Suitability study of Blockchain application in electric utility company business processes

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Abstract. Blockchain technology recently draws populous attention, both in academic research and industry area including energy industry. Blockchain is viewed as an innovative technology that can enhance conventional way of doing businesses, especially those that require intermediary involvement. Perusahaan Listrik Negara or PLN as the state owned electricity company in Indonesia also seek to improve its business process using current technology, including evaluating to implement Blockchain in PLN business processes. This study aims to develop a workable framework in identifying suitable business activity for Blockchain implementation in PLN. The framework is developed from existing frameworks with adjustment to better fit the application in PLN. The developed framework is then used in a focus group discussion involving business process stakeholders to identify which business area Blockchain can enhance the process and suitable for implementation. This study finds that certain existing PLN business process can be enriched by implementing Blockchain technology. Numbers of future innovative businesses that can help PLN to improve customer satisfaction and provide revenue to PLN also identified.

1. Introduction
Blockchain as one of distributed ledger technology recently gained popularity, both in academic research and industry including energy industry. Originally coined by a person or a group of person by the pseudonym of Satoshi Nakamoto [1]. Blockchain is viewed as one of innovative technology that can disrupt conventional way of doing businesses, especially those that involve several parties that are unknown to each other and require trusted entity involvement in the process. Blockchain enable secure and transparent peer-to-peer transaction that may eliminate the need of third party involvement. Although Blockchain are first introduced and developed for financial sector in the form of cryptocurrency, Blockchain potential has now been explored to be used in other business area including but not limited to supply chain, education, healthcare system, real estate, and also energy system.

PT Perusahaan Listrik Negara (Persero) or PLN as the state owned electricity company has the responsibility to provide electricity to all the people of Indonesia. PLN business process covers from primary energy provision, electricity generation, transmission and distribution, up to electricity retailing to the customers. With total customers of over 71 million and over 50 Gigawatts of generation capacity, PLN bears great responsibility to provide affordable and good quality electricity in Indonesia. Not to mention current technology advancement such as distributed energy resources, increasing demand and falling price of renewable energy, and battery technology that can disrupt PLN business. Therefore, PLN needs to constantly innovating and adapting to anticipate the impact of
technology revolution that can lead to business model evolution [2]. Exploring the potential of Blockchain technology to enhance PLN business process is part of PLN efforts to improve its service to the customers.

In this study, the suitability of Blockchain technology to be implemented in PLN’s existing business processes is evaluated. In addition to that, the opportunity of implementing Blockchain technology in accommodating disruption to PLN’s business processes such as distributed renewable energy resources and electric vehicle are also discussed. This study aims to provide PLN insights on how Blockchain technology can be used to enrich PLN’s business processes in the future.

2. Methodology

This study uses several existing framework for evaluating suitability of Blockchain technology implementation such as in banking [3], technology licensing [4], insurance [5], and energy sector application [6] that already existed in the literature and develop a more applicable framework to be applied in assessing PLN business processes. Concurrently, PLN’s business processes are mapped to obtain broad picture of how PLN do its business. A focus group discussion with business process stakeholders then conducted based on the developed framework to identify PLN’s existing business processes that can adopt Blockchain technology. In addition to that, future challenge for PLN’s business that can be addressed with Blockchain technology is also discussed in the focus group discussion. Existing studies and working papers regarding the role of Blockchain technology in energy sectors [7,8] including peer to peer energy trading [9-12] and other commodity trading are used as reference in the discussion. The resulted business process then matched with the taxonomy for Blockchain technology in energy sector provided by Xu [13] and PT PLN [14] to provide insights on how Blockchain technology can be implemented.

After the developed framework succeeds on identifying the suitable business process, additional extension was added to the framework. This extension is used to identify preliminary information to further decide which Blockchain technology and architecture to be used for each suitable business process.

Wibowo [4] propose two level of Blockchain implementation assessment: first is a set of check list to make sure that the business case is suitable for Blockchain implementation, second is a framework built on people – process – technology framework to further assess the Blockchain implementation. Similar to that Cognizant [6] in one of their Digital Systems & Technology series also suggest several question to be asked before a certain business process is to be implemented with Blockchain technology.

PLN’s business processes to be assessed are based on the directorate of PLN decree number 241.K/DIR/2012 [15]. According to the decree, PLN’s business processes divided into input, process, and output. The process part itself is comprised of three parts: vision – mission - strategy development, electric power provision process, and supporting activities for electric power provision process. In this study, we will focus on the electric power provision process which is composed of primary energy management, electric generation management, electric transmission management, electric distribution management, and electric retail management. PLN’s business process as given in the directorate decree is given in Figure 1.
3. Results and discussion

3.1. Developed framework to identify suitable PLN business process to implement blockchain

The first step in Blockchain implementation in PLN is to identify which business process and activity are Blockchain suitable and can enhance the business process. To facilitate the work of identifying, we develop a framework that can be used to identify which process and activity Blockchain technology can be the solution. The developed framework on identifying the suitability of Blockchain technology implementation is given in Fig. 2 below.

As we can see from Figure 2, the developed framework starts the process by determining which business area to be identified to narrow the selection, then move forward to determining which activity in the business area to be examined. Then the determined activity is checked by using two criteria: transactions or data transfer which occur in the process and actors involved in the process.

For transactions and data transfer there are three questions to be asked: whether there is interdependency between all transactions or not, whether the chronological attribute of the data or transactions or important or not and whether security and tamperproof are important and cannot achieved with conventional approach. If the answer of those three questions is NO, then the benefit of using Blockchain in the process is very minimal thus it is not recommended to implement Blockchain.

