Analysis and Design of Distribution Systems Information Flow in the Sugar Supply Chain in Indonesia

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Today's modern supply chain represents a complex and real-time, organization, resource, activity, information, and data source that is involved in the distribution of products and services ranging from upstream to downstream of the supply chain. In the past 4.0 supply chain technology was not just a linear business function, but as the center of the main process of ecosystems that are in a blind spot chained by value. With information as a foundation in the decision-making process so that information can create integrated and efficiently coordinated supply chains. So that it can show continuity from planning to production, inventory, quality, and price control in each chain. An inefficient distribution that results in mistrust among stakeholders, because it has an impact on the decline and loss of value chain in quality and quantity. Integrity problems from the data collected were found in this study. These findings include the identification of various stakeholders, including farmers, importers to customers, and regulators, as well as their needs, which will be described through the use case, and BPMN. The results obtained are that the main actors (stakeholders) of the system are divided into farmers, importers, processing factories, headquarters, hauling services, and markets (customers) in the distribution of product information flow systems. Suggests tracking and tracing based on real-time data flow of product information coming from each actor in the sugar supply chain that is equipped with an accurate data distribution information support system.

Keywords: Actors, BPMN, Supply Chain, Use Case

1. INTRODUCTION

Complex competitiveness and regulation in the agribusiness and food industries require integration and coordination between actors in the supply chain. It aims to improve efficiency and equitable benefits for each business actor involved along the agro-food supply chain [1]. The sugar industry supply chain system is related to the coordination between business interests in managing stock, quality, and price stability in an even distribution system, which is transparent about product flow, financial information from upstream to downstream of the chain [2]. Business actors with an interest in the supply chain consist of various sources ranging from farmers, importers, processing factories to markets that consumer products such as households, industries, MSMEs, Restoration, etc. So that the agroindustry supply chain of sugar is under pressure with increasing imports, low productivity, due to reduced land and labor, unstable prices along the supply chain due to uncertainty of stocks and quality that cannot compete with imported products.

Today's modern supply chain represents a complex and real-time organization, resource, activity, information, and data source that is involved in the distribution of products and services ranging from upstream to downstream of the supply chain. In the past 4.0 supply chain technology was not just a linear business function, but as the center of the main process of ecosystems that are in a blind spot chained by value. With information as a foundation in the decision-making process so that information can create integrated and efficiently coordinated supply chains. So that it can show continuity from planning to production, inventory, quality, and price control in each chain.

One method in designing business processes is to design system improvements, such as Safriyana [3] states that the approach to a systematic methodology is done to analyze and design a system to be more

efficient. Supply chain as a system [4] that cannot be separated from the coordination and integration between stakeholders and the processes in it such as financial flow, product flow, and information flow with the main data availability system comes from suppliers, processors, and consumers. Barriers to IT implementation in the sugar supply chain are the disorganized sector, the business environment, and the lack of information technology literacy among farmers [5]. Illegal or illegal business practices or supply chain actors can also be a cause of resistance to traceability [6]. Upstream business actors such as farmers are very important in tracking where products are distributed so there is a certain pride that can increase appreciation and productivity, so competitive advantage can be distributed through ownership information to end consumers and business competitors [6].

The current condition of the supply chain is traditionally and simply a complex industry from producing sugar drops to producing methylated as a by-product [7]. Problems that occur in the sugar supply chain such as late payment, sugarcane field survey, correct and timely measurement of sugar cane, timely sale of sugar cane to the mill, thereby adding to the communication gap between farmers and sugar mills plus the centralized data available at the head office. The sugar factory is the beginning of a sugar-based business which is unique in that the production period is not all year long, which can cause inefficiencies in many ways such as machine breakdowns, high general costs, and labor costs. The constraint method is then applied to solve multi objectives, mathematical models.

