Designing Ergonomic Tray Dryer To Increase Productivity In Tapioca Production Using Ergonomic Function Deployment Method

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Abstract

Cassava (Manihot Esculenta) is a food plant commodity that is widely used as a source of carbohydrates and food raw materials. Cassava has quite a lot of uses, including it can be used for snacks and raw materials for making foods such as tapioca flour. One of the SMEs that produce tapioca flour is ABC SMEs. The processes that take a long time in the process of making tapioca flour is drying process, which is 8 hours 57 minutes. In addition, the drying process is still manual using sunlight. This tapioca flour drying process is carried out repeatedly so that the operator must continue to carry out activities in an uncomfortable working position. This work position can cause workers to feel sore and allow for injury to workers. This injury can be in the form of musculoskeletal injuries, namely Musculoskeletal Disorders (MSDs) in the operator. Therefore, a proposed design tool was made to overcome these problems. The design of the tool is carried out using the EFD (Ergonomic Function Deployment) approach to produce products that are ergonomic and in accordance with the needs of the operator. Tools that have been designed produce ergonomic tools with dimensions of 225 × 130 × 190 cm with Stainless steel AISI 304 materials, with the results of the REBA score at posture 1 being 4 and the RULA score at posture 2 being 3. The drying process using the proposed tool has a faster processing time of 3 hours 8 minutes to produce 180 kg of tapioca flour, compared to the existing tool which is 8 hours 57 minutes and has an increase in productivity of 25 kg per labor - hour. This can prove that the drying process will experience an increase in productivity after using the selected proposed tools.

Keywords: Ergonomics, EFD, REBA, RULA, Musculoskeletal Disorders

I. INTRODUCTION

Cassava (Manihot Esculenta) is a food plant that is widely used as a source of carbohydrates and food raw materials. Cassava contains a lot of carbohydrates as well as the best calorie producer compared to other plants [1]. According to the Central Bureau Statistics of Indonesia, the amount of cassava production in Indonesia from 2017 to 2018 increased by 1.51%, with the amount of cassava production in 2017 amounting to 19,053,748 tonnes and in 2018 as much as 19,341,233 tonnes [2]. Cassava has quite a lot of uses, including it can be used for snacks and raw materials for making foods such as tapioca flour. One of the SMEs that produce tapioca flour is ABC SMEs. One of the processes that take a long time in the process of making tapioca flour is the starch drying process, which is 480 minutes or 8 hours. In addition, the drying process is still manual using sunlight. Drying process of tapioca flour greatly affects the level of productivity in the process of making tapioca flour.

When operator is lifting a container made of bamboo to the drying area. This operation is carried out repeatedly so that an operator must carry a load of bamboo containers and also wet tapioca flour of approximately 6 kg in this position. Because the operator does this repeatedly, it can cause complaints or disturbances to the parts of the musculoskeletal system which include joints or muscles due to the body is not ergonomic. This position can cause complaints that are commonly called Musculoskeletal Disorder (MSDs) [3]. Therefore, further analysis is carried out on the operator's posture when carrying out the process using several methods that can prove the existence of an error in the operator's posture.

After calculating the RULA (Rapid Upper Limb Assessment) value, which is 7, this value is at level 4 so that investigations must be carried out and changes must be implemented immediately. Further analysis was carried out on the process of laying the bamboo container. This posture uses the REBA (Rapid Entire Body Assessment) value calculation method because the posture used at this stage refers to all parts of the body. After the calculation is done, the REBA value is 11, which means it is high risk and needs to be corrected.

ABC SMEs can produce 250 kg of dry tapioca flour in one day in the dry season, so that in 1-week ABC SMEs can produce as much as 1750 kg of tapioca flour. Under these circumstances, ABC SMEs can meet the demand for cracker producers to send up to 1750 kg of tapioca flour in 1 week. From the results of this production for one-week ABC SMEs gets an income of Rp.7.875.000, -. However, when the season changes from dry to the rainy season, the total production during 1 week of tapioca flour decreases by 43% of the total production during the dry season because the drying process takes 2-3 days in the rainy season. Therefore, the drying process is a very influential process on the production of tapioca flour, if the drying process cannot be done, the productivity in the tapioca flour production process will decrease and cause loss of money and energy to ABC SMEs.