For actors criteria, there are also three questions to be asked. The first question is whether there is multiple actors involved in the process. If there is only single actor involved then it is not advised to use Blockchain. The second question is whether all multiple actors involved in the process trust each other or not. If all actors have trust on each other, then Blockchain may be deemed not necessary. The last and important to be asked regarding the actors involved is whether there is intermediary or third party involvement in the process. Blockchain technology is highly considered to be implemented in a process that involve intermediary.
Figure 2. Developed framework to identify business activity to be implemented with Blockchain.

3.2. Identified area in existing PLN business process where blockchain is suitable to be implemented

After the framework for identifying Blockchain implementation suitability is developed, the framework then used in a focus group discussion (FGD) involving stakeholders that are responsible for each existing business process of electric power provision in PLN. The identified activities are given for primary energy management, electric generation management, electric transmission management, electric distribution management, and electric retail management. The identified activities are given in Table 1.

Table 1. Identified business activities in PLN business process where Blockchain is suitable to be implemented.

| No | Scope                        | Activity                                                                 | How Blockchain Helps                                                                 | Remarks                                                                 |
|----|------------------------------|--------------------------------------------------------------------------|--------------------------------------------------------------------------------------|------------------------------------------------------------------------|
| 1  | Primary Energy Management    | Ensuring the availability of primary energy needed by the generation plant to ensure continuity of operation. Data exchange between multi parties: coal/gas/oil provider, surveyor, transport/logistic provider, multiple division on PLN Headquarter, PLN Region, power plant owner, bank/financial institution. | Blockchain can help to provide platform for all parties to share the data, starting from primary energy need analysis, procurement process, delivery, and evaluation of primary energy usage and quality. Single immutable data will help to optimize all processes. Settlement of payment can also be done seamlessly using smart contract mechanism embedded in the Blockchain platform. | Great candidate for Blockchain application in PLN. |
Table 1. Cont.

| 2 | Power Generation Management | Billing transaction between generation plants and transmission system. Data exchange between independent power producers, generation power plants owned by PLN, transmission line owner, multi division on PLN Headquarter, PLN Region, and bank / financial institution. | Blockchain can help to provide platform for energy meter recording at power plants and other transaction nodes between power plants and transmission line owners. Settlement of payment to IPP can be done seamlessly using smart contract mechanism embedded in the Blockchain platform. | Good candidate for Blockchain application in PLN. Can be combined with automatic billing between Transmission and distribution. |
|---|---|---|---|---|
| 3 | Electric Transmission and distribution Management | Billing transaction between transmission line and distribution line system. Data exchange between transmission line owner, distribution line owner, multi division on PLN Headquarter, PLN Region, and bank / financial institution. | Blockchain can help to provide platform for energy meter recording at transaction nodes between transmission line and distribution line system. Settlement of energy transaction can be done seamlessly using smart contract mechanism embedded in the Blockchain platform. | Good candidate for Blockchain application in PLN. |
| 4 | Retail Management | Billing transaction of customers. Data exchange between PLN retails, customers, and bank/financial institutions. | Blockchain can help to provide platform for energy meter recording at customers, especially for large customers. Settlement of energy transaction can be done seamlessly using smart contract mechanism embedded in the Blockchain platform. | Good candidate for Blockchain application in PLN especially if used for large customers. May be considered as force fit if to be used for all customers. |

3.3. Suggested future business of PLN where blockchain can be implemented
In addition to existing business process, future business area that can be exercised by PLN with the help of Blockchain technology and to accommodate distributed energy resources and renewable energy awareness are also discussed in this study. Two business activities that can be of benefit to be executed by PLN in near future are given in Table 2.
Table 2. Suggested future business activities for Blockchain implementation.

| No | Scope | Activity | How Blockchain Helps | Remarks |
|----|-------|----------|----------------------|---------|
| 1  | Peer to peer energy trading | Energy trading between customers in the grid. Customers who have distributed energy resources (rooftop PV, small wind, battery, diesel) installed can sell their generated energy directly to the customer wishing to buy electricity from certain type of generation. | Blockchain can be used to set up a trading platform between customers. Settlement can be done seamlessly with the help of smart contract. | Great candidate for Blockchain application in PLN in the future. |
| 2  | Renewable energy certificate trading | The owner of power generation powered by renewable energy (hydro, solar, wind) can sell the green certificate associated with each MWh of energy generated by the power plants to customers that are willing to buy them, either for voluntary causes or obligatory purposes. | Blockchain can be used to set up a trading platform between renewable energy generators and customers. Settlement can be done seamlessly with the help of smart contract. By applying international standard for RE certificate register, the certificate can be trade internationally. | Great candidate for Blockchain application in PLN in the future. |

4. Conclusions
Blockchain technology is an innovative distributed ledger technology that can enhance the conventional way of doing business. Blockchain can provide secure and transparent peer-to-peer transaction that may eliminate the need of third party involvement thus increasing efficiency in the process. The framework developed in this study can help to determine which business activity can be enhance by the implementation of Blockchain technology. Several business activities in existing PLN business process has been identified as good candidate for Blockchain implementation in PLN though must be taken with a grain of salt to avoid force fit application. Two business activities named peer-to-peer energy trading and renewable energy certificate trading are suggested to be implemented in near future. Further detailed study of architecture and cost of implementation are needed to justify the viability of Blockchain implementation for the identified business activities.

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