TOOL DESIGN PROCESS FINISHING WORK PART BOTTOM COVER WITH POKA YOKE AND MODEL KANO

by Agus Suroso

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ABSTRACT- **PT.Ostec Indonesia is a company engaged in the manufacture of plastics injection molding is producing products made of plastic resin material such as electronic spare parts and automotive accessories. Unuk win the competition with other competitors, companies must be able to qualify and fulfillment of customer demand that is terhadapa timeliness and quality of the goods. because of that PTostec Indonesia should be able to run a more efficient production.**

Results of preliminary observations on the bottom cover part of production process that is part of the product politron, indicated some of the problems associated with waste (waste) that is not achieving the target time of production by workers during the finishing process. Based on the issues involved, the approach to the analysis of poka yoke method to determine the cause of the error to the movement in doing the job, then look for a solution to prevent such errors. Next to design a stone tool work as a solution to prevent errors canoe model was used to get the attributes and demand workers and workers in line with expectations. To enhance workplace design tools used anthropometric data calculation that gets high and the diameter of the working tools.

The final result obtained design work tool bottom cover part finishing process that can reduce the waste of time prior to the conclusion of tools designed able to reduce the time standard finishing process by the worker by 36.4% ie 48.6 seconds per one process of finishing the bottom cover part.

Keywords : Finishing Processes, Standard Time, Map of Hope, Right Hand Left Hand, poka-yoke, anthropometry, Kano.

INTRODUCTION

PT.OSTEC INDONESIA is a company engaged in the manufacture of plastics injection molding is producing products made of plastic resin material such as electronic spare parts and automotive accessories. In the production process, injection molding machines are already setting the time it takes the machine to print a particular part and become a production target for the operator. But the actual speed in working part operator can not compensate for the speed of the engine so it does not achieve the production target.
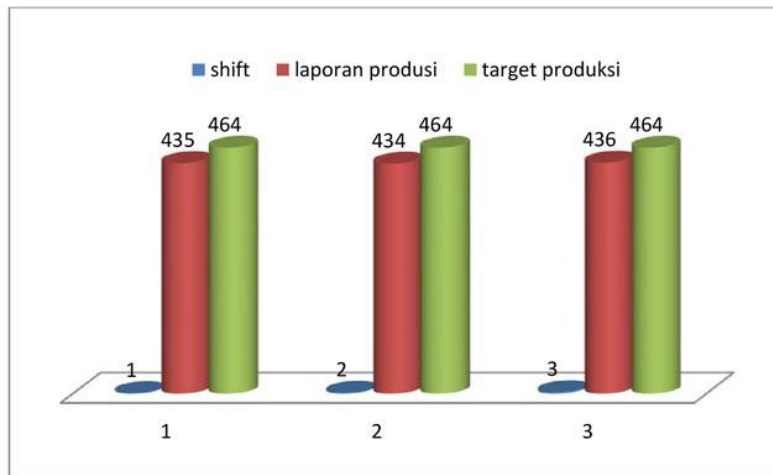
Graph 1.Comparison Target Production and Production Report Operator

the operator cannot reach target production. Shift 1 reach 435 pcs, Shift 2 reached 434 and shift 3 reached 436, while the production target of 464 pcs.
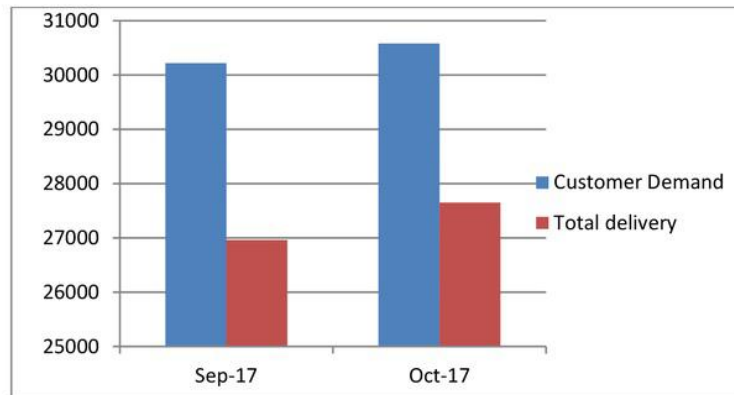
Graph 2. Comparison Between Customer Demand And Total Delivery In September And October

lack incapacity PT. Ostec Indonesia to meet demand part bottom cover. Therefore, it should find a solution to the problem solving that is in the process undertaken by the operator. Activities operator has a part in the process of five (5) working elements that capture part of the machine, Cutting runner smoothing part side, wrapping and Preparation Process parts into the box.

