employee, supplier and customer) skills that are required by the industry. It can be easily performed and identified to backup persons and ascertain continuity of operational industry processes.

I. Benefits of BlcSCM.

Even though Blockchain Technology ensued relatively new and scaled to top-line growth, BlcSCM seizes advantages for SCM in automotive components industry, such as improving data security (immutable, tamper-proof, secure), accelerating decision-making process (valid and unchanged data), ensuring continuity of product production (raw material delivery tracking and monitoring), protection of intellectual property (product design, formula), ensuring customer data privacy and the originality of product (monitoring, tracing and tracking product distribution from manufacturer to customer), cyber-physical security (CPS), IoT, RFID, sensor that supports production machine (ensure the engine operate as planned), and product compliance (tracing material used, design and formula).

V. CONCLUSIONS

Blockchain SCM (BlcSCM) theoretically can be used or implementable in Industry level. In this scope, it proved starkly that Blockchain Technology could be merged in SCM processes. In this vein, Blockchain Technology captures another value of SCM, especially in the automotive components industry. BlcSCM aggregates benefits for people, processes, technology, and organization as well, such as operational efficiency. In the end, it indirectly reduces industry cost of production as a significant contribution.

RESEARCH LIMITATION & FUTURE RESEARCH.

The proposed model of BlcSCM still in development stages that required the validation of the model for the following phase of research. The implementation of a model is required as well; however, there still limitation regarding data information due to corporate secrecy.

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Surjandy, is a PhD student at Bina Nusantara University. Blockchain Technology in Supply Chain Management System is his 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 in Information Systems Department