Design Of Masin Maker Based On Work Posture Analysis, Kansei Engineering And Value Engineering

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Abstract

Masin is a kind of sambal typical of Sumbawa Indonesia in the form of fermented rebon shrimp with the addition of salt and acid. A traditional Masin making is still done manually with the wrong work posture and is done repeatedly and risks causing pain to workers. This study aimed to evaluate the Masin maker's working posture using REBA and design a Masin maker consisting of a fermenter and a Masin work table for grinding and mixing using Kansei engineering and value engineering. The Masin maker design is based on the wishes and needs of the user while considering the added value of the tool and the costs incurred. From the 20 pairs of Kansei words created, 15 pairs of Kansei words were obtained representing the users' wishes and needs, which were then used as information phase on the value engineering method. The results of Reba show a score of 9 which means that the work is a high risk, so improvements need to be made. From Reba and Kansei's engineering results, a Masin maker was designed using value engineering to optimize Masin fermentation and a work table that can improve the user's work posture. The research showed that the Masin maker is luxurious, colorful, beautiful, elegant, modern, thick, heavy, easy to clean, large capacity, safe, comfortable, dynamic, uncomplicated, robust and cheap. This research is expected to provide a Masin maker that can minimize the risk of work-related illness and optimize the making of Masin.

Keywords
Masin, Kansei Engineering, Value Engineering, Work Posture, REBA

1. Introduction

Micro, Small and Medium Enterprises (MSMEs) are productive businesses to be developed in Indonesia to support macro and micro-economic development. Then every MSME needs to make improvements. One of the MSMEs that need to improve is MSME Masin. Masin is a kind of sambal, a product of fermented rebon shrimp with the addition of chili, salt and acid, which the people often make in Sumbawa, West Nusa Tenggara (Jumisayati, 2020). One of the Masin SMEs is Masin SMEs, Mr. Sayhminan. Based on the observations that have been made, masin workers grind chilies in standing and walking positions. This can raise the risk of work-related illness. According to Joanda and Suhardi (2017), poor work posture can cause musculoskeletal disorders in workers. Workers who experience serious work-related illnesses can have lost working days, reduced work productivity and reduced work ability (Umami et al. 2014; Pramono 2020; and Hanif 2020).

In addition, the place for grinding chilies and mixing dough is not located in the same place as the storage room for raw materials and fermentation, thus requiring workers to move places. Thereby extending the material handling distance. According to Andriantantri (2008), the long total material handling distance ultimately causes the total material handling cost expensive. Based on these problems, it is necessary to conduct further studies to minimize the risk of occupational illness in the masin manufacturing process and to minimize material handling costs.

In this study, the design of a milling work table was carried out so that it could improve work posture and the distance of material handling displacement in the Masin process. This research was conducted using an ergonomic approach in the form of work posture analysis and anthropometry, as well as Kansei engineering and value engineering methods. Work posture analysis was performed using the REBA (Rapid Entire Body Assessment) method.

1.1 Objectives

This research aims to analyze the initial and final work postures of the Masin MSME workers belonging to Mr. Syahminan using REBA and Design the Masin work table using Kansei engineering and value engineering.

2. Literature Review

Masin is one of Sumbawa's special foods that resembles a chili sauce made from small shrimp (rebon shrimp) mixed with tamarind and salt. Several studies have been conducted on Masin fermentation, one of which is the Effect of Fermentation Time on the Quality of Rebon Shrimp (Mysist relicta) which results in the best fermentation time of 5 days affecting organoleptic color and texture and the levels contained in Masin (Ramzi, 2016). However, no research has been conducted on optimizing the process of making Masin. So it is necessary to research to improve the optimization of the process of making Masin. In this study, it was found that there were problems with worker posture and material handling processes, so a work table was designed to minimize work postures and shorten material handling distances.

The design of the Masin work table is carried out using Kansei engineering and value engineering. Kansei Engineering, also called Kansei Ergonomics, is a method from Japan that was discovered more than 30 years ago, which is a method that studies the way/mindset of consumers to be applied in making a new product. Nagamachi first introduced Kansei Engineering in the 1970s. Nagamachi did not call it Kansei Engineering when he introduced the concept but called it Emotional Engineering. The design of Kansei Engineering is based on research on the concept design of brassiere products which results in the theme of practical purpose products, namely, appropriate, practical, protected, enjoyable, healthy, simple, breathable, and safe. And the theme of the model is fashionable, colorful, feminine, unique and powerful) (Wahyuning et al., 2011).

