Business Process Re-engineering in a Sugar Mill Manufacture: The Preliminary Study for Designing a Portable Machine

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Abstract. Business process re-engineering is implemented in this research to provide a new business process in a sugar milling industry in Indonesia. The main reason for this research is inability of the local product to compete with the import one, especially on the price. The price of the local sugar is 25% to 50% higher because of high production cost. Value Stream Map is used in this research to identify the non-value added activities so that its contribution to the total cost can be calculated. The result shows that there are ten activities from five different stations which do not have added value in the process from harvesting to thick syrup product. The cost for those activities contributes to about 34% or IDR 269,574,280 to the total production cost. A new business process is proposed as the result of the business process re-engineering. It is proposed that the new process requires a new technology which is a portable machining system. The result of this new proposed business process is expected to reduce the production cost from IDR 6,500 per kilogram to IDR 2,000 per kilogram.

1. Introduction
In Indonesia, the government states sugar as one of the nine basic needs for households. It leads to a fact that sugar has an important role in the economic system of Indonesia. Sugar is not only consumed in household but it is also used as raw material in various industry. In 2017, the demand of this commodity national wide is estimated to reach 5.7 million tons and consists of 2.8 million tons of industry and 2.9 million tons for household consumption. Unfortunately, the national production is only 2.2 million tons, meaning that the country is lack of supply approximately 2.5 million tons [1] and should be imported by the government. The graphic of sugar consumed in 2013-2017 is shown in Fig.1.
In the government policy on the import of this produce, the government also applies VAT free for this commodity. The effect of VAT free policy is to the price of the imported sugar in the market about IDR 7,500 – IDR 8,000 per kg, much lower than production cost of the local manufacturer which is approximately IDR 10,600.

The high production cost of this product is mainly caused by the high price cost of fertilizer and the high cost of production process. Since the government limit its subsidy for the fertilizer, the price is increasing. The process to purchase the subsidized fertilizer is also complicated. For those reason, the farmer is forced to buy the non-subsidized fertilizer. In the production process, many activities are identified as non-value-added activity but require high expenditure, such as delivery costs of the harvested cane from farms to the factories. There is a lack of research conducted in order to reduce the cost of this delivery process. Conversely, the sugar mills company including all the actors in the supply chain of this product desperately need a solution for this cost issue so their product can compete with the imported ones. There is a need to generate dramatic and significant changes in the supply chain. The Business Process Re-engineering (BPR) is proposed as a suitable guidance to assist the process of solving this issue. It is believed that BPR; with its high risk and high return; is an effective way to redesign the business process to be more effective and efficient in order to compete in the global era [2].

The purpose of this paper is to determine process waste in order to redesign the business process in the sugar mill factory to provide a new process that generates a more competitive product in term of price so it can compete with the imported sugar.

2. Research Hypothesis
The hypothesis promoted in the paper is whether BPR approach is capable to reduce waste within the sugar production process from the cane harvesting to the thick syrup. In order to identify the waste in the process, value stream mapping is selected.

3. Review of Literature
The definition of a process is an activity or series of an ongoing and orderly activity that has purpose to achieve a desired outcome [3]. Reengineering is a process of achieving radical improvements in terms of time, quality, value and cost of doing a simultaneous redesign in the process, the organization and the information system. In [4], the authors explain that BPR can be applied to transform the business into a more efficient and flexible one. The key to the successful business process engineering is a new concept, simple but can change useful process in the business. Costumers are the main target in business process engineering because the main goal is to design a process by simplifying the work process so that it can satisfy the customer and increase the existing values, especially the value of the customer. According to [5] business process reengineering is defined as a management approach to rethink the current practices and processes on the business and their reciprocal relationships. In other words, business process engineering is an idea to improve efficiency of the processes by applying
fundamental, radical, dramatic and process approaches; modifying or eliminating non-value-added activities; and rebuilding the processes, structures and cultures within them. In general, BPR is similar to BPI but BPR requires a shorter period of timeframe. In addition, other similarities between BPR and BPI is shown in Table 1.

| BPR | BPI |
|-----|-----|
| The changes are radical | gradual changes |
| Big investment | Small investment |
| Focusing on human resources and technology | Focusing on human resources and work practices |
| Creation of new system | Improvements to existing ones |
| Champion driven | Controlled by the work unit |