The problem that lies in the wrapping process so that the time required mangakibatkan operator exceeds standard time set by the company and result in not achieving the target production and customer demands are not met. By because it will be proposed further improvements to minimize or even eliminate the occurrence of the problem so that employees can work optimally and achieve production targets. Proposed improvements in this issue by designing a work tool by using error analysis motodepoka-yoke. While the design work tool menggunkanan canoe models for the benefit of attributes and data antropomerti operator's body height and diameter of the work tool grip work tool.

LITERATURE REVIEW

Measurement of Working Time

Time measurement is a job to observe and record the times it works well every element or cycle by using tools such as stop watch, observation sheets, stationery and observation board. (Sutalaksana, 1979). in determining standard time, used measures of time working directly with the clock stopping (Stop Watch Time Study) is a step by step:

1. Uniformity Test Data is determining Limit and Limit Full Control Over Under
2. Data Adequacy Test which determines whether the number of samples taken have enough data to be processed in the next process data processing
3. Cycle time is the time of completion of the production unit since the start of raw material has been processed in the workplace in question (Sutalaksana 2006).
4. Normal time is working time has been considering the adjustment factor, the average cycle time multiplied by the adjustment factor.
5. Standard Time is the time required to perform one product by taking into account adjustments and allowances

Operation Process Map

map shows a sequential operation process sequence of processes, inspection, time and materials used in manufacturing or business processes, from the arrival of raw material to the packaging process of production so (Sutalaksana: 2006)

Map Right Hand - Left Hand

Map of the left hand and right hand are picturing a map of the entire elements of movement while working and idle time performed by the left hand and right hand (Sutalaksana: 2006),

anthropometry

Static anthropometry is about physical traits beyond the human is at rest or in a standardized position. While the dynamic anthropometric about keadan and physical characteristics of man on the move or pay attention to the movements that may occur when the worker carries out its activities (Sutalaksana: 2006).

Foka-Yoke Methods

Poka Yoke is a technique to overcome and avoid simple mistakes that caused by human or worker (human error) in the workplace in a wayprevent it directly from the root cause (root cause) errors and drew particular attention in a job or a task that did not have the possibility to make a mistake (Shigeo Shingo, 1960).

Kano Model

Kano Kano Model or Diagram is a diagram that divides the specifications of the products supplied to customers (Berger, et al, 1993) .. Mapping preferences of consumers is a way of understanding the attributes and selected service expected by customers in obtaining satisfaction. namely customer service attributes permiantaan Attractive, Must-Be, One-dimensional, Indifferent, Reverse, questionalble

Design And Product Development

According to Ulrich (2003) concept of the product is a description or estimate of the technology, working principles, and the shape of the product. The product concept is a brief overview of how the products satisfy customer needs. The process of drafting begins with a series of customer needs and specifications of the target, and ends with the creation of some of the concepts of product as a final option. Identifiaksi customer needs is an important part of the concept development phase, which is one phase of the product development process.