Value engineering is a creative and planned approach to identifying and reducing unnecessary costs on products, projects or otherwise (Rompas). The design of value engineering is based on research on the design of grinding and thinning equipment for Karak nasi dough which results in a value calculation by comparing the performance and cost of using the tool in the design of the grinding and thinning tool currently compared to the previous increase of 61% (Rahmadani, 2017).

3. Methods

This research was conducted in 4 steps.

Step 1: Observation process. At this stage, observations were made on the problems that occurred in Masin SMEs. These problems will form the basis for this research.

Step 2: Analysis of Work Posture: assessment of the work posture of Masin workers using the REBA method.

Step 3: Kansei Engineering: this method is used to get a product design that follows the wishes and needs of consumers.

Step 4: Value Engineering: this method is used to minimize costs and increase the value of the work table design.

3.1 Work Posture Analysis

At this stage, a work posture analysis is carried out using the REBA method to determine the final score from the REBA table based on an assessment of work posture. REBA analysis is carried out by calculating the work posture angle using Autodesk Inventor 2017 software, then analyzing the work posture angle into the REBA Worksheet consisting of columns A and B. After that, the final value of the REBA analysis is obtained.

3.2 Kansei Engineering

At this stage, Kansei engineering analysis is carried out to determine the wishes of the Masin makers by distributing questionnaires. This questionnaire contains the wishes that Masin makers expect to help facilitate the manufacture of Masin.

Step 1: Define Strategy
At this stage, the number of Kansei words needed and the number of participants involved in filling out the questionnaire is determined. In this study, 40 participants made Masin and people with plans to produce Masin. The distribution of this questionnaire is to find out the wishes of potential users of the tool related to the Masin maker tool that will be designed.

Step 2: Define Kansei Words
In this study, Kansei words were obtained from the results of the journal literature, which were then discussed through interviews with potential users to find out what the respondents felt, which then became the input for the questionnaire.

Step 3: Compile the Semantic Differential (S.D.) Scale for Kansei Words
Arrange Kansei Words into a Semantic Differential (S.D.) scale structure. The SD scale was used to facilitate participants in filling out the questionnaire.

Step 4: Validity and Reliability Test
Validity and reliability in this study using one method. This measurement will use statistical software, namely SPSS. This study uses a 0.05 level of significance and degrees of freedom (n-2).

Step 5: Factor Analysis
Factor analysis used to structure Kansei words is a statistical approach to reduce the number of variables into smaller groups. Factor analysis studies the interrelationships between variables to obtain a new set of variables in terms of their number being less than the number of previous variables. This new group of variables still reflects the characteristics of the data from the previous group of variables. The factor analysis used is:

- KMO score test (Kaiser-Meyer-Olkin) and bartlett. test
- Anti Image Matrix Analysis

Step 6: Define Item Grouping
The grouping of items is based on the factor analysis results carried out in the previous stage. Grouping is based on the extraction process results, which is the core of factor analysis. According to the respondent group, Kansei's words will be grouped into several factors.

3.3 Value Engineering

The stages of value engineering are as follows:

Step 1: Information Stage
The supporting information used in developing the tool will be presented at this stage.

Step 2: Functional Analysis Stage
In this phase, the FAST (Function Analysis System Technique) diagram is formed, and the relationship between the functions of the Masin work table is formed. The formation of the FAST diagram uses the results obtained from the information phase to assist in determining the highest functions, basic functions, and other interrelated functions of the developed cutting tool concept. The results of establishing the relationship between functions in the Masin work table are used to clearly describe how the Masin work table works so that it will be easier to carry out development at the next stage. At this stage, a proposed FAST diagram will also be formed, improving the relationship between functions of the work table Masin development results.

Step 3: Creative Stage
In the creative phase, an alternative development design concept will be formed based on the root problem and the proposed FAST diagram described in the previous phase. Then calculate the cost of component materials for each of the proposed alternatives. The result of calculating the cost of this component is used in calculating the value that will be carried out in the next stage.