In previous research, similar product development is also carried out using the Quality Function Deployment (QFD) method. A dryer with an oven blower concept can reduce processing time in the tapioca flour drying process, which initially requires 6 hours of drying time using a blower oven type dryer which only takes 45 minutes in the drying process. However, the use of the QFD method is deemed inappropriate because the product design is only based on a need statement and does not pay attention to the ergonomics of the product. In fact, if the product design pays attention to the ergonomic side, it will make the product can be used safely and comfortably by the user. Those, in this research the design of this tray dryer uses an Ergonomic Function Deployment (EFD) method. This method can be used to develop ergonomic concepts based on the principles of ENASE (Effective, Comfortable, Safe, Healthy, Efficient) so that it can produce more ergonomic tools and can also increase productivity in the process of making tapioca flour at ABC SMEs. The purpose of this research is to design ergonomic tray dryer to prevent physical injury to the operator and increase productivity in ABC SMEs.

II. LITERATURE RIVIEW

a. Ergonomics

Ergonomics can be defined as the study of human aspects in the work environment that can be reviewed in terms of anatomy, physiology, psychology, engineering, management, and design. Ergonomics is also related to optimization, efficiency, health, safety, and human comfort at work, home, and recreation areas [4]. The purpose of ergonomics is to create a harmonious combination between the work equipment sub-system with humans as workers [5].

b. Anthropometry

Anthropometric measurements are carried out to align the work posture with the equipment used. This measurement aims to reduce the risk of musculoskeletal disorder (MSDs) complaints due to equipment mismatch with work posture [6].

c. Productivity

Productivity measurement through the output per input ratio approach is the simplest measurement and is capable of producing several measures of productivity, one of which is single-factor productivity. Single-factor productivity is indicated as the ratio of the input (one resource) to the outputs (good and service produce) [7].

d. Rapid Entire Body Assessment (REBA)

Rapid Entire Body Assessment (REBA) is a method developed in the field of ergonomics and can be used to quickly assess an operator's work position or posture of the neck, back, arms, wrists, and feet. In addition, this method is also influenced by the coupling factor, external loads that are supported by the body, and the activities of the workers. Assessment by using. REBA does not take a long time to complete and do a general scoring on a list of activities which indicates the need to reduce the risk caused by the operator's work posture [8].

e. Rapid Upper Limb Assessment (RULA)

RULA (Rapid Upper Limb Assessment) is a survey method developed for ergonomic investigations of the workplace related to upper limb disorders. This

method does not require any special equipment to determine the posture of the neck, back, and upper limbs as long as using the function of the muscles, and external loading affecting the body [9].

f. Ergonomic Function Deployment

Ergonomic Function Deployment (EFD) is a method to make it easier during the design process, decision-making, and recorded in the form of matrices so that it can be reviewed and modified in the future so that you can find out whether the design results are ergonomic or not [10].

III. METHOD

This research is focused on producing the final concept of a tool in the tapioca flour drying process. The drying process on the research object is not good because the REBA and RULA scores are high and require changes and the results from the productivity level are considered not optimal. In designing the proposed tool, supporting data are needed such as need statements, anthropometric data, EASNE principles, and using the Ergonomic Function Deployment (EFD) method.

IV. RESULTS AND DISCUSSION

a. REBA & RULA Score Calculation of Existing Work Posture

In this section, observations are made on both operator postures, namely the operator's squatting posture when taking the bamboo container and also the operator's standing posture when placing the bamboo container in the drying area. Observations on both operator postures used the REBA and RULA methods. To get the existing REBA and RULA scores, an existing operator's work posture is needed. The first step is to observe the operator's working posture and look for awkward postures in the tapioca flour drying activity, then document the operator's working posture from the side so that it can be seen clearly because of the operator's body angle measurement will be carried out.

