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Redesign of Standard Paddock Motorcycle Products Using the Quality Function Deployment (Q.F.D.) Method

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ABSTRACT

One of the two standard replacement aids for motorcycles is the Standard Paddock. The use of Paddock Standard itself was initially only used on sports or racing motorcycles because it did not have standards attached to the motorcycle. However, after the times and technology, leverage standards are in great demand by motorcycle lovers for daily activities and modifications. This research aims to design Paddock Standard tools that suit the wants and needs of consumers who are functional and able to provide safety, comfort, and convenience for their users. The design of the tool uses the Quality Function Deployment (Q.F.D.) method, which will later become a benchmark in making design concepts. There are two design concepts and one combined concept, where the selected is a combined concept A + B. After users test the concept and prototype of the design product as consumers, the average likes the product concept, which can provide more function than the previous tool. When asked if it can be implemented quickly and use the tool every day, most answer that they will probably use it more often every day.

Keywords: Redesign, Standard Paddock, Motorcycle, Quality Function Deployment

INTRODUCTION

The world manufacturing industry, in the era of competitive globalization, is always required to innovate to develop appropriate technology to increase production practically, efficiently, and economically without neglecting standardization of quality and quantity. Competition between automotive industry players in Indonesia can be said to be very tight, one of which is the motorcycle auxiliary industry [1]. Several strategic steps were also taken by existing industry players, ranging from

vigorous promotional activities and product price suppression to the creation of more innovative products [2]. These policies are carried out only for one purpose, namely winning competition, which will have an impact on the high profits received. In this situation, an automotive company will always exist in running its business [3]. Through product development that prioritizes the wishes of the community, it is one of the strengths to get consumers [4].

Motorcycles are products that are also a very much needed means in this day and age to facilitate transportation to various places [5]. Nowadays, especially for sports motorcycles, there is no standard two from the factory because for the reason that the motorbike is designed to corner the road with more slope. If there is a standard two, it will be able to interfere when cornering. Therefore, this standard two replacement tool product is one of the products that has high market potential. One of the two standard replacement tools for motorcycles is the standard paddock / Standard Leverage. This tool is one of the tools used to park sports motorcycles or ordinary motorcycles [6]. This tool is usually used on racing motorcycles when parking in their respective pits. The use of leverage standards itself was initially only used on racing motorcycles because racing motorcycles did not have standards attached to the motorcycle [7]. However, after the times and technology, leverage standards are in great demand by motorcycle lovers for daily activities and modifications. Indeed, using leverage standards has many benefits for motorcycles [8]. One of them makes it easier when washing the motorbike and doing service or modification of the motorbike yourself [9]. Another advantage is that it can make tires durable because tires do not come into direct contact with the floor or asphalt when not in use. Figure 1 of the leverage standard model that is already available in the Indonesian market [10].

Figure 1. Paddock Standard Product Examples

Lifting the rear wheels on a sports motorcycle with an engine capacity of 150cc requires a standard paddock whose holder is flat in shape according to the shape of the swing arm on the motorcycle, which is more suitable to use is the standard leverage model. As for the rear wheel lift of a sports motorcycle, engine capacity above 250cc requires a standard paddock that is different with a "V" shaped retainer because the shape of the swing arm on this motorbike is not flat, so it is given a value or placemat for standard leverage from the factory [11].

The results of interviews with consumers have problems. When used, this product still requires considerable power or at least two people, one to hold the motor and the other to press the

tool. For example, one person can do the motorbike shake and fall to the floor because we focus more on pressing the product. This is because the wheel position of the standard leverage is not flexible or rigid, causing discomfort when using it. In terms of function, the standard leverage is only for certain motorcycles. For example, sports motorcycles with an engine capacity of 150cc cannot be used for sports motorcycles above 250cc or vice versa. This tool is applied only to one wheel or at the rear only, and for the front wheels, a standard model of paddock of different shapes is needed.

