CARANGMAS MAKING MACHINE DESIGN USING THE ERGONOMIC APPROACH (CASE STUDY ON MICRO SMALL MEDIUM ENTERPRISES (MSME))

Oleh
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Abstract: *Ms. Tuminah's Carangmas MSME is a Carangmas home industry located in Sidorahayu Village, Wagir District, Malang Regency. Ms. Tuminah's Carangmas MSME produces Carangmas. MSME Carangmas Mrs. Tuminah was established in 2019, to date employs 4 employees. Where the process of making carangmas is still manual and requires a long time during the process. To fulfill an order of 1500-5000 carangmas in one order, it takes up to 3 (three) days in the manufacturing process. Because at this time the MSMEs are still using simple tools, the time needed for the production process is still fairly long. Moreover, there is still the possibility of work accidents in some of the manufacturing processes. The methodology for designing the Crangmas Making Machine begins by surveying the field to observe the production process, collecting and processing working time data to be used as a support to analyze the time, size, and position of body movements, which are carried out by workers in carrying out work activities with old tools., collecting and processing work data with old conditions, designing Carngmas Manufacturing Machines. The data sources used are primary data and secondary data. The data used in assisting the design of the Carangmas Making Machine include qualitative data (interviews), and anthropometric data. From the results of the design of the workings of the carangmas making machine, namely an electric motor with a speed of 1200 rpm as the driving force for the Mixing and Printing tool. Mixing and printing system. The working system of this tool is the motor connected to the main pulley with a V-belt. the Pulley is a transmitted to the stirrer so that the process of the tool can work together with each other. From the results of using the new machine, the standard time calculation is 0.84 kg/minute if the old tool is 0.72 kg/minute so there is an increase in productivity when the increase is 12%.*

INTRODUCTION

Carang Mas is a traditional snack that has a sweet, delicious, and crunchy taste. Carang Mas cake is made from cassava. Apart from cassava which is usually made from yams or sweet potatoes, some are made from apples. In some areas, this cake is known as walangan (in Javanesse) or chicken claw.

MSME Carangmas Mrs. Tuminah was established in 2019, to date employs 4 employees. Where the process of making carangmas is still manual and requires a long time during the process. To fulfill an order of 1500-5000 carangmas in one order, it takes up to 3 (three) days in the manufacturing process. On the one hand, the MSME owner wants to be able to produce more than 5000 carangmas per day. The rest also add to the creation of flavor variants in the carangmas products it produces. With the design of the carangmas sugar frying and mixing machine, it is hoped that it will be able to fulfill even more orders. Because at this time the MSMEs are still using simple tools, the time needed for the production process is still fairly long. Moreover, there is still the possibility of work accidents in some of the manufacturing processes.

It is against this background that the author intends to design (design) an ergonomics-based frying machine and carangmas sugar mixer in order to provide a solution to the problems of the MSMEs. It was emphasized that the design of the fryer and sugar mixer for this carangmas product aims to minimize the possible risk of work accidents on the operator and speed up the production process time of the carangmas. Along with the increasing consumer interest in carangmas products, the author's ideas are in accordance with the current situation and conditions in the MSME Carangmas Ms. Tuminah.

1. Theoretical Basis Product Design

Product design is very important in manufacturing. A good product design will be able to increase the number and selling price of the product, so as to increase profits optimally. However, a failed product design resulted in the product not being sold in the market. This will cause losses not only in the field of design but in other fields will also be affected. A good product design must fulfill 3 (three) important aspects which are often called the product aspect triangle, namely good quality, low cost, and schedule. right. Furthermore, the product aspect triangle above was developed into a requirement in the design, namely the design must be able to be assembled, recycled, produced, inspected for results, free of corrosion, at low cost, and on time. In designing a product, one must pay attention to detail about the functions of the designed product.

Product Design Definition

Product design is a strategic step to being able to produce industrial products that must be commercially achievable in order to generate a rate of return on investment. This requires the preparation of product concepts – both new products and old products that will be modified into a new product in the form of engineering design (engineering design) and also industrial design (industrial design) to meet market needs (demand-pull) or motivated by a push take advantage of technological innovation (market push). A design case study is a method or stage carried out in a design process, this method is needed to facilitate designers in developing design ideas. The method used by a person varies based on their needs. The first step in realizing a product is the design stage. After the design stage is complete, the next stage is the manufacturing or product production stage. These two stages are carried

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out by two groups or two different people, each of whom has expertise in the field, namely the design is carried out by the design group and product manufacture by-product manufacturing group. In the design, there is the development of tools used during production which is defined as the transformation of a market opportunity into a product that is the result of the integration of all market assumptions and technological capabilities.

Stages of Making Machine Design

The economic success of a manufacturing company depends on its ability to identify customer needs, then precisely create products that can meet those needs at a low cost. To make a product, we usually go through the following stages:

1. Market Research and Feasibility Study

Market Research is conducted to find out the general taste of the market. From this market research, you can get products like what consumers need or want.