Figure 1 Angle Measurement on Operator Posture

The calculation of the REBA score for the existing working posture is carried out based on the results of data collection of operator posture images that have been given lines and angles on the operator's posture. The analysis of the existing work posture using the REBA method on the lifting process of bamboo containers. After calculating the operator's posture, it can be seen that the REBA value obtained is 11, which means that the operator's posture when lifting the bamboo container has a high risk so it needs to be investigated and made changes to the posture.

The calculation of the RULA score for the existing working posture is carried out based on the results of data collection of operator posture images that have been given lines and angles on the operator's posture. The analysis of the existing work posture using the RULA method was first carried out on the laying process of bamboo containers. After calculating the operator's posture, it can be seen that the RULA value obtained is 7, which means that the operator's posture when lifting the bamboo container needs to be investigated and implement changes to the posture.

b. Customer Statement

Customer statement data were obtained from interviews and observations of operators of the tapioca flour drying process to find out what obstacles and complaints were experienced by operators and their needs during the work. The following is a list of questions used to get a customer statement

Table 1 List of Interview's Questions

No.	Question
1.	What problems do you feel when you do the tapioca flour drying process?
2.	How do you handle this problem?
3.	Do you have any suggestions for proposal tools?
4.	What do you feel when you do the drying process? Do you have any complaints or problems?
5.	In your opinion, are the tools that have been used in the drying process safe to use?
6.	In your opinion, what makes this tapioca flour production process more effective and efficient?
7.	Do you have any health problems?

c. Productivity Level Calculation of Existing Condition

The total time in the tapioca flour drying process is approximately 8 hours 57 minutes with a total tapioca flour produced of approximately 180 kg. In the production process, the number of bamboo containers used is 60 pieces. One bamboo container can accommodate 3 kg of tapioca flour, so that in a day ABC SMEs can produce 180 kg of tapioca flour.

Table 2 Existing Drying Process Time

No.	Process Name	Time/Process	Number of Repetitions	Total Time
1.	Laying Wet Tapioca Flour in a Bamboo Container	00:00:48	60	00:48:00
2.	Lifting the bamboo container to the drying area	00:00:58	60	00:58:00
3.	Laying bamboo containers	00:00:14	60	00:14:00
4.	Drying Process	06:00:00	1	06:00:00
5.	Pick up bamboo container	00:00:10	60	00:10:00
6.	Lifting bamboo container to the warehouse	00:00:47	60	00:47:00
			Total Time	08:57:00
			Total Production	180 kg/process

The calculation of the productivity level in the existing conditions of making tapioca flour at ABC SMEs, it is carried out based on the output produced during the existing conditions. With the amount of tapioca flour produced as much as 180 kg/process and it takes about 9 hours for the drying process. Then the calculation of the productivity level is as follows:

$$Productivity = \frac{Units\ produced}{Labor - hours\ used}$$

$$Productivity = \frac{180\ kg\ per\ process}{9\ labor - hours}$$

$$Productivity = 20\ kg\ per\ labor - hour$$

d. EFD Method

The first stage of the EFD method is to identify consumer needs by conducting interviews [11]. The results of the identification of consumer needs will be interpreted into a need statement. Each attribute of product requirements is interpreted according to ergonomic aspects, namely Effective, Safe, Healthy, Comfortable, and Efficient (EASNE). Then determine the technical requirements of the product. So that at this stage the translation of the need statement is carried out to explain in detail the operator's needs.