Standard paddock products need to be redeveloped for user comfort and suitability [12]. This study aims to design and make standard leverage tools that are in accordance with the wishes and needs of consumers who are functional and able to provide safety, comfort, and convenience for their users and can avoid the risk of work accidents and design more effectively and efficiently for users or consumers themselves [13]. To solve these problems, of course, research related to the design of leverage standards is needed in accordance with the wants and needs of consumers. Where the method used is able to solve the problem but does not eliminate or ignore the other side that becomes bad due to the repair [14].

METHOD

Data Collection Techniques

Data collection is a stage where researchers collect information from consumers through the voice of the customer and find out the bang points or priorities of consumer desires or users of standard paddock products. In addition, data in the form of initial specifications of the paddock standard are also needed for product improvements and the shape of the standard paddock product before product development. Data collection is carried out by direct observation of the location and conducting direct interviews with consumers [15]–[19].

1. Questionnaire Distribution

The distribution of the questionnaire is carried out after the completion of making the question items on the questionnaire. The main focus of the questionnaire distribution is to daily or unique or special motorcycle and motorcycle repair shop users.

2. Questionnaire Testing

Questionnaire testing is carried out using validity and reliability tests. This is done to find out whether the questionnaire can be representative of the population of the study [20][21].

Data Processing Techniques

House of Quality (H.O.Q.) Design

The design of the House of Quality (H.O.Q.) is to translate consumer desires into a technical language, which will later become a reference in product design.

a. Concept Classification Tree

This stage is analyzed to combine the solutions found and offered, which then become the basis for new development. This classification tree is used to divide all possible solutions into groups that facilitate comparison and selection.

b. Concept Screening

This concept aims to narrow the number of concepts quickly and improve existing concepts.

c. Concept Scoring

Concept assessment uses better weighting selection criteria and rating scales. Concept assessment can be skipped if concept screening results in a dominant concept.

Product Concept Design. After obtaining details of product specifications according to consumer needs. Then, the next step is to do product design using Sketchup Software.

d. Prototype Making

Making prototypes can be done after obtaining a product design that suits consumer needs. Prototypes are used to assess whether the product is working as expected. The parts in a prototype

are usually the same in terms of material and geometric shape. This prototype also displays the Operation Process Chart (O.P.C.) of product creation. Operation Process Chart (O.P.C.) is used as a diagram that shows the steps of the work process from material to finished product.

RESULTS

Validity Test

This study tested all statements from the questionnaire with valid results, and this is because all questionnaire statements have an r-count weight that is greater than the r-table weight. Table 1 is the validity result of the questionnaire using SPSS 17.0 software.

Table 1 Validity Test Results

Statement	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Statement 1	36.60	6.243	0.830	0.784
Statement 2	36.53	6.372	0.809	0.788
Statement 3	36.59	6.723	0.618	0.809
Statement 4	36.65	6.500	0.701	0.799
Statement 5	36.57	6.696	0.635	0.807
Statement 6	36.57	7.054	0.481	0.824
Statement 7	36.65	7.515	0.283	0.846
Statement 8	36.68	7.536	0.273	0.847
Statement 9	36.69	7.381	0.333	0.841

Reliability Test

A questionnaire can be considered reliable if Cronbach's alpha value is more significant than the r-table. The following are the results of processing carried out using SPSS 17.0 software to see reliability.

