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DESIGN OF CHIP CUTTING MACHINE USING QUALITY FUNCTION DEPLOYMENT (QFD) METHOD

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Abstract— **Chip cutting machine is a tool or instrument used by people who carry out activities or services as traders in the market or at home to meet their daily needs. The early machines used by traders today often experience problems or complaints from them due to their performance, equipment, and supplies when using chip cutters and their components. Chips will be pushed manually into the machine and hands will be in direct contact with the tip of the machine. The purpose of this study is to determine consumer demand for chip cutting machines and to find out how to use the Quality Function Deployment (QFD) method to design machines according to consumer demand for chip cutting machines in order to increase service efficiency to consumers. The data analysis tool in this study uses the House of Quality (HOQ) matrix statistical test with SPSS, while the instruments used for testing are validity tests and reliability tests. Based on the results of the analysis, it shows that consumer satisfaction with the designed machine is positive and significant. The current design results of the machine component that pushes the chips to the semi-automatic arm do not come into direct contact with the chip cutting blade, and the current machine test results show that the design can cut chips with sizes of 2mm and 3mm compared to the initial machine that cut chips with the same size because the blade does not change.**

Keyword: Chip Cutting Machine, QFD, Statistical, Efficiency

I. INTRODUCTION

The world is currently experiencing rapid technological developments, resulting in a variety of products from various communities. Therefore, innovative creativity is needed to produce quality, global products, as technology can help achieve the desired global service to the fullest[1]. Beyond technological factors, other factors influence the work processes carried out by communities, such as the performance of the instruments or equipment used in the process. This occurs because technology needs to improve its performance from the outset, such as in the case of chip machines[2].

Early machines currently used by traders often encounter problems or complaints due to their performance. The equipment and machines used are unsafe when cutting chips, and there is a risk of injury to users because the components that push the chips into the machine are manually pushed by hand without direct contact with the chips, affecting the chips because they are not accustomed to using bad chips. These numerous difficulties prompted researchers to come up with the idea of designing and improving machine performance to develop early chip cutting machines that are safe for users, efficient, profitable, and increase chip production.

Related to the performance that has been achieved, researchers made a chip cutting machine design using the Quality Function Deployment (QFD) method to develop machines according to user desires[3]. Not only to improve existing performance, but as technicians also need to be creative and innovative in order to be able to design and develop better machines to meet the needs of the local industrial sector. Therefore, researchers chose the Quality Function Deployment (QFD) method using the House of Quality (HOQ) which is a matrix that describes a conceptual map in the design process as an idea to find out consumer needs and prioritize technical requirements to satisfy consumers.

II. RESEARCH METHOD

The subjects of this study conducted a study at Hera and observed the initial machine used. The reason for selecting this object was to design and develop the existing initial machine according to customer desires. Sources and Methods of Primary Data Collection: Primary data is typically obtained through various data collection methods, which can be divided into two main categories: qualitative and quantitative.

The House of Quality (HoQ) matrix is the first stage in Quality Function Deployment (QFD)[4]. This matrix attempts to directly translate the Voice of Customer (VoC) into technical requirements or specifications for the chip cutting machine product that will be designed as the final product.

Based on the processing performed, data processing results are obtained. Once the data processing results are known, the next step is to analyze them based on the data processing results, tailored to the previously identified problems. The analysis will be shown in the search results. The analysis was conducted based on previously conducted literature studies. The researcher analyzed consumer desires for the product using the

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House of Quality (HOQ) matrix to identify consumer needs for the machine, which can assist researchers in designing and developing the machine[5].

Machine design and detailing in this context creates a detailed technical description of each machine component, ensuring that the machine can function properly according to its intended purpose.

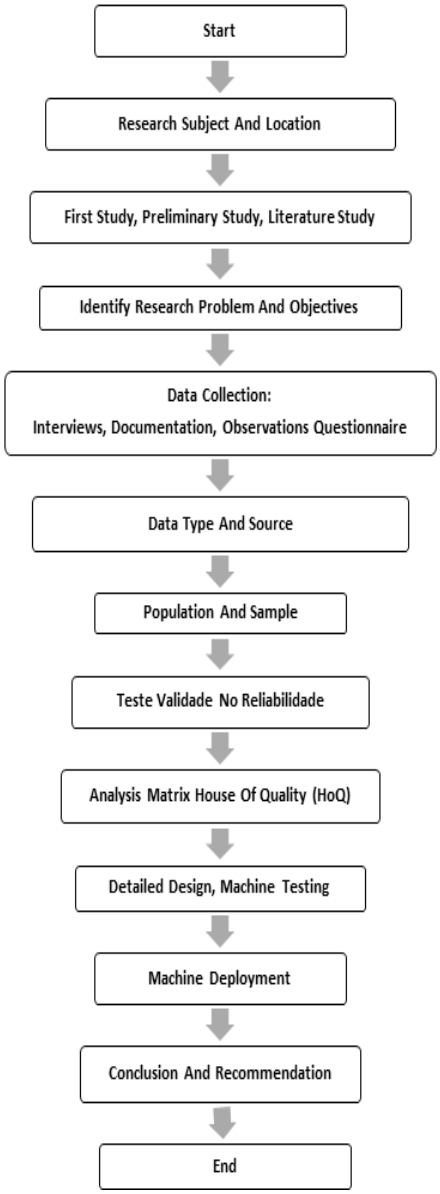

Fig. 1. Research Diagram.