Step 4: Evaluation Stage
In this phase, the best alternative produced in the previous phase will be assessed and selected. The initial step in this phase is to calculate the performance value of each alternative, followed by calculating the value and selecting the best alternative.

Step 5: Design and Development Stage
This stage contains an overview of the overall cutting tool design based on the selected product concept alternatives. This stage includes a complete specification of the proposed Masin work table with Value engineering. Because significant changes occurred in the Masin work table frame, the Masin work table specifications are explained starting from the main frame shape, main frame material, frame dimensions and other parts of the Masin work table. The detailed design was made using the Inventor 2017 software.

Step 6: Recommendation Stage
At this stage, material handling costs and proposed REBA are evaluated. This evaluation aims to validate whether the appropriately designed tools reduce the risk of work postures and minimize material handling distances.

4. Results and Discussion

Results and Discussion in this study, there are three stages.

4.1 Work Posture Analysis

Incorrect body position when welding can cause work-related pain. Here is the working posture of the Masin maker:

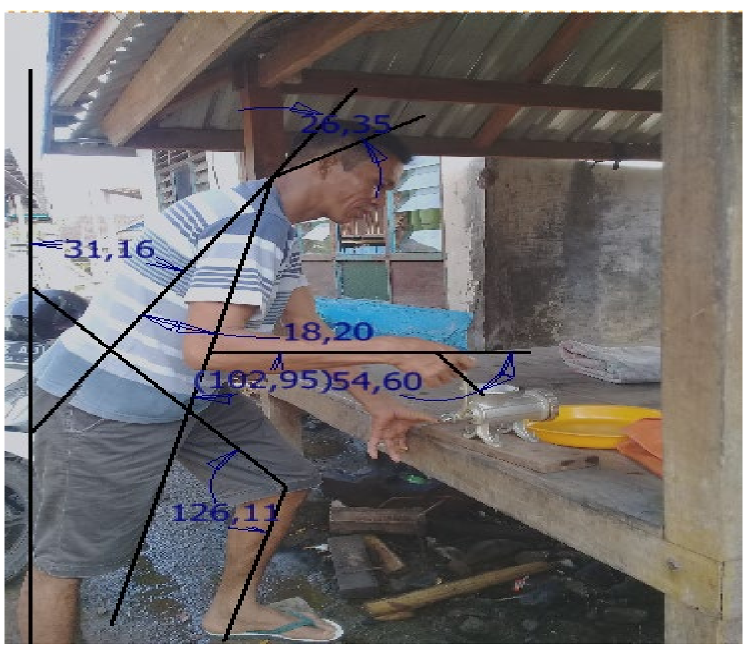

Figure 1. Masin Worker Work Posture

Based on Figure 1, it can be seen that workers grind chilies in a bent position. After calculating the angle in the posture, the results obtained are the back angle of 31.16 °, the angle of the neck of 26.35°, the angle of the upper arm is 18.20 °, the angle of the forearm is 102.95o, the angle of the wrist is 54, 60° and the angle of the foot is 126.11°. The results of the angle calculation are then processed into the REBA worksheet calculation. The results of the REBA worksheet calculation can be seen in the following figure.