The main idea of BPR is to remove or reduce waste. Waste is loss of various resources (i.e. material, time (related to labour, equipment, and capital) caused by activities in the business. Waste can also be described as any human activity that use a certain amount of resources but does not produce added value, such as errors requiring rectification, undesirable user output, unnecessary processing or processing, unnecessary labour movement, and waiting [3]. One of the tools used in BPR is Value stream mapping. Value stream mapping (VSM) is a tool to map a business process (or activities) to determine whether it adds value or not to the end product or service. VSM represents the process from raw materials down to consumers. VSM is used to describe the flow of values of the existing process before improvement (implementation of BPR) and after the improvement. VSM is used to identify the flow of information from consumers to suppliers or cost of streams. After the VSM is developed, the waste occurs in a series of activities can be indicated. According to [6], there is lack of method used to optimise the production process that provides an integrated tool to map a production or a business process. VSM is also considered as an effective tool in this area and has been applied in many fields, such as: production system, healthcare, transportation, construction and many other fields as shown in [7].

4. Research Method
In this research, BPR is the main framework used as a guideline in order to re-design the business process, to reduce waste and cost, and to gain more profit. The framework is presented in [8]. To gain the purpose of BPR in this business, VSM is selected as a tool to identify and remove the waste. The stages in implementing VSM is presented in [9].

5. Result
The case study in this paper is taken from the production process at PG. Madukismo, a sugar mill factory in Yoyakarta, Indonesia. It started operating in 1955. It is indicated that the factory is lack of good business and management practice. It can be indicated by the high cost of goods manufactured that leads to margin declines. An observation has been done to determine any non-value added activities. The business process on PG. Madukismo consists of several stages. The process from sugar cane to sugar syrup (nira) consist of operation in hauling stations, grinding stations, refinery stations, evaporation stations, cooking stations and feeding stations. In this study, the observation is limited to the process until the evaporation station that produces thick syrup. The main reason is thick syrup could be considered as a finished product. It can be easily stored and even it can be sold if necessary. Many industries prefer to have thick syrup instead of white/ brown sugar. The process in this company is observed using VSM and the result shown in Fig.2.
Figure 2. The result from VSM

Similar to any other companies, PG Madukismo also states its Key Performance Indicator (KPI) that is derived from its vision and mission. The KPI is attained from a discussion with the management. The KPI is shown in Table 2.

| No. | Key Performance Indicator (KPI)                  | measurement unit | Target Value |
|-----|-------------------------------------------------|------------------|--------------|
| 1.  | Minimum brix value                             | %                | 60           |
| 2.  | Minimum production capacity                     | Quintal          | 35,000       |
| 3.  | Minimum value of ICUMSA                         | UI               | 81-100       |
| 4.  | Maximum production cost (till thick Syrup)      | IDR/kg           | 6,500        |

The purpose of observing the activities from the sugar cane farm to the thick syrup is to identify any non-value added activities and waste. The result of the observation indicates that there are ten activities from five work stations which do not contribute value or provide an insignificant value contribution to the whole process. Most of the non-valued added activities are activities in the milling process, which are five activities, followed by transportation from field to the factory, four activities and one activity in the purification station. Also, it is found that there are many necessary "non-value-added" activities. This kind of activities is required but not adding any value to the product. There are four necessary “non-value-added” activities from field to the milling station.

In this research, the production cost is also calculated in order to compare the cost that can be saved from the result of the BPR. To compare the cost before and after the implementation of BPR, a total cost equation is developed. The equation is shown in equation (1).

$$ T_{CP} = C_H + C_T + C_M + C_C + C_A + C_E + C_{En} + C_{Mt} \tag{1} $$

Where :

- $T_{CP}$ = Total Cost of Production
- $C_A$ = Cost for pH Adjuster
- $C_E$ = Cost for Evaporator
- $C_T$ = Cost for Transportation
- $C_M$ = Cost for Milling
- $C_C$ = Cost for Clarifier
- $C_{En}$ = Cost for energy provision
- $C_{Mt}$ = Cost for Maintenance.

It has been calculated and confirmed that the production cost before BPR from the harvesting to the thick syrup is approximately IDR 796,713,209 for 35,000 quintals as shown in Table 3. The total cost consists of approximately 34% cost for all the non-value added activities or equals to IDR...
Before the BPR, the cost of energy ($C_{En}$) is almost zero because the usage of the waste of cane sugar to power the boiler.