Table 3 Need Statement and Technical Requirement

No	Ergonomic Aspect	Needs Statement	Description	Code	Technical Requirement	Unit
1	Effective	Tools can work properly according to their function	The design of the tool can function well as a dryer	V1	Functional tools	Binary
2	Safe	Tools have the right material	Materials for tools must comply with food-safe material standards	V2	The drying pan material is food safe	Binary
					Heat resistant material	Binary
		Tools using anti-rust material	Selection of materials to avoid corrosion	V3	Anti-rust material	Binary
3	Healthy	Tools can reduce potential risks/hazards	The design of the tool can reduce the risk of MSDs to the operator	V4	REBA Score	Score
					RULA Score	Score
4	Comfortable	Size of tools	The design of the tool must be ergonomic so that the size of the tool is in accordance with the anthropometric body size of Indonesians	V5	Tool length	cm
					Tool width	cm
					Tool height	cm
5	Efficient	Tools can make the drying process faster	The design of the tool has an optimal temperature so that the drying process becomes faster	V6	Drying system using machine	Binary
		Tools have more than one drying pan	The number of drying pans can make the drying process faster	V7	Number of drying pans	Component
		Operation of assistive devices uses less power	The design of the tool must be able to minimize operator power	V8	Number of drying process	Process

The results of the calculation of the X-axis diameter are 3.50 and the Y-axis diameter is 3.81. After that, the Klein Grid matrix was created based on data from the Performance Weight of Interests and Satisfaction as well as the X-axis and Y-axis centerline values. The Klein Grid matrix can be seen in the following figure.

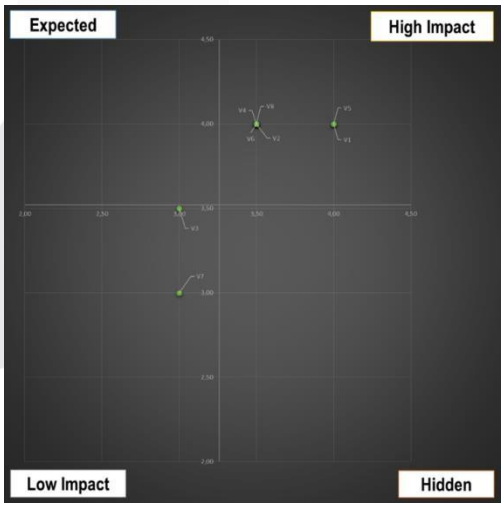
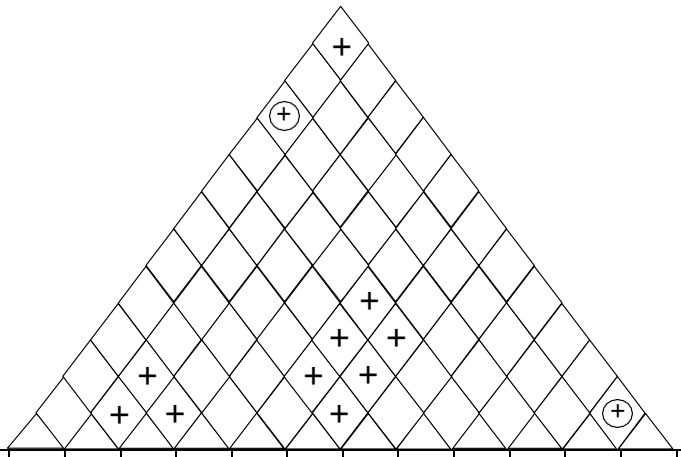


Figure 2 Klein Grid Matrix

Based on the Klein Grid Matrix image, it is known that the attributes included in the High Impact category are V1, V2, V4, V5, V6, and V8, Low Impact are V3 and V7, while Expected and Hidden does not exist.

In HOE there is a ranking of each technical requirement, this ranking is obtained from the results of the contribution value for each technical requirement that has been normalized for the contribution [11]. Normalization of contributions to the house of ergonomics is carried out in order to get the same contribution scale, namely 0-1 units. The picture below shows the results of the House of Ergonomics from the proposed dryer that has been obtained.