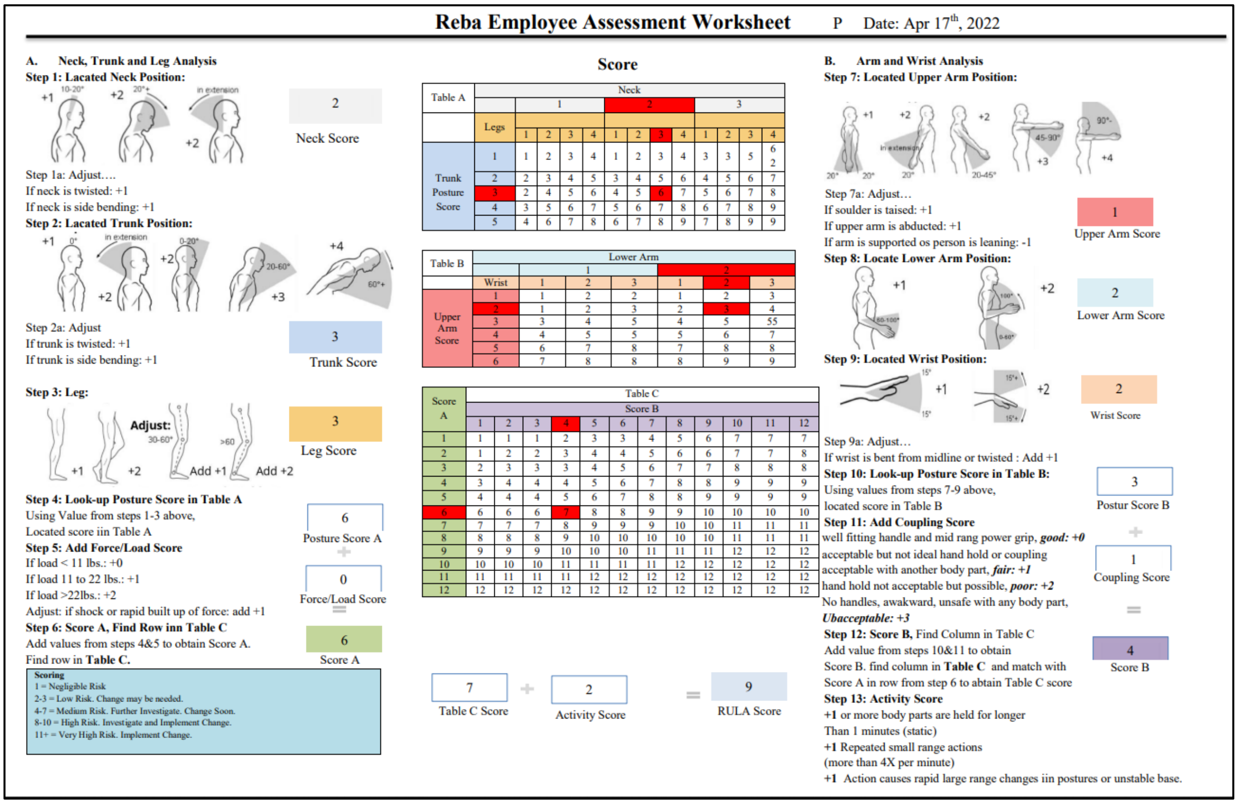

Figure 2. REBA Assessment Worksheet

Based on the Figure 2, it can be seen that the REBA calculation results for workers in chili milling activities is 9. The score is included in the high-risk level, so investigations and improvements need to be carried out.

4.2 Kansei Engineering

Step 1: Define Strategy

This study used 40 participants. Participants in the Kansei questionnaire are Masin makers and people who wish to make Masin. The Kansei questionnaire was conducted to determine the wishes of potential users of the tool related to the Masin-making tool to be designed.

Step 2: Define Kansei Words

The selected Kansei words were 20 Kansei words, then used as a Kansei questionnaire.

Step 3: Compile the Semantic Differential (S.D.) Scale for Kansei Words

Kansei Words that have been determined and represent the characteristics of the work table are structured into an S.D. scale using five scoring scores, a value of 5 indicating the highest positive value and a value of 1 indicating the lowest or negative value. This was chosen because the scale is sufficient to represent and does not burden respondents to choose options on the questionnaire, which can reduce the accuracy of the data (Nagamachi, 2011).

Step 4: Validity and Reliability Test

The data is declared valid if the Kansei word in the questionnaire can describe the product image.

Based on the validation test, it was found that there were seven invalid variables. This is because the value of r count < r table. These variables are easy to use, beautiful, attractive, easy to clean, safe, modern, and thick materials. Then nine variables are declared valid. The variables are a colorful, comfortable, dynamic, expensive, unique design, strong, plain, durable and large capacity.

Based on the reliability test, it was found that the r alpha value of all items was > 0.4026. Then the data is declared reliable because r alpha > r Table 1.

Step 5: Factor Analysis

The data input into the factor analysis is Kansei words that have passed the validity and reliability test. The results of the correlation matrix test can be seen in the following Table 1.