2. Brainstorming

Brainstorming, or in Indonesian also referred to as brainstorming, is the process of gathering ideas to find solutions/ways out of the problems being discussed. From this discussion process, you will get an outline of the goods to be made, how to work, the components to be used, and so on. For example, if we want to make a vacuum cleaner, it would be imagined to make a motor, chasing/container, filter/sieve, hose/pipe, and so on.

3. Define Machine Design Goals and Constraints

Goals and limitations are needed so that we don't overdo it in designing the machine which will result in high selling prices to consumers. Consumers of course want the added value offered in the product commensurate with the costs incurred (reasonable price). Of course, market research is needed to find out market tastes. From determining these goals and limitations, we obtain specifications of what components and materials will be used.

4. Drawing machine

By describing the machine based on the dimensional relationship of the components that have been determined in step 2 above, we will get an illustration of the finished machine. Machines can be drawn in 2 dimensions or 3 dimensions, usually, 3-dimensional drawings are easier for most people to understand. Designing products in 3 dimensions can be done using SolidWorks, Inventor, Catia, etc. software.

5. Engine review

The review is carried out to evaluate whether there are deficiencies in the design that has been designed up to this drawing stage. Discussions by looking at product images are usually easier to develop than just imagining them. At this stage, brainstorming is again carried out to get optimal results and minimize problems that will arise during mass production later. At this stage, usually, the product that is being designed needs to be addressed here and there.

6. Creating Prototypes/Samples

Samples of goods to be mass-produced can be made in various ways. Resin products can be modeled using rapid prototyping machines, stylish car body designs can be modeled using special clay, and product packaging boxes can be made by hand. For common products, it is not necessary to take samples of the goods (iron products) but requires accuracy in drawing and there must be no drawing errors that can have fatal consequences: reject goods.

7. Trial

Before being marketed, of course, we need to test whether the goods we make are really reliable or not. There are those who test it based on time, pressed, dropped, and so on. Cellular phone manufacturers such as Nokia have special machines to test their mobile phones for shock resistance. If things are found that are not satisfactory, of course, the product needs to be redesigned (back to stage 3). Satisfactory things, of course, must be seen from the point of view of consumers, not producers. That's how big manufacturers are currently reviewing their products continuously so that the name of the product they make is maintained.

8. Mass Production

In mass production, quality control is needed so that consumers do not receive damaged goods.

9. Warranty

Warranty is an after-sales service provided by the company that makes the product so that consumers are calm if at any time there is damage to the item. Many consumers prefer to pay a little more to get a guarantee and peace of mind in using the product.

RESEARCH METHOD

Method of collecting data

Data collection techniques are the methods used by researchers in obtaining data in the field. In qualitative research, there are several techniques that are commonly used, namely, literature study, interviews, and observation.

Literature review

The data collection technique that is also widely used is library research. A literature study collects relevant data from books, scientific articles, news, and other credible sources related to the research topic. Literature studies can strengthen the background for doing research and allow us to study previous research so that we can produce newer research.

Interview

Interviews were conducted by means of question and answer with respondents or informants to obtain information needed for research. Interviews are used to explore information or subjective perceptions of informants related to the topic to be studied. Previous researchers must prepare interview questions in advance. Similar to questionnaires, interview questions need to be tested for their abilities so that researchers can obtain the required data.

Observation

Observation is a data collection technique that is carried out through direct observation. Researchers make observations on the spot on the object of research to be observed using the five senses. Researchers are positioned as observers or outsiders. In collecting data using observation, researchers can use notes or recordings. Observation can be participatory when the researcher joins in and carries out activities with the object of observation.

Population and Sample

The population we studied was the MSME Carangmas Ibu Tuminah and the samples we took were from 30 samples from workers who carry out the production process from mixing, frying to printing.

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Place and time of research

Research Place

The research location for this Carangmas micro and medium enterprise was conducted in Sidorahayu Village, RT 03RW 01, Wagir District, Malang Regency.

Research time

The research implementation time starts from the beginning of the survey on April 22, 2021, which will continue in May and June, namely to carry out the design and manufacture of designs according to needs. After that, the last one was continued in July, namely to carry out the final project report on the design.

Data collection

- Bibliography

That is by starting to look for articles or journals that contain almost the same problem, learn from the techniques used in the journal, and learn the methods used.

