Requirement analysis of blockchain systems on cocoa supply chain

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Abstract. The long cocoa supply chain in Indonesia makes cocoa difficult to trace, data in several countries in Indonesia related to national cocoa data. National cocoa production data is needed in creating policies that are right on target, so these things need to be done. The development of industry 4.0 makes the creation of blockchain technology that can overcome these problems. To create a blockchain system for the cocoa supply chain needs a requirement analysis for the time of making the application. The purpose of this research is to identify the needs and know the interactions that occur in the blockchain chain system in the cocoa supply chain. The method used is requirement analysis, use case diagram, and sequence diagram. The results of this study are two inputs: the structure of the cocoa supply chain and activities that occur in the cocoa supply chain, four stakeholders: farmers, collectors, agroindustry, and exporters, one output: the blockchain system from the cocoa supply chain. Interactions that occur in the system is log in to the system, add the activity, execution phase, ordering phase, and validation phase.

Keywords: blockchain systems, cocoa, supply chain

1. Introduction
Indonesia is the third largest cocoa producing country after Ivory Coast and Ghana. According to [1] "cocoa beans are seeds from cacao (Theobroma cacao L.) which come from noble cocoa beans or cocoa beans act after fermentation, washed or without washing, drying, and cleaning". Cocoa plays a role in the national economy as a contributor to the country's foreign exchange, the provider of raw materials for domestic industries, providers of employment, and environmental conservation [2]. In its circulation, Indonesian cocoa has a long supply chain. Based on research conducted by [3], the cocoa supply chain consists of farmers, collectors, agroindustry, exporters, and consumers. The length of the supply chain makes the information cut off in the middle of the supply chain. The farmers does not know how much cocoa that industries need, and industries does not know how much cocoa that farmers produce. It is become big problem when all the stakeholder do not know the transparency of the amount of cocoa. The current situation about the amount of cocoa is the different data from the different institutions. There are institutions which say that domestic cocoa production in 2017 is 600 thousand to 700 thousand tons, but there are also other institutions that say the national cocoa production is only 300 thousand tons [4]. The difference in data on the amount of cocoa production occurs because each party has a different approach in calculating production capacity. Some parties calculate production practically by calculating the amount of export-import cocoa, and other parties estimate the production of cocoa from...
the area of the crop and the level of productivity. This different data is always a polemic, because, with the difference in the amount of cocoa data, the policy can be missed [5]. Therefore, it is necessary to resolve the problem of differences in national cocoa production data.

In the industrial 4.0 era, where all things will be digitized can certainly help in overcoming the problem of differences in national cocoa production data. An advanced digital technology, the blockchain, will be able to overcome these differences. The blockchain is a distributed ledger system that has several advantages namely the system will be decentralized, transparent, the data can not be changed, and each stakeholders will validate the data each other [6]. The blockchain will be record the data from the farmers until data from exporters. So, the amount of cocoa will be known and blockchain can help the problem the lack of the transparency about data.

In building a blockchain system for the cocoa supply chain, a system requirement analysis is needed to determine what components are required to build the blockchain system and also make it easier to continue the coding process. In this study two diagrams of Unified Modeling Languages (UML) are used, namely use case diagrams and sequence diagrams. UML diagram is used to analyze the system requirement because UML provide a language visual model that make the developer easier to make the blueprint of the system [7]. The purpose of this study is to identify the elements needed by the blockchain system in the cocoa supply chain and analyze the interaction of activities that occur between stakeholders.

The results of this paper is the blockchain need two inputs: the structure of the cocoa supply chain and activities that occur in the cocoa supply chain, four stakeholders: farmers, collectors, agroindustry, and exporters, one output: the blockchain system from the cocoa supply chain. Interactions that occur in the system is log in to the system, add the activity, execution phase, ordering phase, and validation phase.

2. Research Methodology
This research in knowing the system requirement described in the input-output diagram where this diagram will illustrate several components of the system including input, output, resources, stakeholders, role, mission, objective, threats, and control. UML diagram for interactions that occur between stakeholders in the system. The flow of this study can be seen in figure 1.
3. Result and Discussion

3.1 Requirement Analysis

Requirement analysis is to identify what components are needed by the system. In this study, what elements are required in building a blockchain system in the cocoa supply chain. Requirement analysis is identified using the input-output diagram. The component that described in the input-output diagram is stakeholders, objectives, threats, and resources. The input-output diagram can be seen in Figure 2.

![Input Output Diagram](image)

The input-output diagram, which can be seen in Figure 2, is a component needed to build a blockchain system in the cocoa supply chain. To get the output which is blockchain system that is suitable for the cocoa supply chain, two inputs are needed, namely the structure of the cocoa supply chain and the activities of each actor. The structure of the cocoa supply chain is used to determine how many stakeholders are involved in the system. This structure will determine how many ledgers will be formed on the blockchain system. In addition to knowing the structure of the chain, activities in the supply chain must also be identified to determine the design of the ledger display that will build. Existing activities must also be sequential and detailed because the blockchain system wants each activity in sequence when validating process. The closed blockchain is a system that executes order-execute architecture, so its execution is executed sequentially [10].