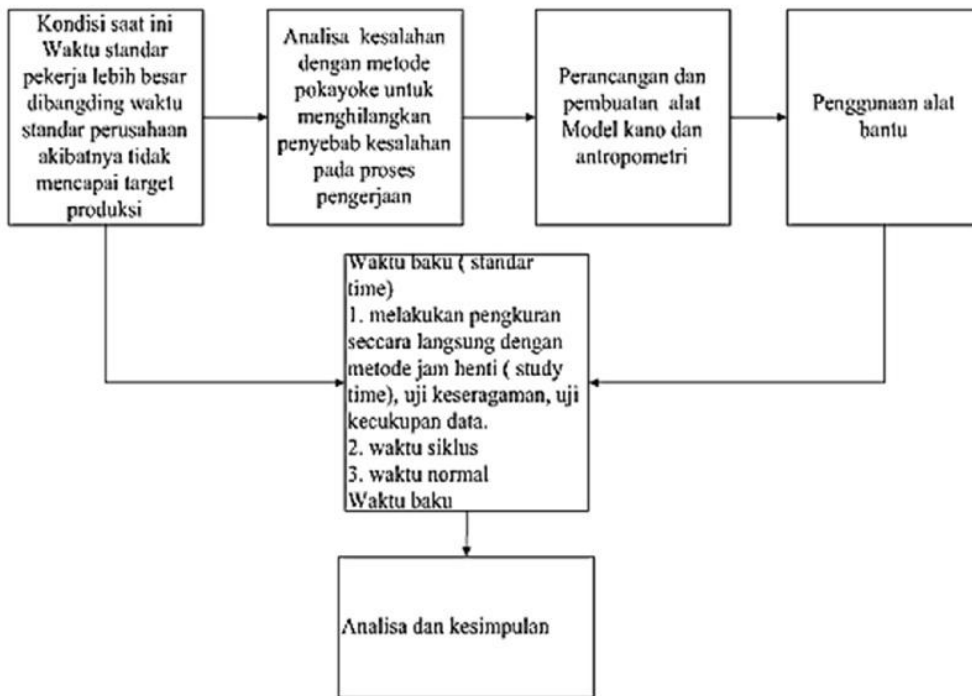Framework in this study as shown below.

Figure 1.Flow chart Framework Research Design Tool WithFoka-Yoke Method and Model Kano

METHOD

Data processing

Data processing is performed to make the raw data obtained from the company can be useful in research. The data in this study is to recapitulate the results of interviews and questionnaires, anthropometric measurement, calculation processing time and canoeing.

Design

The design is made to be able to determine the shape of the new tools will be developed and conducted trials in the studied company so that it can be analyzed further. picture of the flow diagram in the design stage can be seen from the picture below.
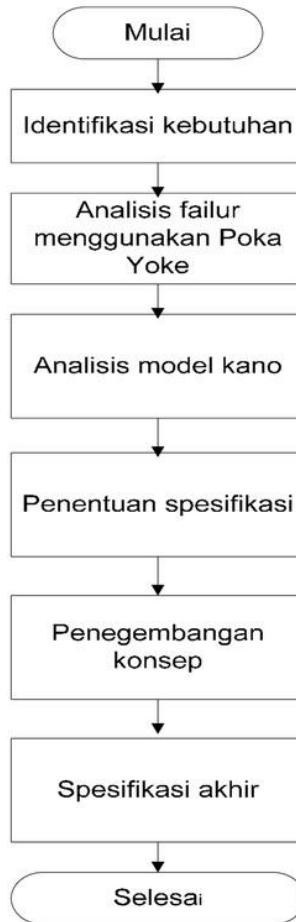

Figure 2 Stages Design Process Flow Chart

Implementation

Implementation is done in order to determine how effective the design examined in dealing with problems that occur in the company. Implementation also provide evidence of the theoretical results to real-world designs.

Analysis

The analyzes were conducted to examine what things can happen and change in the company if it is applied to the company's research.