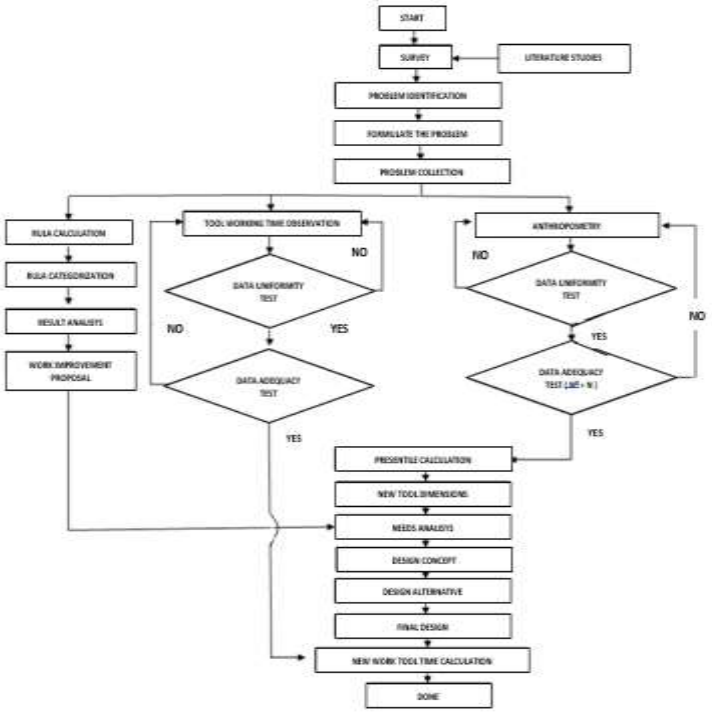
- Interview

Collecting data using the interview method, namely by holding an interview session with Mrs. Tuminah as the owner of MSMEs to obtain data, and also interviewing one of the employees to ask complaints that occur to anybody members that occur while working.

- Observation

The method of data collection by observation is by coming directly to Ms. Tuminah's MSMEs and seeing firsthand the process of making carangmas and seeing firsthand the workers, including the situation and condition of the workers involved in the production of carangmas.

Flowchart



2. Data Collection and Processing

Activity Analysis

Activity analysis is an analysis carried out to determine user activities when using this working facility so that it can be determined what factors influence the activity. The following are activities related to the use of work facilities and facilities related to this work station:

1. General Activities

In this case, what is meant by activity, in general, is the activity carried out in the operation of the machine for making carangmas which ergonomics include:

a. Prepare raw materials and work tools that already exist.
b. The process of frying and mixing raw materials for making carangmas
c. Draining process
d. Carangmas Printing Process
e. The process of taking carangmas from the mold
f. Workers or operators clean tools that have been used.

2. Specific Activities, In this case, to find out the activities carried out when using existing work tools.

No	Activity	Tool
1	Put the raw ingredient for making carangmas into the wok	Input to wok
2	Turn on the stove	Stove switch
3	Turn on the machine	On/Off switch
4	Drive the pulley	Electric motor
5	Frying process and carangmas stirring	Stirer on wok
6	Touchdown carangmas	Carangmas mold
7	Preparing container for the product	Container

Needs Analysis

Need for New Work Facilities

With the improvement of the concept of compiling existing tools, it is expected to increase production after using new tools. The things that must be considered from the

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criteria for the *need for a new work station are as follows:*

No	Facilities	Criteria	Description
1	Engine frame	User/operatr safety when using new machine	The need for this new work facility is the need to equip work facilities with a strong frame and good quality materials.
2	Electric motor	Efficient use of energy resources	This work facility uses a electiric motor as the main power to drive the mixer.
3	Mixer	Strength or performance	The need for the durability of thus new work facility includes the use of working time facilities during stirring to meet the needs.
4	Tool model	Shape of new work facilities	Needs in an attractive form and according to the user, this new tool is made with a practical model and in accordance with the required layout, so the shape of this tool must seem strong and apply appropriate and targeted technology so that need for form is very considered in designing this tool.
5	Overhaul	Ease of maintenance	Maintenance for this work facility is to clean the residue form the stirrer, fryer and mold in a regular basis, with easy maintenance.

Environmental Needs

If we observe the existing work facilities, it can be seen that the condition of the tools is inadequate in meeting work productivity targets, while the development of existing tools in UMKM is not better, so it can be concluded that UMKM in the field of carangmas wants to increase and develop productivity. So the desired hope is the creation of a machine that facilitates the work as it should.

Ergonomic Analysis

Anthropometry Implementation

Ergonomics aspects in a design are an important factor as well as a discussion of the user's body dimensions which are commonly referred to as anthropometric data. Anthropometric data is used as a basis for consideration in determining the size of the design of the new work station to be designed, which relates to the human body as the user. Anthropometric data used are as follows:

1. Hip Height When Standing
    a. Percentile used: 50 cm
    b. Measurement result: 80 cm
    c. Application: To determine the machine height. To adjust the height of the frying pan, short people will have no difficulty in reaching and operating the appliance, while tall people will adjust it.
2. Hand Grip Height Up When Standing
    a. Percentile used: 50 cm
    b. Measurement result: 185 cm
    c. Application: To determine the height of the stirrer adjuster.