III. RESULT

The first test is the Feasibility Test with the results of all items can be said to be valid as it has a value of r count greater than r table. Based on the results of all such valid consumer needs, the researcher takes as a target for design and development and focuses only on existing consumer needs[6].

The next test was the reliability test with the result that the reliability if the Cronbach alpha value obtained from data processing using SPSS software is greater than 0.60, the Cronbach alpha value obtained is 0.632 this shows that the distributed questionnaire can be said to be reliable, because the Cronbach alpha value is greater.

Table 1.
Reliability Test Result

Reliability Statistics	
Cronbach's Alpha	*N of Items*
.632	9

The House of Quality (HOQ) is one of the steps in the Quality Function Deployment (QFD) method. In general, this matrix is a tool for translating consumer desires into technical responses for a product[7]. In this study, the House of Quality (HOQ) is used to translate consumer demands for a chip cutting machine into design requirements for the machine. The House of Quality (HOQ) matrix diagram is shown in the following figure:

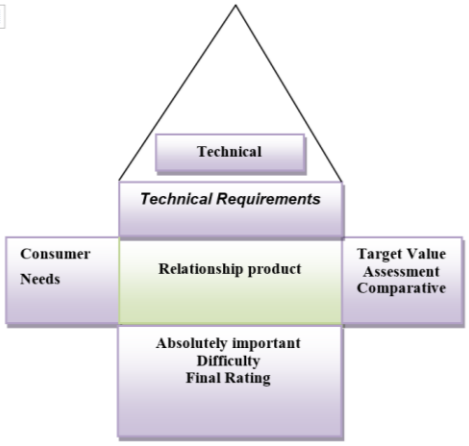

Fig. 2. Matrix HoQ.

Absolute importance is a way to give weight to each correlation of technical design elements with consumer needs to get an important absolute value, that is, we calculate each correlation against the existing target value so that the technique can prioritize each component that has a large target value, the formula used to calculate the target value (target value × points) + (target value × points) from P1 to P9.

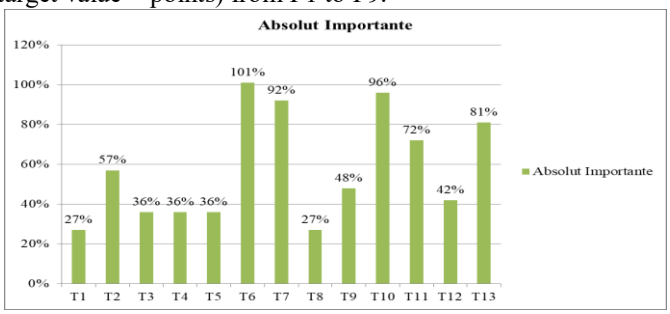

Fig. 3. Absolute Importance.

The detailed design of a machine produces a detailed technical description of each component, ensuring that the

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machine functions properly for its intended purpose[8]. The design and details of the machine components can be seen in the image below:

Fig. 4. Designing Machine Model.

Machine prototyping and testing is the process of creating a preliminary model of a machine to ensure its effective and safe operation. Machine prototyping is often used to validate designs, identify potential problems, and optimize machine performance. This testing is conducted to evaluate various aspects of safety, durability, and functionality.

IV. CONCLUSION

Based on the results of research on the design and development of the performance of a chip cutting machine using the Quality Function Deployment (QFD) method to answer consumer needs, researchers concluded the following:

1. The House of Quality (HOQ) matrix analysis revealed that the criteria that needed improvement and were prioritized for design and development were ease of use, portability, affordability, ease of maintenance, high productivity, a more attractive machine design, strong materials and components, safety, and the ability to cut chips of various sizes.
2. Based on the HOQ analysis, the materials selected and used by technicians to design the machine were 3x3 steel, 1mm steel plate, 3mm stainless steel sheet, 10x10 steel, 5x4 bearings (2.2, 2 cm, 4.5 cm), small wire, a small drill bit, bolts, nuts, 12 ml cast iron, and a rubber plunger.
3. Based on the comparative evaluation, the researchers compared the existing machine to the initial competitor for this research through observation and analysis.
4. Based on testing of the current machine, the design can cut chips of 2mm and 3mm sizes, compared to the initial machine, which cut chips of the same size because the blade remains unchanged.

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