	Direction of Goodness	TB	TB	TB	TB	LTB	LTB	LTB	LTB	LTB	TB	MTB	LTB	
	Technical Requirement / Needs Statement	Functional tools	The drying pan material is food safe	Heat resistant material	Anti-rust material	REBA Score	RULA Score	Tool length	Tool width	Tool height	Drying system using machine	Number of drying pans	Number of drying process	Normalized raw Weight
		1	2	3	4	5	6	7	8	9	10	11	12	
1	Tools can work properly according to their function	◎									◎	○	○	0,13
2	Tools have the right material		◎	◎	◎									0,14
3	Tools using anti-rust material		○	○	◎									0,09
4	Tools can reduce potential risks/hazards		△			◎	◎	○	○	○			△	0,14
5	Size of tool					◎	◎	◎	◎	◎				0,13
6	Tools can make the drying process faster	◎						△			◎	◎	○	0,14
7	Tools have more than one drying pan	○										◎	◎	0,07
8	Operation of assistive devices uses less power	◎									◎		◎	0,14
	Unit	Binary	Binary	Binary	Binary	Score	Score	cm	cm	cm	Binary	Co mpo nent	Process	
	Value	Yes/No	Yes/No	Yes/No	Yes/No	<11	<7	80 - 100	50 - 70	140 - 160	Yes/No	>1	<10	
	Contributions	2,7801313	0,9952657	0,9047547	1,2880551	1,6693597	1,6693597	1,2246153	1,2246153	1,2246153	2,4879196	2,0576265	2,2729367	
	Normalized Contributions	0,140416	0,0502678	0,0456964	0,0650557	0,0843143	0,0843143	0,0618516	0,0618516	0,0618516	0,1256572	0,1039244	0,1147991	
	Ranking	1	11	12	7	5	5	8	8	8	2	4	3	

Figure 3 House of Ergonomi

e. Concept Generation

In concept generation, there are several stages, namely clarify the problem, search externally, search internally, explore systematically, and reflect on the solution and the process [12]. The first step is to classify the problem according to the pre-determined needs statement regarding the function and features of the product. After that, make a function diagram of the needs statement and describe it in a black box diagram that operates on material and energy flows.

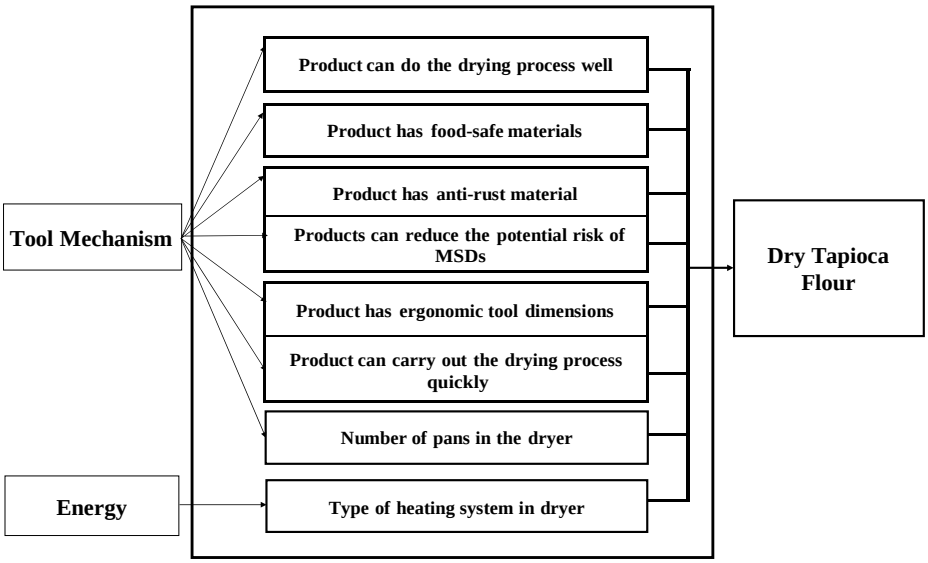


Figure 4 Black Box Diagram

Based on the functions that have been obtained from the decomposition, then the options are described using a morphology chart which serves to facilitate the selection of a combination of several options to create the concept of a proposed tool according to the wishes of the user. The morphology chart is listed in the following table