Flow chart Steps Design

The following will explain how the stages in the manufacture of plastic mounting tools protectife part of a type of bottom cover. Flowchart of stages of the design process tools protectife plastic mounting type on the cover bottom part can be seen in Figure 3.
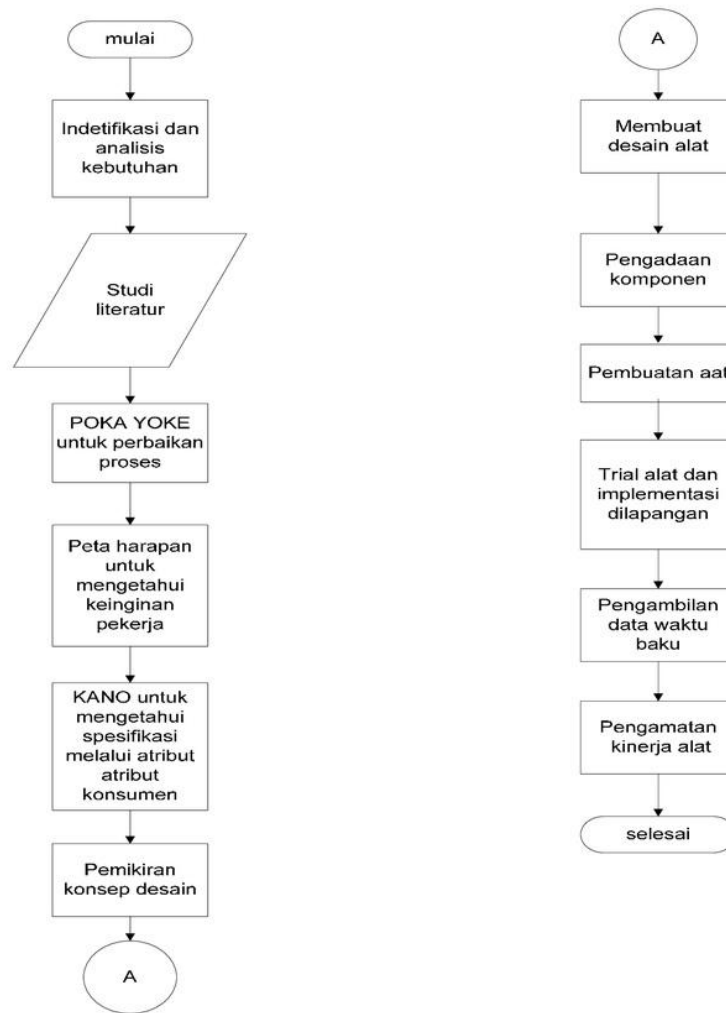
Figure 3. Flow Chart Steps Planning

Identification and Analysis of Needs

The tools will be made should meet the following criteria:

1. Easy to use
2. Simple, it takes a big place
3. easily moved
4. In accordance with the functions and needs

Study of literature

The study of literature is used to understand the basics of the theory related to the design of the tool, which is expected to provide an overview of design-making tool.

Map Of Hope

The conduct interviews orally to all workers of the complaints and needs of workers as well as the desired expectations of workers to achieve comfort while working.

Canoe

A diagram that divides the specifications of the customer into three types must be, one-dimensional and attractive and compared to the level where a specification through the attributes of consumer desires.

Table 1Formulas In Kano Category Determination Of Data Questionnaire Fungtional And Disfungtional

consumer needs		Dysfungtional				
		1	2	3	4	5
		like	hope	Neutral	Tolerance	Do not like
Fungtion al	1. Likes	Q	8	A	A	O
	2. hope	R	I	I	I	M
	1. Neutral	R	I	I	I	M
	2. Tolerance	R	I	I	I	M
	3. Do not like	R	R	R	R	Q

Thought Concept Design

Any thoughts or ideas that there is put into an initial design which is also called the sketch

Creating a Design Tool

After thinking about the design of the tool is then determined what kind of model to be created, then made a final design that is used as a reference in making tools.

Component Procurement

Components that there is no need to be provided as possible because it concerns the readiness tool. If there is one component that is not available then it will disturb terselesainya timely tool.

Toolmaking

Once everything is available, including tooling to be used, then the next step is pembutan or assembly tools. Normally this process will take a long time. If obstacles usually use a common workshop for accomplishing the manufacture of the tool with direct supervision in the field.

Trial Tools and Implementation on the Ground

This effort was conducted to determine the ability of the packaging tool dim sum into Styrofoam boxes that have been made, whether it meets the wishes or not. Trial conducted several times to get good results.

DATA COLLECTION AND PROCESSING

Finishing Process Standard Time Part

1. Determining the cycle time

The formula for calculating the cycle time (WS)

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

$$WS = \frac{120.78}{18} + \frac{203.75}{16} + \frac{542.71}{17} + \frac{662.85}{17} + \frac{39.12}{15}$$

$$WS = 92.91 \text{ sec / Process}$$

2. Normal time (wn)

Normal time obtained by providing cycle time adjustment factor. Normal time can be calculated using the formula:

$Wn = wsxp$

P = adjustment factor bootm cover part finishing process

$+0.11\ p = 1$ or $p = 1{:}11$

$Wn = 92.91$ sec / finishing x $1{:}11 = 103.13$ sec / finishing

3. standard time

$WB = Wn\ (1 + \% \text{ leeway})$

L = allowances or allowance provided to workers Finishing Process Part Bottom Cover is 30%

$WB = 103.13\ (1 + 30\%)$

$WB = 134.06$ sec / finishing

Body anthropometry

1. Precentil value (P 5) hand grips dimensions:

    P 5 $= X - (1{,}645 \times \sigma)$

            $= 4{:}46 - (1{,}645 \times 0.2)$

2. Precentil Value Dimensions Height Elbow Stand:

    P 5 $= X - \mu (1{,}645 \times \sigma)$

            $= 102.2 - (1{,}645 \times 1{:}48)$

            $= 98.62$ cm

In Wrapping Process Design Tool Using this lower Precentil (P5) dikrenakan in the design tools standing posture and require suppression while working. To calculate tinggi table and diameter hand grip with a normal distribution of data may be used by the formula:

$Z = (X - \mu) / \sigma$

$X = Z \times \sigma + \mu$

Where :

- Z is the z value in a normal distribution z table
- μ is an average measurement
- σ is the standard deviation
- X is the value precentil

1. Hand grip diameter:

    $\sigma = 0.2$ cm $\mu = 4{:}46$ cm

    4:13 Precentil%, then the value of z in the table z = -1.73

    X $= (-1.73 \times 0.2 \text{ cm}) + 4{:}46 \text{ cm} \rightarrow X = 4.1$ cm

    Then roll the handle diameter is 4.1 cm foam

    Elbow High Standing

    $\sigma = 1{:}48$ cm $\mu = 102.2$ cm

    Precentil 98.62%, then the value of z in the table z = 2.2

    X $= (2.2 \times 1{:}48 \text{ cm}) + 102.2 \text{ cm} \rightarrow X = 105.45$ cm

    Then the draft table height of 105.45 cm

Map of Left Hand Right Hand

Table 2.Map of the Left-Hand Right Hand

PETA AND LEFT HAND RIGHT HAND					
Left hand	Distance (Cm)	Time (Seconds)	Time (Seconds)	Distance (Cm)	Right hand
Total	130 cm	66 seconds	89 seconds	275 cm	Total

Analysis Foka Yoke

Table 3.Analysis Foka-Yoke

No.	Cause of the problem	Securities Issues	Solutions
1	Platik rolls decision and refund of the edge of the table	Operator fatigue, resulting slow motion	Creating a work tool as the ergonomic plastic rolls according to function
2	Plastic rolls are not in a fixed position	Movement of the right hand and left hand while unrolling the plastic is not optimal so it takes a lot of	Make a roll of plastic retainer that is designed according to the needs and size of the plastic rolls oprator
3	Part are not in a fixed position or a touch will move	Movement of the right hand not optimal so	Designing tools to facilitate workers perform wrapping packing part is that part in a fixed position.
4	Part is not in a fixed position	Pengalusan surfaces must be repeated because there are waves thereby increasing working time	Designing tools in order to work as a part daam fixed position
5	Position parts and plastic rolls are not fixed	The cutting process is not neat	Designing a work tool in accordance with the size of the roll of plastic parts and also making it easier for operators to cut plastic daam in accordance with a predetermined size

Analysis Methods Kano

Determination of customer requirements through a survey conducted by using a questionnaire. CR is then divided by category attractive, one-dimentional and must be based on the sharing of satisfaction canoe models. Customer requirement against tools Bottom Cover Part Finishing process can be seen in Table 4.23.