Table 1 Iteration of the KMO and Bartlett Tests

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.592
Bartlett's Test of Sphericity	Approx. Chi-Square	106.947
	df	36
	Sig.	.000

The value of the MSA variable from the anti-image correlation in the Anti-Image Matrix process can be seen in the following Table 2.

Table 2 iteration Result of Anti Image Matrix (MSA Value)

No	Kansei *Word*	R table	Total Correlation of Correlated Items	Information
1	Colored	0,3120	0,501	Valid
2	Comfortable	0,3120	0,515	Valid
3	Dynamic	0,3120	0,600	Valid
4	Expensive	0,3120	0,691	Valid
5	Unique Design	0,3120	0,752	Valid
6	Strong	0,3120	0,589	Valid
7	Plain	0,3120	0,678	Valid
8	Durable	0,3120	0,639	Valid
9	Large Capacity	0,3120	0,546	Valid

Based on the Table 2, the MSA value for each variable has been met because all variables have a value > 0.5.
The extraction process is the essence of factor analysis, which is to extract a set of existing variables so that one or more factors are formed. The results of the extraction process from 9 Kansei words that have passed the validity and reliability test can be seen in the following Table 3.

Table 3 Extraction Process Results

Communalities		
	Initial	**Extraction**
Colored	1.000	.930
Comfortable	1.000	.851
Dynamic	1.000	.794
Expensive	1.000	.570
Unique Design	1.000	.451
Strong	1.000	.703
Plain	1.000	.562
Durable	1.000	.401
Large Capacity	1.000	.493
Extraction Method: Principal Component Analysis.		

Based on Table 3, 9 variables are considered capable of explaining the factors. Furthermore, three variables are not able to explain the factor because it is known that the extraction value is less than 0.50. The variables are a unique design, durability and large capacity.

Step 6: Define Item Grouping
The Table of Total Variance Explained shows the value of each variable being analyzed. In this study, there were 13 components analyzed. The results of the analysis of Variance explained can be seen in Table 4.

Table 4 Total *Variance Explained*

Total Variance Explained									
Component	Initial Eigen*value*s			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.845	31.606	31.606	2.845	31.606	31.606	2.845	31.606	31.606
2	1.748	19.419	51.025	1.748	19.419	51.025	1.748	19.419	51.025
3	1.163	12.926	63.951	1.163	12.926	63.951	1.163	12.926	63.951
4	.970	10.781	74.732						
5	.782	8.690	83.422						
6	.587	6.526	89.948						
7	.408	4.528	94.476						
8	.376	4.181	98.657						
9	.121	1.343	100.000						
Extraction Method: Principal Component Analysis.									

Based on the Table 4, it is known that the number of factors formed is three factors. This is because the eigenvalues below one are not used in calculating the number of factors formed.

The rotation process is a continuation of the extraction process. A rotation process is used to eliminate the doubts that arise when determining which variable will be included in the group of factors. The determination of these factors can be seen in the Rotated Component Matrix table. The numbers in this table are called factor loadings. The largest variable of the factor loadings value shows the strongest correlation between these variables and the formed factors.

Based on the factor analysis results, three components of the matrix (factors) indicate a grouping with a significant correlation. (Table 5)

Table 5 Factor Analysis Grouping Results

Faktor		
1	**2**	**3**
Comfortable	Colored	Dynamic
Strong		Expensive
Plain		

4.3 Value Engineering
Value engineering has six stages.

Step 1: Information Stage
The information used is the result of Kansei engineering and work posture analysis.

Step 2: Functional Analysis Stage
The function analysis phase uses the Function Analysis System Technique (FAST) diagram. (Figure 3)

