Identification of critical part in ripple mill repair design using quality function deployment method

Rosnani Ginting*, Sawaluddin and Alfin Fauzi Malik
Department of Industrial Engineering, Universitas Sumatera Utara, Medan, Indonesia 20155

*Email: rosnani_usu@yahoo.co.id

Abstract. At the company found problems related to the length of the product assembly process. The assembly system can be optimized by eliminating, combining, or simplifying the way the product is assembled so that the time needed in the assembly process becomes more minimum. If this design improvement is also carried out on other products produced by Jayatech Palmindo company, it will have a significant impact on reducing assembly time and unit costs in the production process. The integration of the Quality Function Deployment, Design for Manufacture and Assembly methods is expected to provide the right solution to improve the design of the ripple mill product and other products at Jayatech Palmindo company so that assembly time can be further shortened, and minimal unit costs without changing the value from the company's products.

1. Introduction
Ulrich and Eppinger (2001) state that a product as an object is made with the aim of meeting the needs of consumers who are difficult to satisfy and always want better than before. Technological progress and development require that producers be able to make products that have a "more" nature (better, stronger, more modern, easier, etc.) in accordance with the needs of consumers who are becoming more numerous. Design is the act of turning an idea or concept into real information. Design is different from making or building. The design creates a concept before the process of conversion into physical form or can be realized, the concept can be referred to as the design process. According to Caldecote (1989), the design is the process of turning ideas into information on how products can be made. Design is the application of technical and scientific principles to manage the components of a device. If the device is adjusted and realized to achieve certain results, it must meet the six requirements as outlined by Pye (1989).

QFD is a way to improve the quality of goods or services by understanding the needs of consumers and then linking them with technical characteristics to produce goods or services at each stage of making the goods or services produced. QFD is used to help the design process to pay more attention to customer desires. Quality Function Deployment (QFD) is defined as a structured process or mechanism to determine customer needs and translate those needs into relevant technical needs, where each functional area and organizational level can function and act. QFD also includes the proper control of operational processes towards targets. The main tool of QFD is the matrix, where results are achieved through the use of interdepartmental or functional teams by gathering, interpreting, documenting, and prioritizing customer needs.

The QFD component planning matrix can be completed when the component requirements have been added to the top of the matrix in response to the technical characteristics on the left. The next step is to add relationships and specifications. An example of a Design Deployment matrix can be seen in Figure 1.
2. Method
QFD (Quality Function Deployment) is defined as a design development method aimed at customer satisfaction and translating customer desires into design targets and important points in quality assurance for use in the production phase. QFD can be seen as a process where the voice of the consumer is given weight to be used throughout the production process. There are 6 basic elements of QFD, namely the determination of consumer needs (The QFD what), how consumer needs can be achieved (The QFD how), the relationship between consumer needs, the value/weight of target needs, the relationship between meeting each need, quantification/calculation of importance. House of Quality is the most commonly used tool in QFD. House of Quality consists of the following components: objective statement, consumer voice (voice of customer), level of importance, competitive judgment, supplier vote, target weight, correlation matrix, absolute matrix weight relationship and relative weight.

3. Result and discussion
The questionnaire was divided into 2 stages, the first stage was an open questionnaire. This questionnaire was distributed to 15 respondents and contained questions about the workers' assessment of the assembly process. The results of the respondents' answers contained in this preliminary questionnaire found several modes that support the attribute of the questions in the second stage questionnaire, namely the closed questionnaire. Based on the data obtained in the previous steps, the HoQ matrix is then made. The product QFD can be seen in Figure 2.
### Relationship’s Degree:
- \( V = \text{Strong Relation}, \text{weight} = 4 \)
- \( v = \text{Middleweight Relation}, \text{weight} = 3 \)
- \( x = \text{Weak Relation}, \text{weight} = 2 \)
- \( X = \text{No Relation}, \text{weight} = 1 \)

### Customer Requirement

| The size of the components is a major consideration that influences the ripple mill product assembly process | 5 9 9 0 9 9 9 3 | 1,0 | 7,83 | 11,47 |
| Component weight is a major consideration that influences the ripple mill product assembly process | 5 0 0 0 0 0 0 1 | 1,0 | 7,11 | 10,43 |
| Component strength is the main consideration that influences the ripple mill product assembly process | 3 0 0 1 0 0 0 1 | 1,0 | 3,31 | 4,86 |
| Kelicinan komponen menjadi pertimbangan utama yang mempengaruhi proses perakitan produk ripple mill | 3 3 9 1 3 1 3 3 | 1,2 | 4,05 | 5,94 |
| Component slippage is the main consideration that influences the ripple mill product assembly process | 3 9 9 1 9 0 3 3 | 1,0 | 3,44 | 5,04 |
| The use of tools is a major consideration that influences the ripple mill product assembly process | 5 0 3 9 9 9 3 9 | 1,5 | 12,27 | 17,99 |
| Mechanical assistance is the main consideration that affects the strength of the ripple mill product | 3 3 0 0 3 0 0 0 | 1,2 | 3,62 | 5,30 |
| The affordability of the entry location is the main consideration that influences the ripple mill product assembly process | 4 0 3 3 9 0 9 3 | 1,5 | 7,40 | 10,85 |
| Ease of use of the equipment is a major consideration that influences the ripple mill product assembly process | 5 3 0 0 1 1 3 1 | 1,0 | 8,43 | 12,37 |

| Level of Difficulty | 3 3 3 4 2 3 3 |
| Degree of Importance (%) | 13 16 12 21 10 15 13 |
| Cost Estimation (%) | 14 14 14 19 10 14 14 |

**Figure 2. Recapitulation of QFD ripple mill.**

QFD processing results show that all processes have the same level of difficulty except in assembly speed and design efficiency. While the process with the highest level of importance is the speed of assembly with a value of 21. The technical characteristics and the level of difficulty (weighting) will then be used for subsequent processing. The data obtained in the previous steps are recapitulated using the deployment design matrix. QFD Phase II ripple mill products can be seen in Figure 3.
The conclusion obtained from Figure 3 is that the most important part to be repaired immediately is the assembly time and the cost of assembly which has a difficulty level with a value of 4, the degree of importance with a value of 20 and 16 and an estimated cost with a value of 36 [6]. The most important parts to be repaired are then analyzed further using the design for manufacture and assembly method (Jack B. Reveille, 1998).

4. Conclusion
The results of QFD Phase II ripple mill products indicate that the most important critical parts to be repaired immediately are assembly time and unit cost which have a difficulty level of 4, degrees of importance with values 20 and 16 and estimated costs with a value of 36. This shows that both this critical part must be prioritized for repairs because it is a source of problems in the assembly process of ripple mill products.

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