Table 4. Customer Requirement (Cr) Against Aids Finishing Process Part Bottom Cover

No.	Category	Attribute
1	must be	The size is designed according to the specifications table part
		Sebadan hook designed with a foam plastic wrap
		Designed 95 cm high table of 10 -20 cm below the standing elbow height of the average worker
2	One dimensional	Points can be designed part in ride and lowered by using additional tools with the system up and down buttons
		Place plastic wrap with a table designed sebadan
		Place plastic wrap made of iron pipe
		Order table is made of iron pipes
3	Atraktive	Tablecloths made of rubber

Process Flow Map

Process flow map using the type of process flow map is a map that describes the worker process flow work flow group of people.
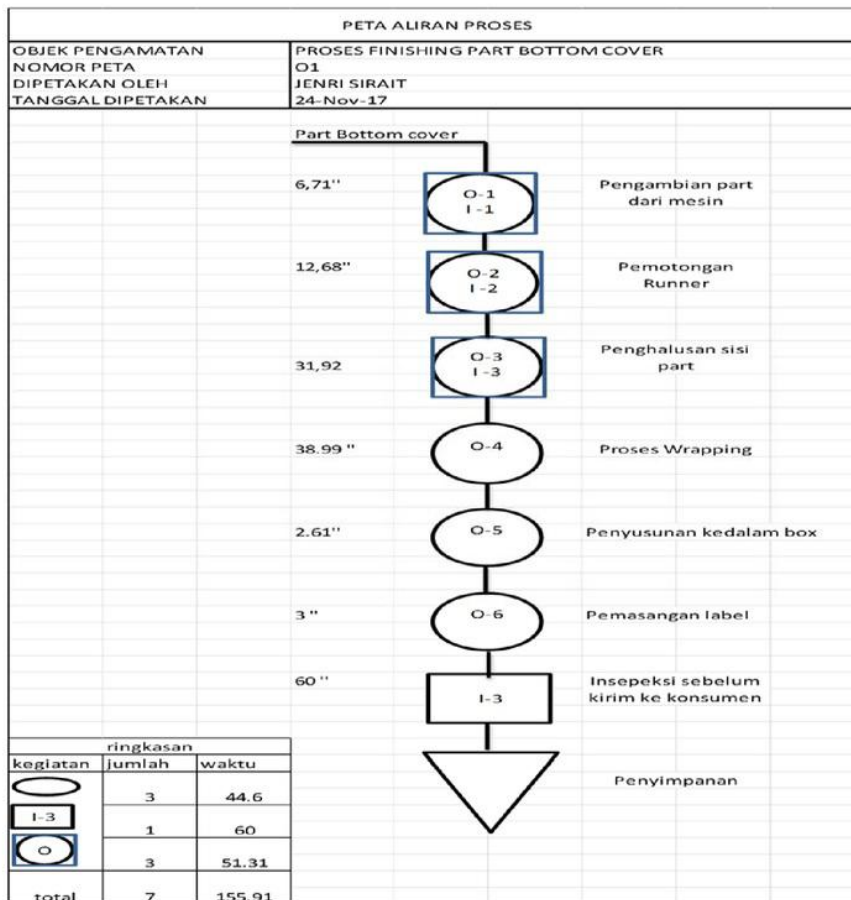

Figure 4. Map Process Flow

DESIGN AND ANALYSIS

Finishing Tools Cover The Bottom Part

The needs of workers who are critical to the process of finishing the bottom part by using plastic cover protectife types are as follows:

1. Reducing the time workers during the wrapping process
2. Facilitate the process of wrapping.
3. Reducing the burden of power that comes out during the wrapping process.

Map Of Hope

Map of hope is made to find the design of tools finishing bottom cover part that is in the process of wrapping with plastic protectife type.

Table 5.Map of Hope Aid Finishing Process Part Bottom Cover

No.	Complaint	Needs	Hope	design
1	Parts hand pain because it raised repeatedly protectife plastic gulugan	Wrapping tool bottom cover has a table laying and retaining the roll of plastic protectife	The tools have a strong table and lever retaining rolls	The tools have a strong table and plastic rolls Protectif retaining lever can rotate 360
3	Right hand and left arm stiff and sore	Retaining part bootm tools cover for wrapping process	Large is a table that can hold the part so as not to slide	Make a retaining table that will be subject hidrolic scaled with the help of water.
4	Parts of the left and right shoulder soreness due to the high table does not fit the needs of workers	Tools which have high ergonomic packaging	According to the item table used so that workers need not lowered position.	High in the design table after measuring the data antopometri standing elbow height.
5	Pain in the hands	Part surface Pengalusan tools already in wrapping	Smoothing tool is made in the form of roll	Tools made of roll that can rotate 360