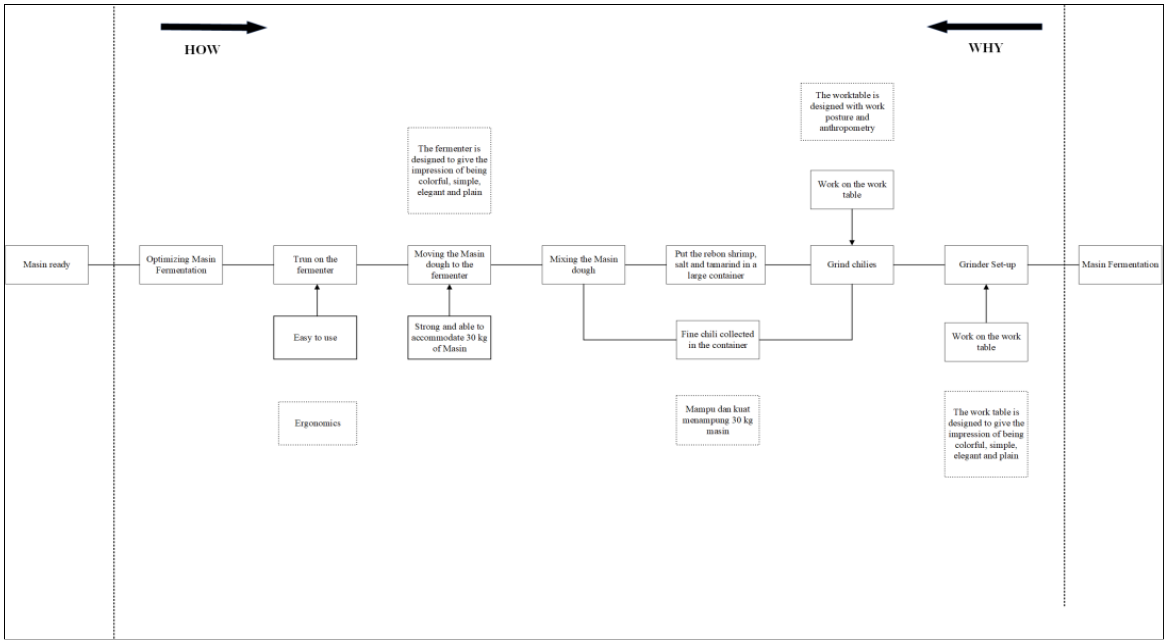

Figure 3 FAST Diagram

Step 3: Creative Stage
Creative development is to provide suggestions for each factor of the three factors obtained from factor analysis. (Table 6)

Table 6 Creative Stage Suggestions

<table>
<tr><th>No</th><th>Kansei Word Indicator</th><th>Evaluation</th><th>Suggestion</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Strong</td><td>Evaluation of Alternative Materials</td><td>Multiplex with a thickness of 12 mm and 15 mm. Blockboard thickness is 12 mm and 15 mm.</td></tr>
<tr><td>Evaluation of Framework Alternatives</td><td>Hollow iron measuring 30 mm x 30 mm with a thickness of 0.9 mm and 1.2 mm</td></tr>
<tr><td>2</td><td>Colored</td><td>Color Selection Evaluation</td><td>Questionnaire Results</td></tr>
<tr><td>3</td><td>Dynamic</td><td>Adjuster Selection Evaluation</td><td>Adjuster for iron and rubber</td></tr>
<tr><td>4</td><td>Comfortable</td><td colspan="2">Created with a work table design based on anthropometry</td></tr>
<tr><td>5</td><td>Plain</td><td colspan="2">Created by not giving a pattern or image to the work table</td></tr>
<tr><td>6</td><td>Not expensive</td><td colspan="2">Created based on the concept of value engineering that considers costs in every evaluation calculation</td></tr>
</table>

Step 4: Evaluation Stage
Based on the cost and performance value, the value is calculated, and the chosen alternative for the frame is hollow steel with a thickness of 0.9 mm. The selected alternative wood material is multiplex with a thickness of 12 mm. The selected adjuster is made of rubber. Moreover, the color chosen is yellow.

Step 5: Design and Development Stage
The design results using the Inventor 2017 software can be seen in the following image. (Figure 4)