By implementing the basic thought of the BPR, a new process is proposed. The main idea is doing most of the process from sugar cane to the thick syrup in the harvesting location. By implementing this idea, many waste can be significantly eliminated. This new process requires a new technology which is a new portable machines. It is estimated that the machines can be loaded into two trucks the detail of the portable truck is show on figure 3 and figure 4, the estimated total production cost is approximately IDR 538,446,079. The detail of the cost is shown in Table 4. The outcome of the new process is also estimated to affect the achievement of the KPI as shown in Table 5.

From Table 4 and Table 5, it is indicated the proposed new business process provides a radical improvement to the organisation. In Table 4, there are two cost elements introduced: cost for energy used, and cost for maintenance. The result of BPR recommends that a new portable machine is introduced. These two new cost elements are cost generated from the new portable machine.

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**Table 3. Cost of Production Before Process Re-Engineering**

| Stations Name          | Cost      |
|------------------------|-----------|
| Harvesting and Transporting | IDR 502,944,867 |
| Milling station        | IDR 252,945,414 |
| Purification station   | IDR 19,968,235  |
| Settings pH            | IDR 7,489,435   |
| Evaporation station    | IDR 13,365,258  |
| **Total**              | **IDR 796,713,209** |

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**Figure 3. Purposed design for portable truck extraction**

**Figure 4. Purposed design for portable truck purification - evaporation**
Table 4. Estimated Production Cost After Process Re-Engineering

| Stations Name            | Cost     |
|-------------------------|----------|
| Harvesting and Transporting | IDR 253,789,900 |
| Milling station         | IDR 207,459,583    |
| Purification station    | IDR 12,581,929     |
| Settings pH             | IDR 7,489,435      |
| Evaporation station     | IDR 13,365,258     |
| Energy used             | IDR 16,537,500     |
| Maintenance             | IDR 27,222,474     |
| **Total**               | **IDR 538,446,079** |

Table 5. Target and Estimated Result of the KPI

| No. | Key Performance Indicator (KPI)          | Measurement Unit | Target Value | Result   |
|-----|------------------------------------------|------------------|--------------|----------|
| 1.  | Minimum brix value                       | %                | 60           | 65       |
| 2.  | Minimum production capacity              | Quintal          | 35.000       | 35.000   |
| 3.  | Minimum value of ICUMSA                  | UI               | 81-100       | 81-100   |
| 4.  | Maximum production cost (till thick syrup) | IDR/kg     | 6,500        | 2,000    |

The proposed new business process has two KPIs that are above the target. The target of this KPI is 60% and with the new process, it is estimated to reach 65%. The main reason for this achievement is because the sugar cane is process straight away (almost instantly) after it is harvested. Processing the sugar cane right after it is harvested will maintain the sucrose and other concentrated material compare to cane from the previous process. Another improved KPI is the maximum production cost till thick syrup. The target from the company is maximum IDR 6,500 per kilogram. It is approximately 60% of the maximum production cost for the sugar or about IDR 10,600. While with the new proposed business process, the cost is approximately only IDR 2,000 per kilogram. It saves almost 70% from the previous business process. If presumed that the production cost after the thick syrup to the white sugar is similar at IDR 4,100 per kilogram, the total production cost of the new process is only IDR 6,100. This cost is cheaper that the imported sugar.

6. Conclusions

In this research, a Business Process Re-Engineering is implemented in a sugar milling company in order to determine a new radical change in its business process. The BPR process uses Value Stream map to identify the activities and categorize it into value added and non-value added activities. From the result of the observation, it is indicated that there are ten non-value added activities that contribute IDR 269,574,280 out of IDR 796,713,209 to the total production cost (about one third of the production cost). A new business process is proposed which is doing the process from harvesting to the process that produce thick syrup in the harvesting area. This proposed process eliminates most of non-value added activities and waste within the old business process and reduce almost 70% of the total production cost. This new process requires a new technology support which is a portable machine. It is indicated that the similar research with different commodity is another good research opportunity. For that reason, a team of researchers has been assembled to initiate the same research in Sago industry in Indonesia. Based on this reason, BPR is a good research opportunity for many other farming products which have high transportation cost to the factory after it is harvested. The result of the BPR is going to require a new technology which is another research opportunity in this area.

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