Table 2. Reliability Test Results

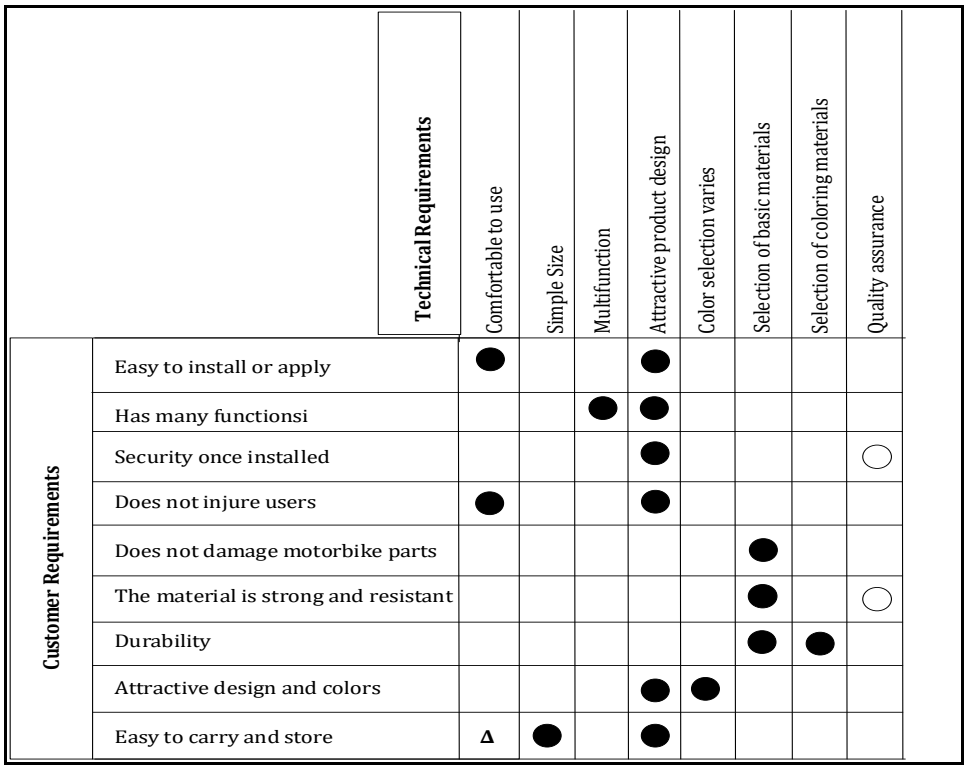
Cronbach's Alpha	N of Items
0.835	9

Table 2 indicates that Cronbach's alpha value obtained is 0.835. This shows that the questionnaire that has been distributed can be said to be reliable because of the value of Croncbach's alpha > r-table.

House of Quality (H.O.Q.)

Relationship Product

The product relationship stage shows the relationship between customer needs that have been collected and technical design elements that are the result of the translation of customer needs. Figure 2 below shows the relationship between customer needs and technical language.