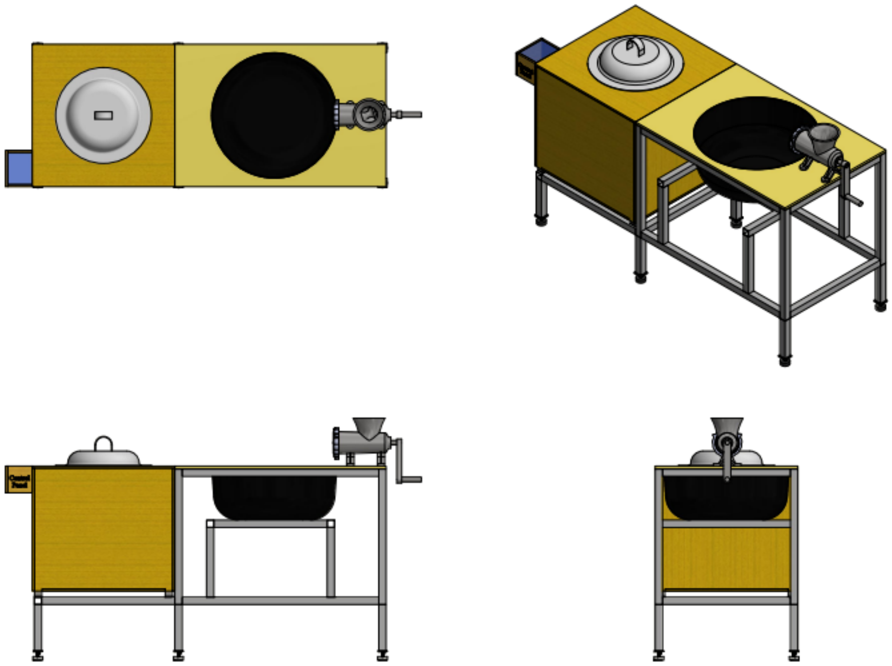

Figure 4 Masin Maker Design

Step 6: Recommendation Stage
At the recommendation stage, testing is carried out on the designs made at the development stage. Testing is in the form of testing material handling calculations and final REBA analysis.

Material Handling Test

The costs of material handling (OMH) will be influenced by the type of equipment used, the cost of making one Masin, and the distance traveled in one masin making. According to the Masin seller, the cost of making Masin once is Rp. 100,000. The distance from the storage place to the production site is 15 meters, with a total displacement of 6 times the Masin maker. Then the total distance of the displacement once the manufacture of Masin is 90 meters, so the amount of material handling costs per meter is:

OMH permeter=cost/d
OMH per meter=Rp100,000/90meter
OMH per meter=Rp1.111,1/meter

The total displacement distance after the work table is designed 3 meters due to the presence of a work table, so Masin makers do not need to find an easy place to do the milling outside the house. With a work table, all Masin-making activities, namely chili grinding, mixing and storage of Masin, can be carried out at the work table. The following is the calculation of material handling costs after the work table is designed:

Proposed OMH=OMH per meter x total displacement distance
OMH proposal=Rp1,111.1 x 3 meters
OMH proposal=Rp 3,333.3

Final REBA analysis

Based on the angle has been described using Autodesk Inventor 2017 software and produces a neck angle of 16.86°, an upper arm angle of 36.3°, a forearm angle of 19.6°, a palm angle of 61.8°, and a leg angle. 104.2°. The next step is to analyze the work posture using the REBA worksheet.

Based on the results of the final REBA analysis, the analysis using the REBA worksheet showed that the table c and activity score each got 2 and 1, then added 3 with a score of 3. Score 3 entered into action level 2, namely low risk, which shows that the work posture of the Masin maker has changed from high risk to low risk.

6. Conclusion

The initial work posture of Masin workers at Masin MSME, Mr. Syahminan, using the REBA method, obtained a REBA score of 9. A score of 9 belongs to action level 4, namely High risk or High risk, which indicates that this work posture requires further investigation and immediate implementation of improved work posture. The final working posture of Masin workers at MSME Masin, Mr. Syahminan, using the REBA method, obtained a score of 3. The REBA 3 score entered into action level 2, namely low risk or low risk, which indicates that the work posture of Masin makers has changed from high risk to low risk.

The work table design based on the results of the Kansei Engineering questionnaire is to get three factors or groups. Namely, Group one with comfortable, strong and plain design criteria. Group two with a colorful design. And group three with a dynamic and inexpensive design. Moreover, the design of the work table uses value engineering. Namely, the material chosen is a framework using 30 x 30 mm hollow iron with a thickness of 0.9 mm and multiplex with a thickness of 1.2 mm. For a dynamic design, use a rubber table adjuster. Not expensive, realized by evaluating the value that considers the cost of each proposal. The color chosen is yellow. The design is comfortable because the table design is based on the anthropometry of the average Indonesian.

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Biography

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