Table 4 Morphology Chart

Function \ Option	Option 1	Option 2
Product can do the drying process well	Automatic Thermo-Control	
Product has food-safe materials	Stainless Steel	Galvalum
Product has anti-rust material		
Products can reduce the potential risk of MSDs	Anthropometric Data	
Product has ergonomic tool dimensions		
Product can carry out the drying process quickly	Single Blower	Double Blower
Number of pans in the dryer	60 Dryer Pan	
Type of heating system in dryer	Wood Furnace	LPG Gas Stove

The number of concept combinations on the morphology chart is 1x2x1x2x1x2=8 concept combinations. The following table shows the combination of concepts from each selected concept.

f. Concept Selection

In concept selection, the first step that must be done is to make selection criteria by considering the needs statement and adding other criteria. The criteria at this stage are usually expressed at a fairly high level of abstraction and generally cover 5 to 10 dimensions and are chosen to distinguish concepts [12]. After determining the selection criteria, concept screening is carried out on 8 combination concepts, the following table is the comparison symbols that will be used for the concept screening table.

Table 5 Concept Screening

	Concepts								
Selection Criteria	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**Reference**
Product Convenience	+	+	+	+	+	+	+	+	0
Product function	0	-	0	-	-	-	0	0	0
Product speed	0	-	+	+	-	0	+	+	0
Product safety	+	0	0	+	0	0	+	+	0
Easy to use	-	0	0	-	-	-	0	0	0
Durability	0	+	+	0	0	+	+	0	0
Sum +'s	2	2	2	3	1	2	4	3	
Sum 0's	3	2	3	1	2	2	2	3	
Sum -'s	1	2	0	2	3	2	0	0	
Net Score	1	0	2	1	-2	0	4	3	
Rank	4	6	3	4	8	6	1	2	
Continue?	COMB	NO	YES	COMB	NO	NO	YES	YES	

Concept scoring is the final stage of concept selection. The weighting value in concept scoring is processed in the form of a percentage of each selection criteria.

Table 6 Percentage Weighting of Selection Criteria

No	Needs Statement	Selection Criteria	Weight
1	Tools can work properly according to their function	Product function	13,11%
2	Tools have the right material	Durability	24,59%
3	Tools using anti-rust material		
4	Tools can reduce potential risks/hazards	Product safety	13,11%
5	Size of tool	Product Convenience	13,11%
6	Tools can make the drying process faster	Product speed	22,95%
7	Tools have more than one drying pan		
8	Operation of assistive devices uses less power	Easy to use	13,11%

After obtaining the percentage weighting for each selection criteria, then an assessment of each selection criteria is carried out to obtain the ranking results from the selection of the selected proposed tool concept.

Table 7 Concept Scoring

		Concepts							
		C		G		H		A & D	
Selection Criteria	**Weight**	**Rating**	**Weighted Score**	**Rating**	**Weighted Score**	**Rating**	**Weighted Score**	**Rating**	**Weighted Score**
Product Convenience	13,11%	5	0,66	5	0,66	5	0,66	5	0,66
Product function	13,11%	4	0,52	5	0,66	3	0,39	2	0,26
Product speed	22,95%	3	0,69	4	0,92	3	0,69	4	0,92

Product safety	13,11%	4	0,52	4	0,52	4	0,52	3	0,39
Easy to use	13,11%	4	0,52	5	0,66	3	0,39	3	0,39
Durability	24,59%	3	0,74	4	0,98	3	0,74	4	0,98
Total Score		3,66		4,39		3,39		3,61	
Rank		2		1		4		3	
Continue?		**No**		**Develop**		**No**		**No**	

Table 8 Final Specification

Final Specification			
No	**Technical Requirement**	**Value**	**Unit**
1	Functional tools	Yes	Binary
2	The drying pan material is food safe	Yes	Binary
3	Heat resistant material	Yes	Binary
4	Anti-rust material	Yes	Binary
5	REBA Score	<11	Score
6	RULA Score	<7	Score
7	Tool length	225	cm
8	Tool width	130	cm
9	Tool height	190	cm
10	Drying system using machine	Yes	Binary
11	Number of drying pans	60	Component
12	Number of drying process	1	Process

In accordance with the specifications obtained, the proposed design tool is obtained as shown in the image below.