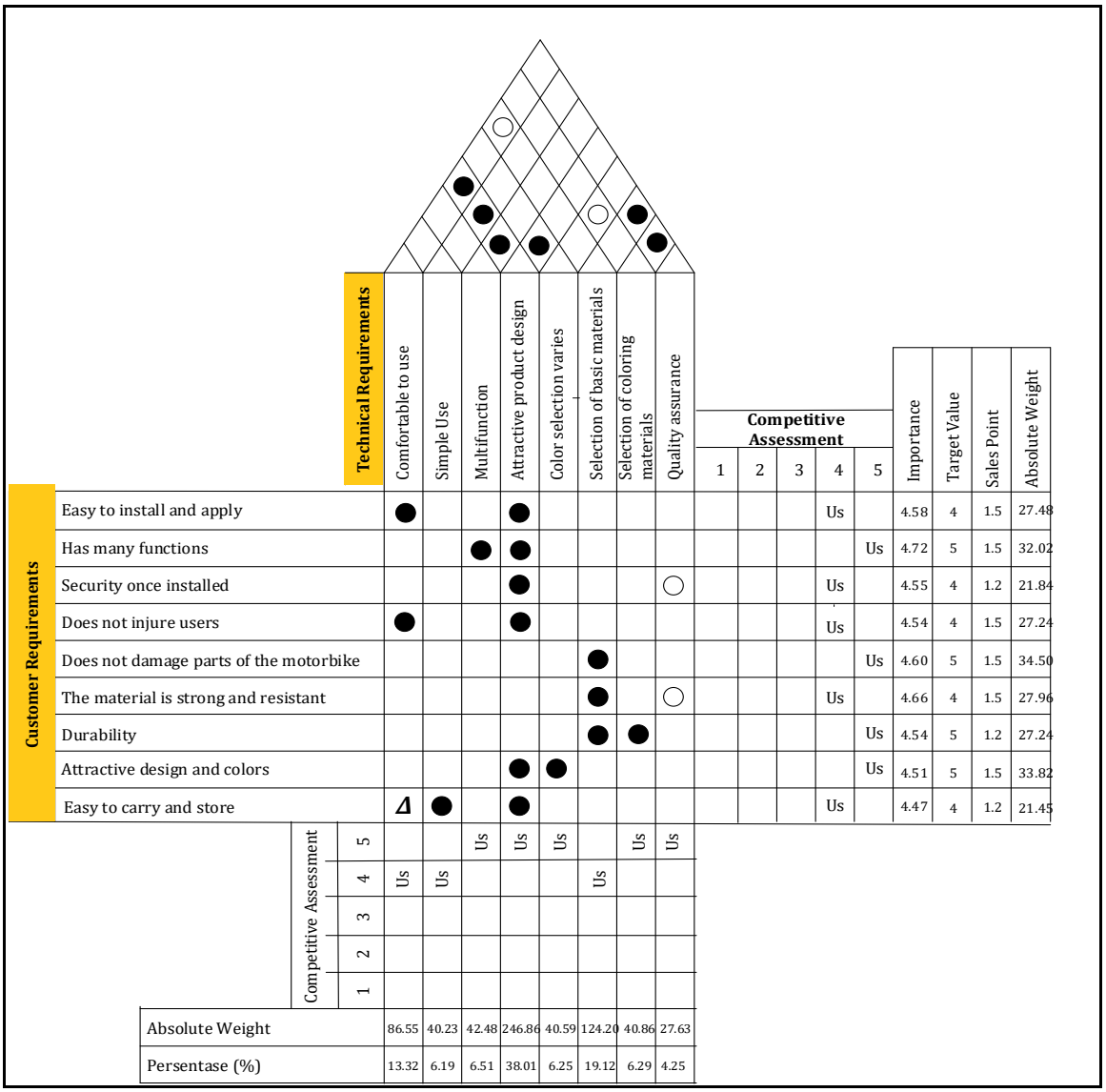


	Technical Requirements	Comfortable to use	Simple Size	Multifunction	Attractive product design	Color selection varies	Selection of basic materials	Selection of coloring materials	Quality assurance
Customer Requirements	Easy to install or apply	●			●				
	Has many functionsi			●	●				
	Security once installed				●				○
	Does not injure users	●			●				
	Does not damage motorbike parts						●		
	The material is strong and resistant						●		○
	Durability						●	●	
	Attractive design and colors				●	●			
	Easy to carry and store	Δ	●		●				

Figure 2. Relationship Product

House of Quality (H.O.Q.) matrix

The house of quality (H.O.Q.) matrix in Figure 4.6 can show the overall results of each processing that has been carried out. In the matrix, there is also a percentage that shows the elements that get the highest customer attention, namely the product design elements.



Customer Requirements	Technical Requirements: Comfortable to use	Simple Use	Multifunction	Attractive product design	Color selection varies	Selection of basic materials	Selection of coloring materials	Quality assurance	Competitive Assessment 1	2	3	4	5	Importance	Target Value	Sales Point	Absolute Weight
Easy to install and apply	●			●								Us		4.58	4	1.5	27.48
Has many functions			●	●									Us	4.72	5	1.5	32.02
Security once installed				●				○				Us		4.55	4	1.2	21.84
Does not injure users	●			●								Us		4.54	4	1.5	27.24
Does not damage parts of the motorbike						●							Us	4.60	5	1.5	34.50
The material is strong and resistant						●		○				Us		4.66	4	1.5	27.96
Durability						●	●						Us	4.54	5	1.2	27.24
Attractive design and colors				●	●								Us	4.51	5	1.5	33.82
Easy to carry and store	Δ	●		●								Us		4.47	4	1.2	21.45
Competitive Assessment 5			Us	Us	Us		Us	Us									
4	Us	Us				Us											
3																	
2																	
1																	
Absolute Weight	86.55	40.23	42.48	246.86	40.59	124.20	40.86	27.63									
Persentase (%)	13.32	6.19	6.51	38.01	6.25	19.12	6.29	4.25									

