Design and Construction of Sago Rasper (As Business Process Re-Engineering of Sago Flour)

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Abstract. The forest area of Sago in Indonesia is about 1.25 million hectares with a seedling density of 1,480 per hectare. Only about 40 percent of the area is productive with the starch productivity of 7 tons per hectare per year, because of the number of sago crops that are harvestable but not harvested so that they are damaged. This happens because the business and the raw material sources are at a great distance. Therefore, there is a need for business process re-engineering of sago to be more efficient and effective. By redesigning the sago rasper to fit into the truck and can be laid out with other tools. The method used in this research was parameter measurement technique of Quality Function Deployment (QFD), validity and reliability test, morphological chart then designed by using SolidWork software. There were 5 attributes used in QFD: safe, high productivity, strong, durable, and price. Eventually, virtual design of sago extraction tool in accordance with customer requirements and expert machining was designed and constructed. The benefits of the research for Sago flour business process are machine optimization, reduced labor, shorter production time and higher productivity.

1 Introduction

Sago is an alternative food substitute for rice. In Indonesia, rice has been an essential staple food for the society, the most common food ingredients as a source of carbohydrates although there are some regions in Indonesia that make alternative food as staple food [1]. The demand for rice in Indonesia populated 212 million people is 30 million tons per year and it will continue to increase as the population grows. If the average population growth is 1.8% per year, then the population of Indonesia in 2010 is estimated 238.4 million and in 2015 is 253.6 million. Considering the potential condition of national rice production, it is estimated that by 2015 the rice supply will experience a deficit of 5.64 million tons [2].

Indonesia has the largest sago plantation area in the world of which about 48% of the total world sago area or approximately 994,000 ha are in Papua and West Papua provinces. It is estimated that the potential of dry starch of sago in the Indonesian easternmost province is about 4.75 million tons every year, but the actual production is only about 200 thousand tons. This means that 4.55 million tons of dry starch is wasted because they have not been harvested [3]. Based on the problem, there is a great business opportunity for sago flour processing in Indonesia. In Indonesia, sago is generally eaten as traditional food such as papeda, consumed as the staple food. Besides, it is also consumed as complementary food such as plate sago, sinoli, bagea and others [4]. Additionally, sago may be used as raw material for various industries such as food industry, adhesive industry, cosmetics and other industries [5]. Business Process Engineering is one thing that can be done to improve the effectiveness and efficiency [6]. To undertake Business Process Engineering required information on the entire process used by the company [7]. By conducting business process engineering, it is expected that there will be a significant and drastic change in the company performance. The purpose of using the concept of Business Process Reengineering is that the processing system will be more computerized so that the presentation of information run more quickly, accurately, effectively and efficiently, and the improvement in the operational management system as an effort to survive and develop among other competitors can be expected.

The result of business process re-engineering is a proposed business process. Increasing the capacity of sago processing at the farm level can certainly be improved by improving the processing techniques at each stage, especially at the stage of pith destruction and extraction because these two stages are the most time and energy consuming of all processing stages. One of the alternatives is to create sago processing tools which are interconnected at each stage so that the process starting from the pith destruction to starch drying can be done more efficiently and effectively in terms of time and energy to increase productivity. The real demand of the consumer needs to be identified to redesign the tool. The process design is performed in response to consumer needs by using the QFD method [8]. To serve this purpose, QFD has applied in many area, such as: supplier selection in supply chain [9]; developing scenario for industrial development [10]; and infrastructure [11].

Based on the result of the field survey, the rasper machine used in the sago flour processing industry in Klaten is made of wood cylinders and nail spikes, driven by 5.5 HP gasoline engine. The disadvantage of the machine is the construction of the machine directly contact with the product so that it might be easily rusty resulted in the quality of the rasped starch. There is the other problem for the industry that is the lack of raw material supplies caused by the far distance between the industry and the source of raw materials. The far distance causes the high cost of sending raw materials. The traditional business processes which are semi-mechanical results in wasteful expenses, time, and workers.

Business process re-engineering on sago flour processing has not been conducted previously. Several previous studies have been conducted on the prototypes of sago rasper, sago starch extractor, and sago starch dryer. This research combines the processing tools in one set aims to improve the efficiency of the business process which is later expected to increase the productivity in the business process of sago flour. This study focuses on the design and construction of mobile sago rasper to be operated with other sago processing tools such as the extractor, precipitator, and dryer without reducing the effectiveness of the rasper. It is expected to improve sago processing production system through the transfer of sago processing technology with production tools such as sago rasper, extractor, and dryer previously constructed.