For short operators, it is not difficult to adjust the stirrer position and tall operators will adjust to the stirrer position.

3. Shoulder Height When Standing
   a. Percentile used: 50 cm
   b. Measurement result: 131 cm
   c. Application: To adjust the height of the electric motor. to adjust the height of the placement of the electric motor for the stirrer for safe use for tall and short operators.
4. Bone Height When Standing
   a. Percentile used: 50 cm
   b. Measurement result: 73 cm
   c. Application: To adjust the frying height. To adjust the height of the tool so that a tall operator does not bend over and for a short operator it wil adapt.
5. Long Forehand Span
   a. Percentile used: 50 cm
   b. Measurement result: 67 cm
   c. Application: To adjust the width of the carangmas making machine. then the shorthand will have no difficulty in reaching and operating, while the long hand will adjust.
6. Eye Height When Standing
   a. Percentile used: 50 cm
   b. Measurement result: 140 cm
   c. Application: to adjust the tool so as not to injure during operation. To match the view of a tall operator and for a short operator to adjust.
7. Length of the arm span to the side
   a. Percentile used: 50 cm
   b. Measurement result: 159 cm
   c. Application: To determine the width of the frying pan draining and printing. Eating for shorthands is not difficult to reach parts of the machine and for long hands, it will adjust.

Technical Analysis

Technical analysis includes an analysis of the specifications of the tool to be made, where the specification includes the operating system, components, and materials that will be used in the design of the tool to be made.

Operating System Analyst

Operating system analysis serves to determine the steps that will be used as a system for the operation of the tool to be made. The operation of the tool uses an electric motor as a power source to rotate the frying pan, where the operating system used is by entering the dough in the first machine, namely the frying pan. As well as the second tool, namely printing on a printer which is one print produces 49 carangmas.

Component Analysis

Component Analysis serves to determine the components that will be used for the tool to be made. Some of the components contained in the carangmas making machine:

Material analysis

Material Analysis serves to determine the material to be used for the machine to be made. This relates to the tool frame and stirrer, where the materials used are wide plate iron and stainless axles.

- Frame = Holo iron and galvalume plate
- Frying Pan = Stainless
- Stirrer = Stainless Steel
- Printer = Iron pipe

Aesthetic Analysis

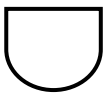
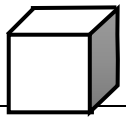
Aesthetic Analysis Aesthetic analysis includes the analysis of shapes, colors, and graphics that will be displayed in the design or design that will be made. What shapes, colors, and graphics are highlighted as the identity of a product or tool to be made.

Place	Stylish Illustration
New Work Station	**- Comfort Ergonomics**

So the aesthetic analysis is taken from socio-cultural and environmental studies that are used to place the new tools, so the form that is highlighted in the new design is - Comfort, and Joy is intended for workers in carrying out work so that productivity can be increased.

Shape Analysis

Shape analysis serves to determine the overall condition of the graphic color, geometric properties and precision manifested in the cube shape. For this reason, it is necessary to adjust the factors that affect the feasibility of a new workstation. It must be noted at the same time that in its application in the field, there is nothing that can create difficulties for the operator. The shape analysis serves to determine the overall condition in determining the shape of the carangmas making machine that is in accordance with the function as a tool to facilitate SMEs in the field of making carangmas. The form to be used is a simple form with a size or dimension that is in accordance with the operator's anthropometry, and does not create a dangerous impression. In analyzing the shape described above, the shape of the carangmas making tool is in the form of a rectangular cube for the frame and a crescent moon for the stirrer.

No	Shape	Characteristic
1	Crescent 	• Following the inside of the wok has an optimujm area and height • Shows the direction based on the width
2	Cube 	• Formal looks • Rigid

So the above forms can be applied to the design as a basic form for designing new tools so that with these forms the product to be produced can choose one of the characteristics that match the characteristics of the product to be designed.

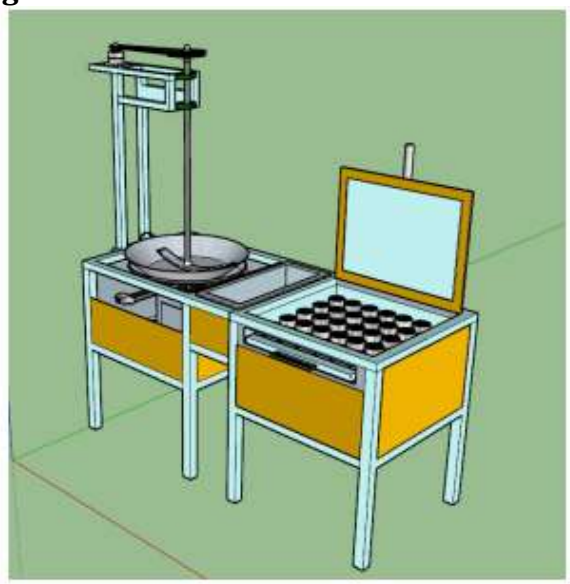
Design criteria

The design criteria are criteria based on the function and aesthetics of the design and application to formulate and provide solutions to a problem / provide solutions that have been solved in different ways. Criteria for fryers and carangmas printers are as follows:

a. Practical Design
b. Easy operation and maintenance
c. Large Capacity
d. Resistance
e. Easy to move