Figure 3. House of Quality (H.O.Q.) matrix

Product Design

The raw materials used from the Paddock Standard are shown in Table 3.

Table 3. Paddock Standard Product Raw Material

Number	Product Description	Final Product Raw Material
1	Trunk	Galvanized iron pipe
2	Anchoring	Iron plate
3	Wheel coasters	Iron U.N.P.
4	Wheel	Wheel
5	Bolts and nuts	Bolts and nuts
6	Ordinary iron paint	Anti-rust iron paint

Product design is needed as a benchmark in the process of making products, and Product Design is shown in Figure 4 to Figure 7

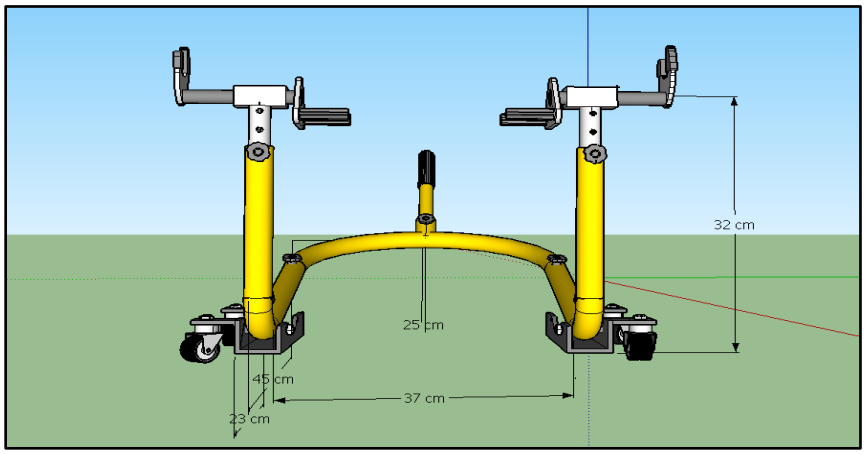