Figure 1: Input-output diagram

An inefficient distribution that results in mistrust among stakeholders, because it has an impact on the decline and loss of value chain in quality and quantity. Integrity problems from the data collected were found in this study. These findings include the identification of various stakeholders, including farmers, importers to customers, and regulators, as well as their needs, which will be described through use cases, and BPMN. How the quality of interaction between actors in the creation of shared value will affect the overall supply chain performances?

Based on the needs analysis illustrated through the input and output diagram by identifying what components are needed by the system. Analysis of needs is identified using an input-output diagram. The components described in the input-output diagram are stakeholders, controls, threats, and resources [8].

The relationship between sugar mills and farmers is driven by farmers cultivating the land system of the right to use the factory to plant sugar cane by sharing the profits of 65% owned by farmers. In gathering information about the socially sensitive issues of sugar cane farmers by the sugar mill staff (which they contract) can produce biased opinions. To overcome this problem, field visits and interviews with sugarcane farmers were conducted by researchers to validate the data.

This study aims to identify and analyses entities and processes to develop a distribution system based on product information flow that includes all logistics activities based on flow from upstream to downstream of the supply chain. Based on the analysis, we designed the initial conditions of the supply chain based on the flow of sugar cane commodities and sugar products.

2. METHODS

The steps in analyzing interactions between stakeholders based on Usman et al. [9] are to use an integrated modeling language (UML) and use case diagrams which are then followed by a depiction of business process workflows in BPMN 2.0 and simulated to answer system requirements.

The research design of the information flow system in the sugar supply chain begins with the real condition of the product distribution flow from upstream to downstream of the supply chain, as follows:

2.1 Identification and analysis of stakeholder needs

Identify and analyze the construction entities from the initial state of the sugar supply chain. Entities built consist of main stakeholders such as farmers, importers, processing factories, head offices, as well as transportation services to the market (customers). Then business operators in sugar supply level carry out functional distribution activities from upstream to downstream.

2.2 Use case building

Identify system entities and then analyze system functional requirements using a use case diagram. This use case diagram represents the main actors and use-cases together with their relationships in the supply chain.

Based on the system entity and the use case model, a sequence diagram is constructed that represents the exchange of information between the actors and their processes in the distribution of sugar. This sequence diagram can show product flow and information.

2.3 BPMN design

The business process diagram illustrates a system at the highest level. Business process diagrams facilitate the graphical display of data flow control between processes at each level of the system build. Business process diagrams are also used to analyze the process flow to be developed, results, and discussion.

3. RESULT AND DISCUSSIONS

Indonesia, the grouping of sugar into three types namely [10]: Raw sugar derived from imports, white crystal sugar, refined crystal sugar. GKP is a sugar produced in a processing plant in Indonesia and is intended for direct community consumption such as for households, restaurants, and hotels, and small-scale food and beverage sales. Whereas GKR type of sugar is only intended for the pharmaceutical, food and beverage industry and is prohibited for direct consumption.

The process of making sugar that occurs in the milling process is a system consisting of the following processes: sugar cane grinding, juice clarification, evaporation of clear juice, crystallization, centrifugation, and sugar packaging [11].

The supply chain of the sugar industry in region x Indonesia starts from the upstream chain with the business actors being farmers, but if there is a shortage of sugar stocks in the community then based on government policy, imports will be carried out following the applicable auction standards and not when the sugar cane is owned by farmers, after that sugar cane and raw sugar will be processed in a sugar factory to produce white crystal sugar which can be directly consumed by the public and small home industries.

Figure 2: Current state sugar supply chain

3.1 system identification and requirements analysis

System identification is done by recording the needs of every business actor in the supply chain following the rules, the role of inputs and outputs desired by the system formed (Table 1). In general, the needs of all stakeholders are to be able to provide product flow information transparently and reliably in real-time data so that the information is given about the quantity, quality, and price of sugar can be traced from downstream to upstream of the chain and vice versa.