In the stakeholder component, there are four relevant stakeholders, namely farmers, collectors, agroindustry, and exporters. Farmers, collectors, agroindustry, and exporters are members of the cocoa supply chain. These stakeholder will play a role in the blockchain. They will interact each other, when one party record their data, the other parties will be verified and validate the data. They have an agreed contract and this contract is the basis for verifying and validating the data. The data that fit with the contract will be verified and validate and add into the block, but if the data does not fit with the contract the other stakeholders will not verified and validate the data.
The blockchain system must be able to be accessed by all relevant stakeholders because the purpose of the blockchain system in the cocoa supply chain is to utilize its traceability and transparent data, so that the system must be built with the aim of the system being able to be implemented. In the resources component, there are four resources including unified modelling languages (UML), application programs, blockchain platforms, and programming languages. UML is used to describing the blockchain system that will be built in the diagram form. UML will make it easier for programmers when coding runs. Application programs that used to draw the UML diagram is power designer, rational rose, star uml, and so on. The blockchain platform is used as a coding medium when want to create a program. There are several blockchain platforms like hyper ledger, multichain, and others. The programming language is the language used for making applications later. Programming languages that can be used are C language, R language, and so on.

In the control component there are several controls to make the blockchain system, they are the system must be easy to use, accessible at any time, can only be seen by the relevant stakeholders, the activity must be sequential, and the activity that has been added cannot be changed. Control is used to monitor the course of the system. The system must be easy to use and can be accessed at any time is a control to allows users who have high mobility. The system must be visible to the relevant stakeholders as a monitoring process, the added activity must be sequential because the validation process based on the previous procedure, and the added activity cannot be changed to support the system so the all data in the system are true.

In the threat component, there are three threats, namely the system is difficult to apply to the cocoa supply chain, it is difficult for stakeholders to change their habits, and internet network instability. The cocoa supply chain consists of different people which will certainly be difficult when applying an application that is used together. At this time stakeholders rarely record their activities, changing their habits is a difficult thing especially not everyone is open to change. Internet networks are needed in this application, while the internet network in Indonesia is still not spread evenly, this will certainly complicate the implementation of blockchain applications.

3.2 Activity Interaction
Activity interaction is an important thing to be analyzed to see how each stakeholder contributes to the making of the system. Activity interactions are described in two diagrams, use case diagrams and sequence diagrams. This diagram can be seen in Figure 3 and Figure 4.

Figure 3 show the interaction between stakeholder when blockchain applied on the supply chain of cocoa, while figure 4 shows the detailed activity based on use case diagram. Figure 4 show about the activity of farmer when they want to adding the activity into blockchain application. In the first activity is log in to the system, this activity did by all stakeholder. After stakeholder log in to the system, they must add the activity into the system. The information that attaches to the system is the name of the activity, with whom the activity occurred, and the amount of cocoa when the interaction occurred. The third activity is the execution phase, the execution phase is a phase that occurs when a stakeholder wants to add their activity. In this phase the stakeholder sends the proposal that consists identity, transaction payload, and the identifier from chaincode [10]. For example in figure 4 farmer want to insert their activity into the block, so farmer must send the proposal. Collector and agroindustry will execute the activity and give the endorsement to the proposal. The proposal that has enough endorsement will be continue to the ordering phase.

The fourth activity is the ordering phase, the ordering phase is a phase to spread the endorseement and determine the consensus for the activity. So, the activity will be grouped into the block and generate the sequence of hash chain from the block that consists of the transaction [10]. For example, the activity that sends from farmer spread into collector, agroindustry, and exporter. The last activity is validation phase, validation phase is phase to validate the transaction. In this phase, if validator does not satisfy
with the endorsement, so the activity stated do not valid or will be ignored, while the valid activity will be add into block [10].

Figure 3. Use Case Diagram.

Figure 4. Sequence Diagram.

4. Conclusion
This study analyzes the needs of the blockchain system that will be applied to the cocoa supply chain and knows the interaction between stakeholders in the system. The result is that in producing blockchain system output in the cocoa supply chain, two inputs are needed, namely the cocoa supply chain structure and activities for each actor. Four stakeholders involved in the system, namely farmers, collectors, agroindustry, and exporters, the goal is all of information is transparent so the real amount of cocoa can
be known, four resources namely UML, application programs, blockchain platforms, and direct programs. Five controls namely the system must be easy to use, accessible whenever and wherever, only visible to relevant stakeholders, activities must be sequential, and activities the added cannot be changed, and the threat is that the system is difficult to implement, the user has difficulty changing habits, and the instability of the internet network. The interaction between stakeholders in the system in designing blockchain applications for cocoa supply chains is log in to the system, add the activity, execution phase, ordering phase, and validation phase.

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