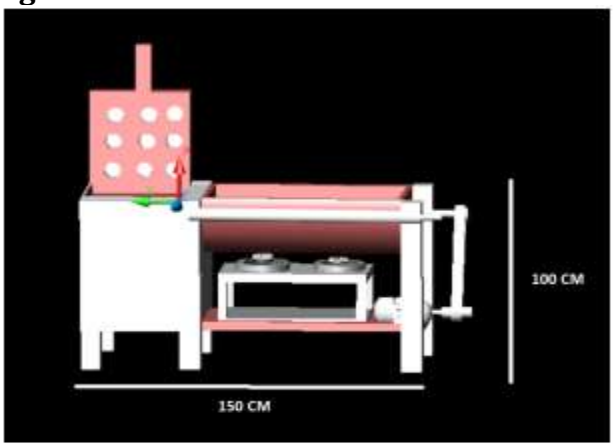
Alternative Design Design Of Carangmas Manufacturing Machine Design

A. Alternative Design 1



ADVANTAGES	DISADVANTAGES
- Has 4 functions at once, frying, stirring, draining and final process - Made of sturdy and safe materials - The stirrer can be disassembled and cleaned - Easy operation	- Very wide shape - Heavy - Pricy

B. Alternative Design 2



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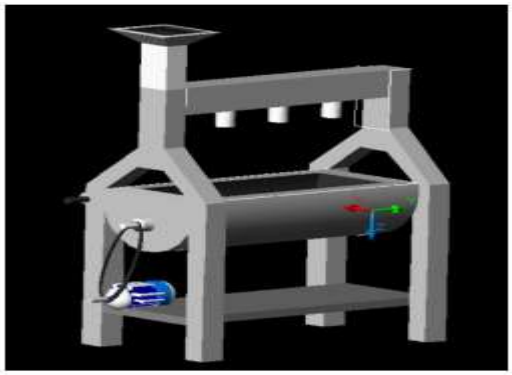
ADVANTAGE	DISADVANTAGE
- Has 3 function at once, frying, stirring, and final process - Made of sturdy and safe materials - Easy operation	- Very wide shape - Stirrer can't be cleaned - Pricy

C. **Alternative design 3**



ADVANTAGES	DISADVANTAGES
- Sugar misxing with large capacity - Made of sturdy and safe material	- Only has 1 function, for mixing sugar only - Hard operations - Pricy

CRITERIA	**Design Alternative**		
	Alternative 1	**Alternative 2**	**Alternative 3**
Practical Design	2	1	1
Easy to move and maintenance	3	2	2
Large Capacity	3	3	3
Durability	3	2	1
Easy to move	2	1	1
TOTAL	**13**	**9**	**8**

Information:
1= Less Good
2= Good Enough
3= Excellent

Conclusion: So the results obtained in this design process, then the alternative tool chosen is alternative 1 because it has the largest number of values, namely 13, where the design of the tool is more effective and meets the design criteria that will be selected later. In addition, the level of safety of use is also good and the shape is in accordance with the expected.

RESULTS AND DISCUSSION

Anthropometric Calculation Results

Based on the results of calculations using the Anthropometric method were obtained as follows:

1. Hip Height When Standing
    a. Percentile used: 50 cm
    b. Measurement result: 80 cm
    c. Application: To determine the height of the machine to set the height of the frying pan, the short person will have no difficulty in reaching and operating the tool, while the tall person will adjust.
2. High Grip Of Hands Up When Standing
    a. Percentile used: 50 cm
    b. Measurement result: 185 cm
    c. Application: To determine the height of the stirrer for short-bodied operators there is no difficulty when adjusting the position of the stirrer and the high-bodied operator will adjust to the position of the stirrer
3. Shoulder Height When Standing
    a. Percentile used: 50
    b. Measurement result: 131 cm
    c. Application: To adjust the height of the electric motor to adjust the height of the placement of the electric motor for the stirrer to be safe to use for operators who are tall and who are short-bodied
4. The Height of the Internode Bone When Standing
    a. Percentile used: 50 cm
    b. Measurement result: 73 cm
    c. Application: To adjust the height of the fryer To adjust the height of the tool so that the tall operator does not bend and operators who are short will adjust
5. Forward Hand Span Length
    a. Percentile used: 50 cm
    b. Measurement result: 67 cm
    c. Application: To adjust the width of the carangmas manufacturing machine, the shorthand will have no difficulty in reaching and operating, while the long hand will adjust.
6. Eye Height When Standing
    a. Percentile used: 50 cm
    b. Measurement result: 140 cm
    c. Application: to customize the tool so as not to injure during operation
    d. To adjust the view of operators who are tall and operators who are short will adjust
7. Length of Hand Range To The Side
    a. Percentile used: 50 cm
    b. Measurement result: 159 cm
    c. Application: To determine the width of the frying fryer slice and print Eat for shorthands it is not difficult to reach part of the machine as well as for long hands will adjust