Figure 4. Product Front View Design

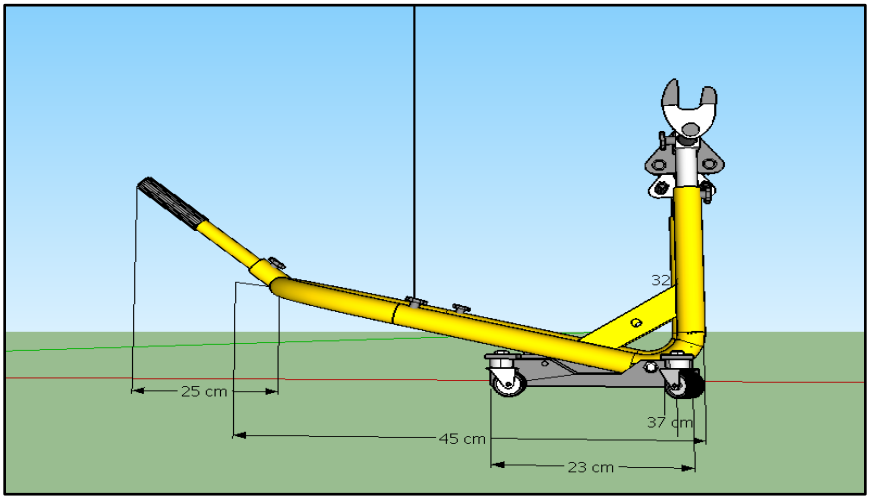


Figure 5. Product Side View Design

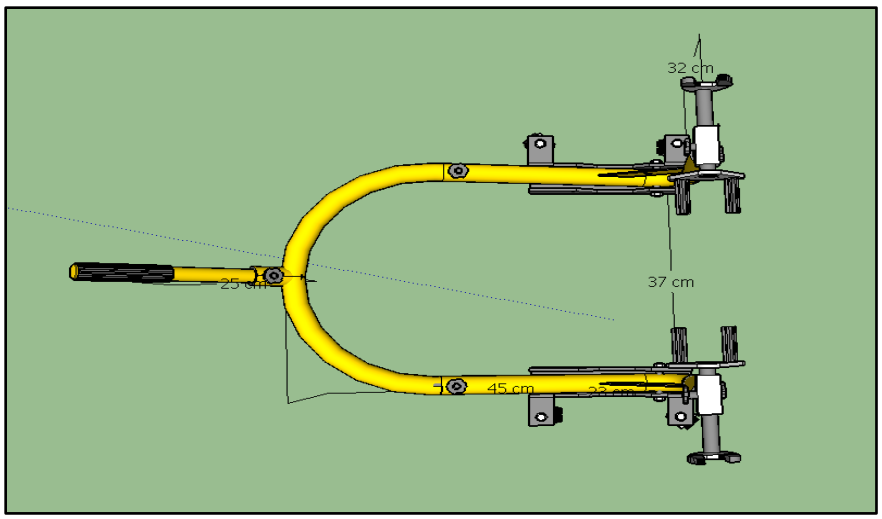


Figure 6. Product Top View Design

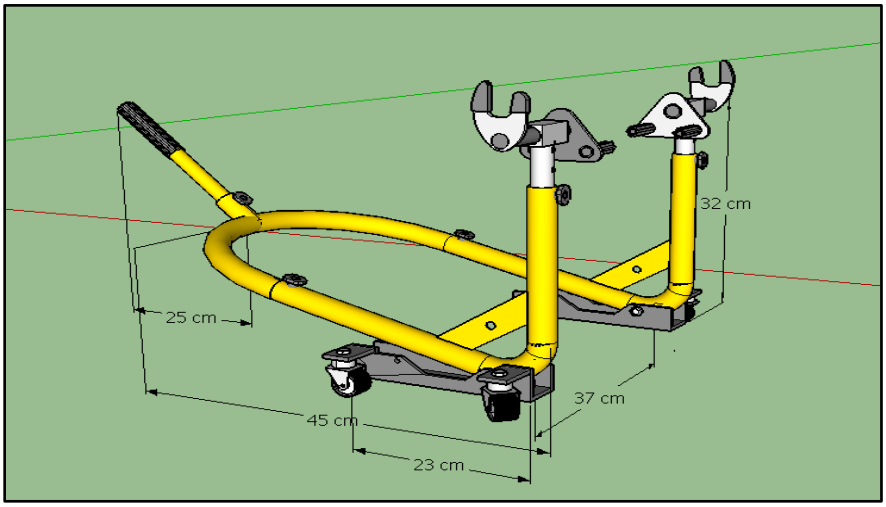
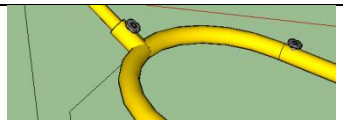
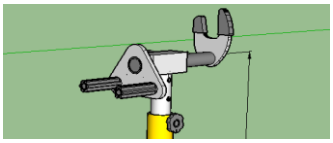
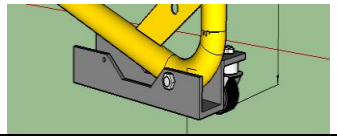
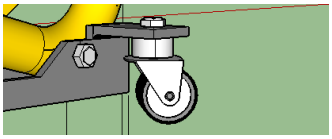
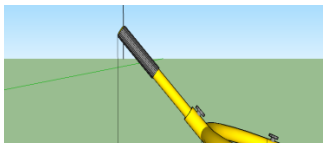
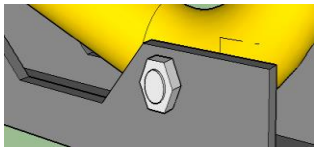


Figure 7. Product Top View Design

Product detail designs that describe in detail the overall product are shown in Table 4.