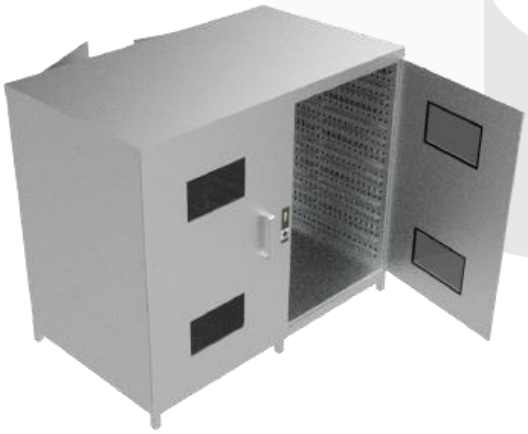


Figure 5 Design of Tray Dryer

Figure 6 Design of Drying Pan

g. Material Strength Analysis

Strength analysis of the material is carried out to determine whether the material used has met the specifications and is in accordance with the predetermined criteria. Strength analysis of the material is carried out on the drying pan because the drying pan will support the load in the form of wet tapioca flour. The analysis was carried out using the Autodesk Inventor 2019 software. The load used in this analysis is 40 N which is the maximum load of wet tapioca flour. The

following are the results of the analysis on the part drying pan with the von mises stress variable:

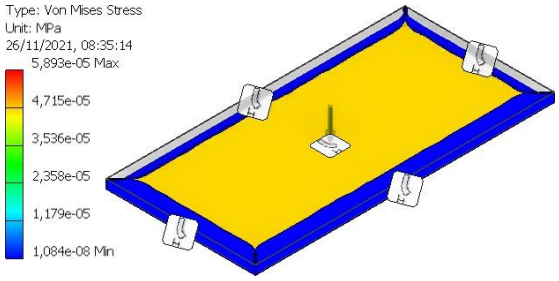


Figure 7 Material Strength Analysis of Drying Pan

Based on the picture above, the part drying pan with material stainless steel AISI 304 has maximum stress of 0.0000589311 MPa while the yield strength on stainless steel AISI 304 is 190 MPa. This shows that the part drying pan design on the proposed tool can accommodate a predetermined maximum load, which is 4 kg or 40 N.

h. REBA & RULA Analysis of Proposed Work Posture

The following is the posture for the calculation of the proposed REBA & RULA:

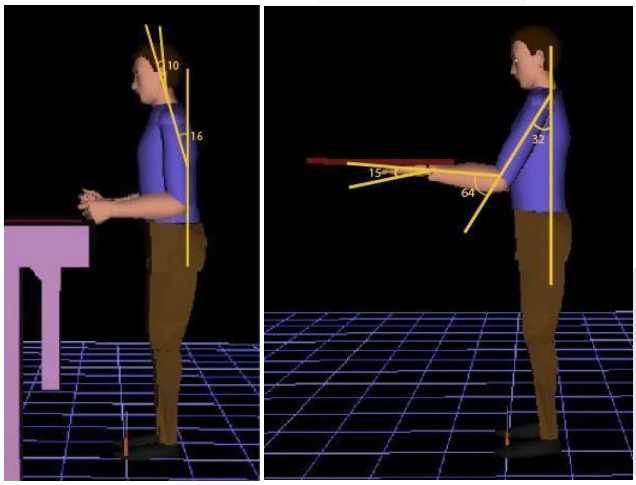


Figure 8 Proposed Work Posture

REBA calculation is done manually by making an angle on the proposed operator's work posture which has been visualized using Jack 8.2 software, the operator uses a table with a height of 100 cm. The image below is a calculation to get the results of the REBA posture score on the proposed tool. the proposed operator's REBA score when the position takes the pan is 3 which means it has a medium risk. the proposed operator's RULA score when the position takes the pan is 3 which means it need further investigation.