DISCUSSION

The results of calculations in the size of anthropometry used to design this working facility are: Eye height when standing with a 5% percentile of 156.55cm is used to know and

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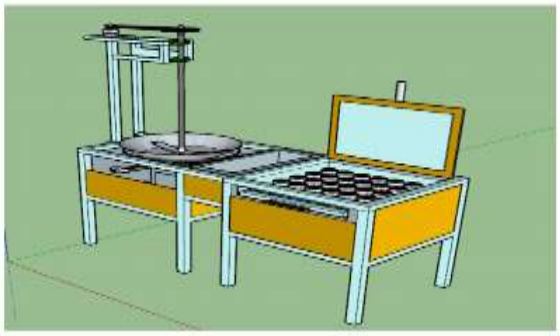
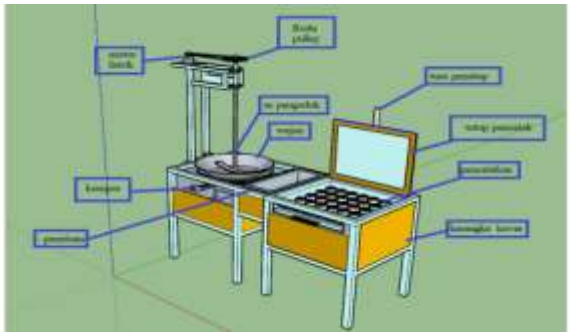
determine the input line of sight of the carangmas manufacturing machine, Shoulder height when standing with a 50% percentile of 144.45cm is used to determine and determine the height of the carangmas manufacturing machine, Elbow height when standing with a 5% percentile of 102.95cm to find out and determine the height of the carangmas manufacturing machine, Elbow height when standing with a 5% percentile of 102.95cm to determine the height and determine the height of the carangmas manufacturing machine, Elbow height when standing with a 5% percentile of 102.95cm to determine the height of the carangmas manufacturing machine, elbow height when standing with a 50% percentile of 144.45cm is used to determine the height of the carangmas manufacturing machine, elbow height when standing with a 50% percentile of 144.45cm is used to determine the height of the carangmas manufacturing machine, elbow height when standing with a 50% percentile of 144.45cm is used to determine the height of the carangmas manufacturing machine, elbow height when standing with a 50% percentile of 1 from the carangmas manufacturing machine, Forward hand range with 5% percentile of 61cm to determine the width of the carangmas manufacturing machine, Hand-to-side range with 5% percentile of 61.28cm is used to determine the length of the carangmas manufacturing machine, Index finger width with 5% percentile of 1.65cm to find out and determine the width of the On /Off button (switch button) for the carangmas manufacturing machine, and knee height when standing with a 50% percentile of 47.95 cm is used to determine and determine the height of material output in the carangmas manufacturing machine.

Final Ergonomic Carangmas Making Machine Design

This carangmas manufacturing machine prioritizes a mechanism that is simple, practical, comfortable, and easy in its operation and in accordance with ergonomic principles.





Carangmas maker tooling steps

1. Plugging the machine cable into the outlet
2. Put the oil in the pan.
3. Turn on the Stove
4. Enter the material for making carangmas.
5. Raise the ON switch to start the engine.
6. Mengatur kecepatan menggunakan dimmer
7. Lower the Off button to turn off the machine.
8. Take the dough then drain
9. After the dough is drained then the dough is put into the mold and then pressed
10. Dough removed from the mold

11. After all is done can unplug from the outlet.

Product Specifications

1. Capacity : 3 kg
2. With a mold 3 cm in diameter, 42 pcs
3. Frame Material: Holo 4x4 Iron and Galvalume Plate
4. Stirring material: Stainless Steel
5. Pan Material: Stainless
6. Electric Motor: 1/2 HP (1200 rpm)
7. Pulley: diameter 30 cm
8. Dimensions : 50 cm x 80 cm x 120 cm
9. With a stirring speed of 50 rpm
10. Overall Weight of Equipment: ± 65 Kg

Budget Cost

The cost of making carangmas manufacturing machines is the cost of raw materials, labor, and other costs. The breakdown of the cost of making a carangmas manufacturing machine is as follows:

No	Item Description	Price	Description
1	Material cost :		
	1) Galvalume sheet	Rp.217.000	2 pcs
	2) 4 x 4 iron rectangular shape	Rp.790.000	6 pcs
	3) 12 meter cincretenesser		
	4) 5 ml Medium B type plywood	Rp.115.000	1 pcs
	5) 12 B 2 x 2 iron rectangular shape	Rp.75.000	1 pcs
	6) ¾ inch Strip sheet iron		
	7) A1 20 x 30 Pulley	Rp.73.000	1 pcs
	8) 10 ml dynamo pulley axle		
	9) Spinner Dynamo	Rp.28.000	1 pcs
	10) 5000 volt Dimmer	Rp.150.000	
	11) Capasitor	Rp.50.000	1 pcs
	12) BKN Ucp 204 Bearing	Rp.165.000	1 pcs
	13) Medium size Rivet	Rp.160.000	1 pcs
	14) 14 mm + 12 mm screw		
	15) Screw + ring	Rp.12.000	1 pcs
	16) 13 mm screw	Rp.80.000	2 pcs
	17) ½ inch diameter iron pipe	Rp.100.000	5 pcs
	18) 5 cm diameter iron pipe	Rp.15.000	1 pcs
	19) Stainless pipe	Rp.7000	1 pcs
	20) Axle stainless	Rp.20.000	1 pcs
	21) Sheet of stainless	Rp.30.000	1 pcs
	22) 62 mm Van belt		
	23) Medium size hinge	Rp.53.000	1 pcs
	24) 10 meter wire strand	Rp.50.000	1 pcs
	25) (½ meter) wire strand	Rp.30.000	1 pcs
	26) Putty	Rp.60.000	2 pcs

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	27) Hammertoon paint silver	Rp.50.000	1 pcs
	28) Medium size brush	Rp.25.000	1 pcs
	29) Thinner	Rp.8000	1 pcs
	30) Cast stove	Rp.30.000	1 pcs
	31) Regulator	Rp.30.000	1 pcs
	32) Wok	Rp.60.000	1 pcs
	33) Light switch		1 pcs
	34) Wire	Rp.17.000	1 pcs
		Rp.33.000	1 pcs
		Rp.250.000	1 pcs
		Rp.50.000	1 pcs
		Rp.160.000	1 pcs
		Rp.25.000	1 pcs
		Rp.10.000	1 pcs
2	Manufacturing cost	Rp.1.000.000	1 unit
3	Testing cost, miscellanious	Rp.255.800	
TOTAL COST		**Rp.4.429.000**	

Calculation of Working Time of Carangmas Manufacturing Machine Using New Tools in Minute Units

By using a new tool by doing the process of frying, stirring, and printing per 5 kg with thirty experiments can be seen the difference in the stirring process with the old way of working. It can be seen from the following table:

Sampel	Xi	Xi^2	$Xi-\bar{X}$	$(Xi-\bar{X})^2$
1.	60	3600	2.44	5.95
2.	65	4225	7.44	55.35
3.	64	4096	6.44	41.47
4.	62	3844	4.44	19.71
5.	61	3721	3.44	11.83
6.	55	3025	-2.56	6.55
7.	54	2916	-3.56	12.67
8.	56	3136	-1.56	2.43
9.	58	3364	0.44	0.19
10.	61	3721	3.44	11.83
11.	57	3249	-0.56	0.31
12.	59	3481	1.44	2.07
13.	54	2916	-3.56	12.67
14.	62	3844	4.44	19.71

15.	63	3969	5.44	29.59
16.	51	2601	-6.56	43.03
17.	55	3025	-2.56	6.55
18.	54	2916	-3.56	12.67
19.	52	2704	-5.56	30.91
20.	49	2401	-8.56	73.27
21.	63	3969	5.44	29.59
22.	57	3249	-0.56	0.31
23.	53	2809	-4.56	20.79
24.	55	3025	-2.56	6.55
25.	59	3481	1.44	2.07
Σ	1439	83287		458.16

Analysis of Fried Time Data, Stirring And Printing Carangmas Using New Tools in Minute Units

- **Data similarity test**

$$\bar{x} = \frac{\sum xi}{n}$$

$$= \frac{1439}{25}$$

$$= 57{,}56$$

$$\sigma = \sqrt{\frac{\sum(xi - \bar{x})^2}{N}}$$

$$= \sqrt{\frac{458.16}{25}}$$

$$= 4{,}28$$

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UCL $= \bar{x} + k.\sigma$

$= 57,56 + 2\ (4,28)$

$= 66,12$

LCL $= \bar{x} - k.\sigma$

$= 57,56 - 2\ (4,28)$

$= -48,6$

- **Data sufficiency test**

$n = 25$

Level of trust 95%, k = 2

Level of accuracy 5%, s = 0.05

$$N' = \left[\frac{k/s\sqrt{N(\sum Xi^2) - (\sum Xi)^2}}{\sum Xi}\right]^2$$

$$= \left[\frac{2/0,05\sqrt{25(83287) - (1439)^2}}{1439}\right]^2$$

$= 11,42$

$\approx 11,42$

Conclusion

Since N' < n, then the data is sufficient.