2 Research Method

The focus of this study was to design a more efficient sago rasper design by using Quality Function Deployment (QFD) and Morphological Chart methods. The object of this research was a sago processing manufacture, sago rasper section, with the subject of sampling was the experts in sago rasper in Daleman, Tulung, Klaten, Central Java and the experts in the engineering at Indotech Cipta Mandiri workshop Jl. Taraman Raya, Sinduharjo, Ngaglik, Sleman, Yogyakarta

3 Result and Discussion

3.1 HOQ results

The relationship between technical requirements and customer requirements, the relationship between technical requirements, importance rating, direction of improvement and importance values are described in the form of HOQ matrices as shown in Figure 1.

3.2 Morphological Chart

Having obtained technical requirements, the goal was defined by creating a morphological chart with several goal options. After that, the expert chose an option that met customer and technical requirements. The morphological charts are presented in Table 1.

3.3 Design of the Sago Rasper

The design shown in figure 2 was referred to the QFD so that the design had been built on customer requirements, technical requirements and morphological charts. Thus, this design was expected to meet consumer desires.

3.4 How it Works

The device was operated manually by inserting blocks or pieces of sago that had been separated from the bark of the stem into the hopper and dropped to the rasper cylinder through the hopper to be shredded. At the top of the hopper there was a booster for the sago pith. This booster served to provide a thrust force on the slices of the sago pith so that the pieces of the pith are pushed toward the rasper cylinder. The pressure on the pith will accelerate the rasping process. This driver is very easy to use and very helpful for the operator. The sago spikes bar consists of 6 main parts, namely: 1. Main Frame, 2. Motor drive (3-phase electric motors), 3. Transmission system using a belt pulley, 4. Hopper, 5. Rasping result Channel (unloading), and 6. Rasper Cylinder. A propulsion mechanism had been created and located at the top of the hopper so as to improve the safety of the use of the tool so as to reduce the accident rate at the time of the rasping process.

3.5 Advantages

The research was about designing sago rasper with high mobility by being loaded up to the truck to be laid out with other tools without reducing the value of the tool usage. The following are advantages of the machine toward the sago business process:

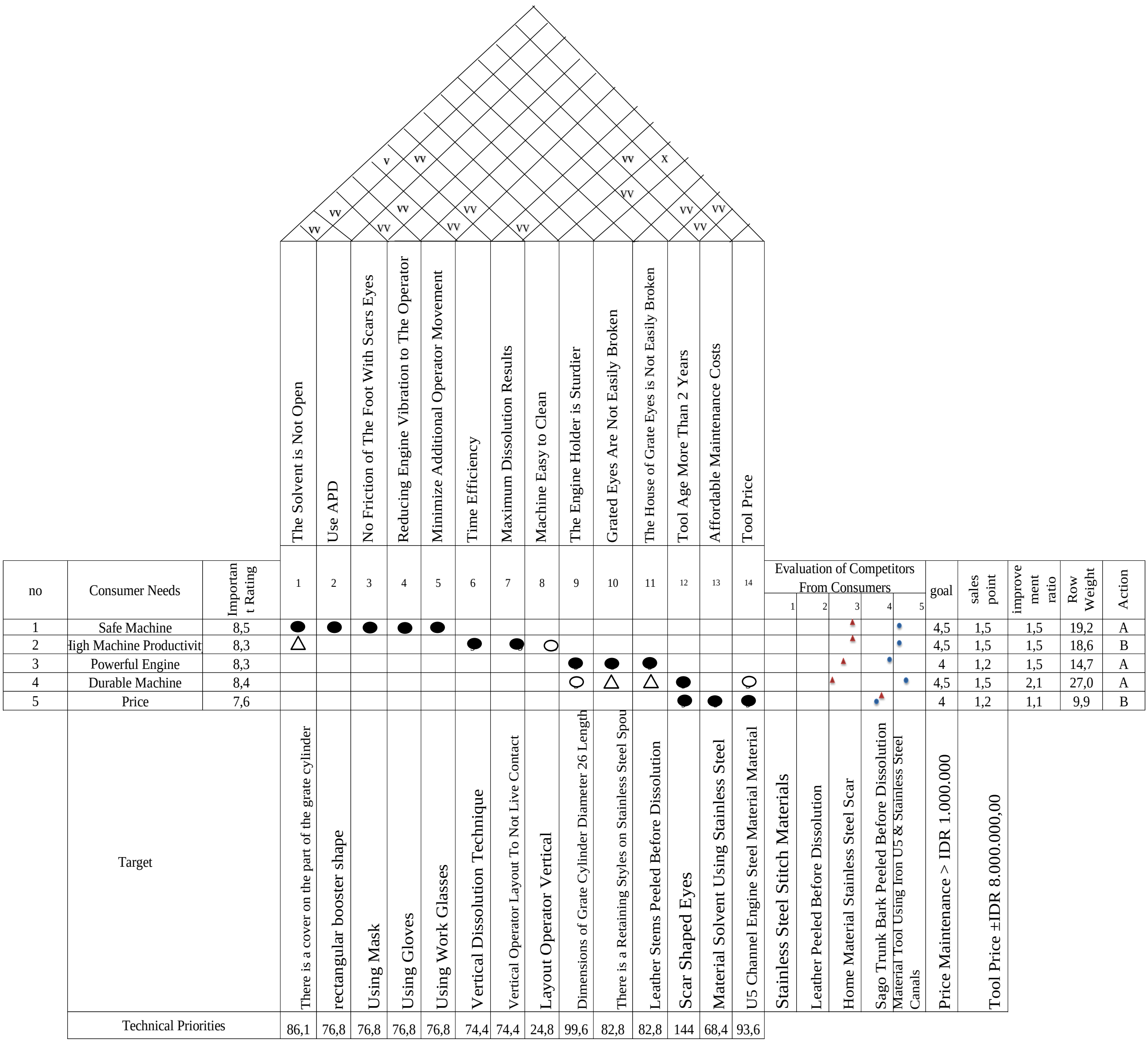

Figure 1. The House of Quality

Table 1 Morphological Chart

NO	FUNCTION	MEANS
1	Adding Cover On Rasper Cylinder	Available
2	Booster On Hopper	Rectangle
3	Mask	Yes
4	Gloves	Yes
5	Work Glasses	Yes
6	Redesign Grate Technique	Designed With Vertical Layout
7	Minimize Direct Contact Between Operator And Machines	Designed With Vertical Layout
8	Redesign Operator Layout	Designed With Vertical Layout
9	Redesign Re Dimensions Length And Cylinder Diameter	Diameter 26cm Length 40cm
10	Add Retaining Partition On Discharging Funnel	Yes, By Using Stainless Material
11	Separate Sago Pith Before Grated	Yes
12	Rasper Spikes	Needle
13	Machine Material	Stainless Steel
14	Machine Cantilever Material	Channel Iron U5
15	Spikes	Stainless Steel
16	Separate Sago Skin From Pith Before Grated	Yes
17	Spikes Case Material	Stainless Steel
18	Separate Sago Skin From Pith Before Grated	Yes
19	Machine Material Selection And The Frame Using Channel Iron U5 And Stanless Steel	
20	Affordable Maintenance Cost	> ± Rp 1.000.000,00
21	Affordable Tool Price	±Rp 8.000.000,00

Figure 2. Proposed Design of Sago Rasper.

3.5.1 Reducing Manpower

Based on the result of the reengineering process, the number of labour can be reduced. The existing process is shown in Figure 3 and the proposed process in shown in Figure 4.

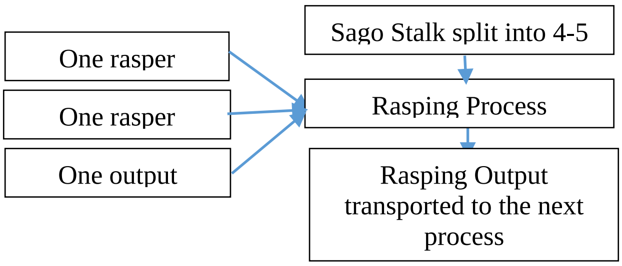

Figure 3. Flowchart of the existing Rasping process in Sago Flour Industry in Klaten.

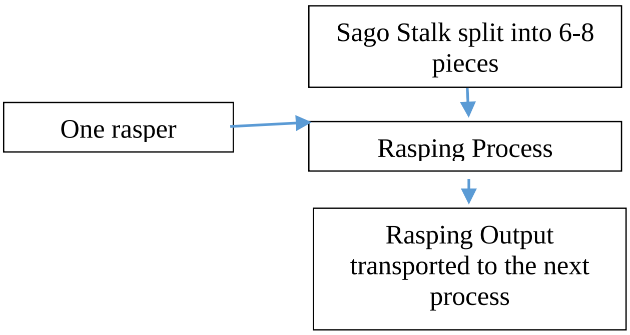

Figure 4. Flowchart Rasping process using the proposed design

It can be compared from Figure 3 and Figure 4 that there is a reduction in labour from three workers to one worker. Thus, the proposed sago-rasping process is more efficient.

3.5.2 Tool Optimization

By optimizing the design of the improved rasper, the capacity of rasping process obtained was 649.38 kg/hour, compared to the machine used by the industry that was only 416.67 kg/hour.

4 Conclusion

The conclusions drawn after data processing and discussion are as follows: There are five attributes used in QFD namely safe, high productivity, strong, durable, and price. Technical requirements and goals for designing and developing sago extraction tools are obtained from the experts. The virtual design of sago extractor fulfils customer requirements and the expert expectation. It provides a positive impact on the business process of sago flour that is reducing manpower and optimizing tools.

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