Table 1: Stakeholder identification based on needs

Stake Holder	Requirement	Stake Holder	Requirement
Farmers	The amount of quality sugar cane	Importir	Specifications following government regulations
	Timely payment		Licensing and procedures
Milling Factory	The efficiency of the production process	Head Office	The stability of the amount and quality of sugar
	Quality cane		Marketing and distribution efficiency
	Productivity		Price policy
Logging services	Cutting cane based on schedule and warrant	Market (Customer)	Sugar stock certainty
	Maintaining the quality of sugar cane during the transport process		Price stability
	Deliver until the cane is rolled		Standardization of sugar consumption

3.2 System identification and requirements analysis

The use case is a diagram that presents the interaction between the actors in the system. The desired benefits in the design of use cases are to facilitate communication and provide clarity about the needs of the actors in the system. The use case diagram component consists of a system that states the boundaries and relationships between actors. Actors as the role of the success of the operation of a system. Whereas the use case is a functional picture. In the case of this study, the use case is described in Figure 3.

Figure 3: Use case information flow from upstream to downstream of the sugar supply chain

The use case described above explains that the upstream stakeholders in the supply chain consist of importers of raw sugar and sugar cane farmers. In this case, state-owned companies will do raw sugar milling if the condition of sugar in the stock market decreases, or the condition of the factory that is not currently milling sugarcane, because farmers' gardens have not harvested sugarcane because the age of the plant and the level of maturity of the sugarcane is not optimal. Based on its regulations and policies, the government will announce an auction to any factory that has the right to grind raw sugar into consumption sugar.

When the harvest season arrives, the farmer will contract a felling and transport service which is a partner who has collaborated with the factory so that it is easy in terms of implementation. SOP, and experience in cutting and transporting sugarcane. It is common knowledge that the optimal queue time is not more than 36 hours because it can affect the quality of sugarcane and sugarcane stock to be milled and the price paid. Sugarcane to be milled must meet the Sweet, Clean and Fresh (MBS) requirements for quality. sugar cane into sugar by SNI. Sugar will be packaged, including 1 kg, 5 kg, 10 kg, and distributed to subsidiaries by auction at the head office. Only after that, the distributor is sent to the retailer, as well as traders and consumers directly according to the order.

3.2 System identification and requirements analysis

The integrity of the data collected in the flow of product information from planting to the marketing process to the distributor. Some of the plantations planted with sugar cane are owned by the factory where farmers work the fields until harvest and are handed over to the factory with 65% of farmers and 35% of the factory's share of the farmers. There is a bound and integrated relationship between farmers and mills so that it needs to be spelled out with the Business Process Model and Notation (BPMN). BPMN as a management support tool in business processes aimed at supporting business processes, business users by providing intuitive notation representing the complexity of a system (Figure 4).

Figure 4: BPMN

System Analysis and Design BPMN 2.0 [12] was used to design the model. System analysis and design begin with making a flow chart. The flow diagram depicts stakeholders, roles, processes, data, and information transfer. The system analysis carried out aims to present business flows using graphical notations that describe business process conditions based on sequences and information that occur in real conditions.

The explanation of BPMN depicted in the design drawing above is the distribution of product information flow from upstream to downstream of the supply chain. Business activities are carried out by the main stakeholders. So that each of them has coordination and is integrated. However, some of the information flowing in the supply chain is not based on an agreement on data taxonomy, in storing and transferring data.

Therefore, there is often no synchronization of distributed data among stakeholders. This causes inaccuracy and the data are still centralized in the data center or centralized.

4. CONCLUSION

The results obtained are that the main actors (stakeholders) of the system are divided into farmers, importers, processing factories, headquarters, hauling services, and markets (customers) in the distribution of product information flow systems. Information flow distribution is based on product movement from upstream to downstream of the supply chain. So that document control or data information based on communication, integration, and coordination between actors becomes an important factor.

Suggests tracking and tracing based on real-time data flow of product information coming from each actor in the sugar supply chain that is equipped with an accurate data distribution information support system. Based on 4.0 technology, Block chain has the potential to create smart and efficient supply chains in tracking product information with real-time visibility.

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