Calculating Standard Time and Standard Output

Performance is used based on the anchoring of the operator's activities. These performances are:

❖ Skill	: Good (C1)	: +0,06	
❖ Effort	: Good (C2)	: +0,02	
❖ Condition	: Average	: 0,00	
❖ Consistency	: Average	: 0,00	+
	P1	: 0,08	

So, amount of performance (Po = 1) = Po + P1

$= 1 + 0,08$

$= 1,08$

While the allowance given by the operator is :

- Individual needs = 2%
- Influencing factor :
  - Expended energy factor = 5%
  - Work attitude = 2%
  - Work = 1%
  - Athmosphere = 3% +

= 13%

Then calculate the cycle time (Ws) :

$$Ws = \frac{\sum Xi}{N}$$

$$= \frac{1439}{25}$$

= 57,56 minute/kg

While the normal time (Wn) :

Wn = Ws × p

= 57,56 × 1,08

= 62,1 minute/kg

Amount of standard time (Wb) :

$$Wb = Wn \times \frac{100\%}{100\% - 13\%}$$

$$= 62,1 \times \frac{100\%}{100\% - 13\%}$$

= 70,79 minute/kg

Then, standard output is (Os) :

$$Os = \frac{1}{Wb}$$

$$= \frac{1}{70,79}$$

= 0,014 minute/kg

Precentage increase in standard output

$$\text{Precentage increase} = \frac{\text{New tool output} - \text{old tool output}}{\text{old tool output}} \times 100\%$$

$$= \frac{0,84-0,72}{0,72} \times 100\%$$

= 0,12 %

= 12 %

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With the new design for the carangmas manufacturing machine that is ergonomic and able to increase work and production productivity, the amount of Standard Output has increased by 12%.

Comparison of Old Tools And New Tools

Based on the data obtained from old tools and new tools can be inferred as below table:

Comparison	New Tool	Old Tool
Normal time	77,8 minute/kg	70,79 minute/kg
Standard output	0,72 kg/hour	0,84 kg/hour
Operation process	Slow	Fast
Quality	Manual, Less Ergonomic	Automatic and Ergonomic

Comparison of Old Production Processes And New Production Processes

The old production poses still use a makeshift tool that operates manually. The tools used tend to be simple kitchen appliances with operator creativity in the application of tools in the production process.

Advantage	- Easy operation
Disadvantage	- Separate tool components - Lack of resistance to tools - Low safety and comfort - Pricy

While the new tool has a semi-automatic drive machine with a high level of the economy that is supported by high-quality tool materials and contains a considerable number of production processes, it is very helpful for the production process in saving work time and increasing production results in one time of the production process.

Advantage	- Easy operation - Automatic driving machine - High quality base fram - Safety and Ergonomic - Large capacity
Disadvantage	- Bigger tool size

From the data that has been obtained, comparisons can be taken between old tools and new tools, namely old tools are still very simple and manual with a low level of comfort while the new tool is already an automatic drive tool with a high ergonomic level so as to make the operator easy and comfortable when doing the production process. Apart from that, there is also a fairly efficient advantage that the new tool has more material load so that it can save production time but with enough output results.

CONCLUSION

From the description and explanation of the previous chapters, it can be concluded that the Carangmas Manufacturing Machine is designed more ergonomically with sizes that are in accordance with the anthropometry of the operator's body compared to the old tool. Conclusions can be reached as follows:

a. The new Carngmas Manufacturing Machine has a tool length of 120 cm, a width of 50 cm, a height of 80 cm, an overall height of 120cm, a slicing width of 20cm, and a printing width of 50cm, a frying width of 50cm.
b. The use of carangmas manufacturing machine is very practical and convenient, Stirrer can be disassembled so as to facilitate in cleaning tools.
c. With the new design for the ergonomic carangmas manufacturing machine and able to increase work and production productivity, the amount of Standard Output increased by 12%.

SUGGESTION

As the perfecter of this carangmas manufacturing machine, then here are the suggestions that can be considered in the future, namely:

a. From the results of the design of tools that have been done can be further developed in the future,
b. We recommend that this carangmas manufacturing machine there is an alternative to raw materials/constituent materials that are affordable and environmentally friendly
c. The results of development on the design of this engine are then expected to use alternative fuels such as biogas, solar panels, and so on.
d. The design is more flexible, practical, and environmentally friendly
e. Preferably on MSMEs CARANGMAS to use tools that have been designed so that the production process can run better in the future.

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