After getting the final result of the proposed REBA score, the operator's REBA score using the existing tool can be compared with the operator's REBA score using the proposed tool. Based on the calculation results, it is known that the REBA score decreased by 64% from the existing score. This decrease is caused by changes in the operator's work posture when working using ergonomically proposed tools. This decrease in score also means a lower risk of Musculoskeletal Disorder in operator.

Comparison of the RULA score of the operator using the existing tool with the RULA score of the operator using the proposed tool is based on the calculation results, it is known that the RULA score decreased by 58% from the existing score. This decrease is caused by changes in the operator's work posture when working using ergonomically proposed tools. This decrease in score also means a lower risk of Musculoskeletal Disorder in operator

i. Productivity Evaluation Analysis

Productivity evaluation analysis was carried out to find out whether the drying process using the selected tool had increased productivity or not compared to the existing drying process. The total time in the drying process using the proposed tool is 4 hours 8 minutes with a total tapioca flour produced is 180 kg.

Table 9 Proposed Drying Process Time

No.	Process Name	Time/Process	Number of Repetitions	Total Time
1.	Laying Wet Tapioca Flour in the drying pan	00:00:48	60	00:48:00

3.	Laying drying pan	00:00:10	60	00:10:00
4.	Drying Process	03:00:00	1	03:00:00
5.	Pick up drying pan	00:00:10	60	00:10:00
			Total Time	04:08:00
			Total Production	180 kg/process

The processing time in the drying process using the proposed tool is faster than the existing process time, this is because the drying process is carried out using a drying machine and the operator does not need to lift the drying pan to a distant drying place for sixty repetitions. The calculation of the productivity level in the proposed conditions for making tapioca flour at ABC SMEs, is carried out based on the output produced in the drying process using the proposed tool. The amount of tapioca flour produced is as much as 180 kg/process and it takes about 4 hours for the drying process. Then the calculation of the level of productivity is as follows:

$$Productivity = \frac{Units\ produced}{Labor - hours\ used}$$

$$Productivity = \frac{180\ kg\ per\ process}{4\ labor - hours}$$

$$Productivity = 45\ kg\ per\ labor - hour$$

Based on these calculations, it can be seen that using the proposed tool in the drying process can increase the level of productivity at ABC SMEs by 25 kg per labor – hours. So that the increase in the level of productivity is more than 100% compared to the existing condition.

V. CONCLUSION

In this study, using the Ergonomic Function Deployment (EFD) method and adapted to the EASNE aspect, it can be used to determine the design parameters in designing ergonomic proposal tools and can reduce the risk of musculoskeletal disorders injury to operators of the tapioca flour drying process. The proposed tool has dimensions of 225 x 130 x 190 cm which have been adapted to human anthropometry so that it can meet ergonomic principles for the operator. The operator's REBA score on the existing tool is 11 for the operator's posture during the baking process and the operator's RULA score on the existing tool for the baking process is 7. Meanwhile, the operator's REBA score when using the proposed tool is 4 for the operator's position when taking the tray. pans and a RULA score of 3 for the position of the operator when placing the pan, which is smaller than the REBA and RULA scores of the existing tools. Thus, it can be seen that the difference in the decrease in the REBA and RULA scores on the operator's posture when placing the pan is 64% and when placing the pan by 58%.

Existing manual drying process using sunlight takes 9 hours to dry 180 kg of tapioca flour. So that the productivity level for the existing drying process is 20 kg per labor – hour. Meanwhile, by using the proposed tool, the drying process time for 180 kg tapioca flour is 4 hours with the productivity level for the proposed process is 45 kg per labor-hour. So that the increase in the level of productivity is more than 100% compared to the existing condition. This proves that using the selected proposal tool, will be able to increase productivity in the tapioca flour drying process.

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