Table 4. Overall Product Parts

Part	Picture	Description	Sum
Trunk		Strong iron pipe material is used to make the product frame.	1
Anchoring		The iron plate material is sturdy, as a retainer in the motorcycle swing arm.	2
Wheel Coasters		U.N.P. iron material is thick for coasters on wheels	2

Wheel		A wheel that can move in any direction.	4
Handle		Iron pipe material is used to hold the tool while in use.	1
Nut bolts		As a reinforcement or glue each component to the product.	7

Test Finished Product

Respondents really like the idea of product design, with the advantage of being able to make users use this tool more often every day. However, the most dominant drawback lies in the movement of the wheels and the slightly heavy iron pipe material. The average respondent responded that it would be challenging to get users to use this every day. Still, with the current function that makes it easy and flexible, it will make users apply it every day at home or help with workshop activities. Respondents also hope that if the variety of tools for motorcycles is more and more diverse, then one day, it can help more motorcycle users. The result of the finished product is shown in Figure 8.

Figure 8. Paddock Standard Finished Product Yield

DISCUSSION

There are 2 product design concepts, namely concept A and concept B. Each concept has its advantages and disadvantages, which will later be compared so that the final product design is selected. The advantage of concept A is that the retaining part can be used and functions for all types of swing arms on motorbikes and can be used for both the front and rear wheels. This part of the retainer is more flexible by being able to adjust the low or high position of the retainer, and the shape is easier to dismantle and install. The drawback is that the size is quite large, and it cannot or is still complicated to move [1]. Concept B has the advantage of a smaller and simpler design. The stem for the handle is designed to be installed and dismantled. When this product has been applied, but you

want to move the motorbike from its original parking position, you don't have to remove it first because the wheels are designed to be more flexible. The disadvantage of concept B is that the retaining part is used and functions for the swing arm of specific motorbikes and can only be used for the rear wheel. Research from [22] has research results obtained using a Static Anthropometric approach in its design so that using Paddock Standards feels comfortable for the safety of motorbike workers/mechanics. This can be seen from the four body dimensions: Shoulder Width, Hand Grip Circumference, Knee Height, and Knee to Waist, providing the correct measurements for the product design so that 95% of the total population can use Paddock Standard products, especially on automatic motorbikes, and the Paddock Standard selling price is IDR 510,000/product. The product design for this motorbike, from now on referred to as the motorbike wheel support, is an integration of a paddock product which has the function of lifting the vehicle until the wheels are raised, which allows it to roll. [23] The design and prototype were made simultaneously to anticipate motorbike tire leaks, both front and rear. The components of this emergency support use various materials, namely ASTM-A36 steel for the front and rear supports, rubber for the wheels, ASTM-A36 steel for the axle and stainless steel for the bolts and nuts. The design of this emergency support is designed to adapt to the shape of a motorbike, especially an automatic motorbike, and is designed using inventor software.

CONCLUSION

The criteria desired by users or consumers from these auxiliary products are those that are easy to install or apply, multifunctional, safe when installed, do not injure users, do not damage parts of the motorcycle, have solid and resistant materials, attractive designs and colours, durability and easy to carry and store. The correct final design is a product that is comfortable to use with the right size and precision, not a slippery and smooth surface. Aids have more functions than ever and are easy to disassemble and reassemble. The product design of this tool is a simple shape so that it is not difficult to store, bright in color so, attractive and lightweight. The selection of primary materials from the product must be solid and durable for long-term use, and quality assurance can be obtained by using components that meet Indonesian national standards.

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