From the map expectation wrapping tools cover the bottom part can be known design tools to be expected by the workers in order to help overcome physical complaints suffered by workers and reduce work time obtained from the calculation has been done before

There are four very important part in the design of this tool are:

1. Vertical lever on the end of the table, its function is to hold rolls of plastic and designed to rotate 360 degrees.
2. Triplex board at the top of the table as the bottom part retaining cover to be wrapping.
3. hidroulic water to remove the part that was already in triplex board, it is easy for the operator to take part are already attached to the triplex board equipped with up and down buttons.
4. Perforated pipe at the end of the table as a foam roll

Concept testing proposal

Concept testing in this study conducted by creating a tool based on the design that has been determined and can be immediately used and tested that in the eternal as a working prototype. The purpose of making a working prototype is to do the implementation while the mill and can do the analysis of the prototype. The purpose is to obtain the temporary implementation of standard time of prototypes and can be directly compared to the time before the finishing process.
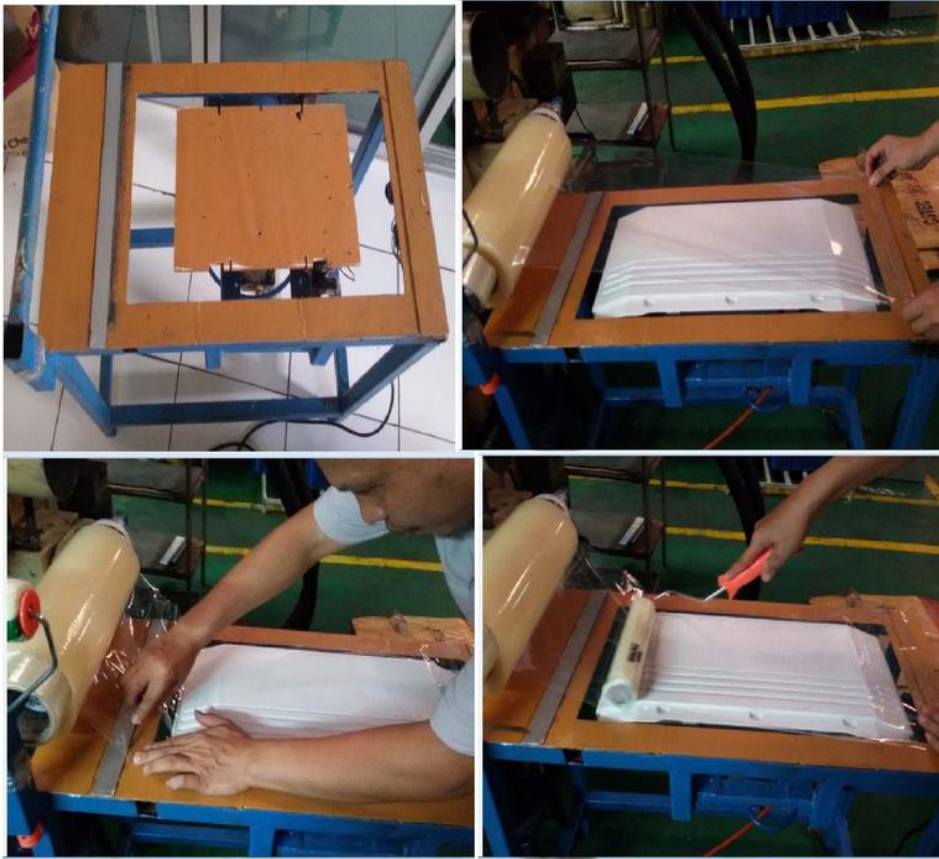
Figure 5. Implementation of the Concept Proposal

Determination Standard Time Using Result Finishing Process Design Tool Part Bottom Cover.

1.   Calculating the Cycle Time

After pass the test the adequacy of the data that has been getting from the measurement results of each element of the process of bottom cover part. Next calculate the cycle time.

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

$$WS = \frac{69.42}{16} + \frac{172.40}{17} + \frac{386.82}{16} + \frac{325.02}{19} + \frac{37.49}{18}$$

$$WS = 57\,832 \text{ sec / Process}$$

2.   Calculating Time Normal

Normal time obtained by providing cycle time adjustment factor. Normal time can be calculated using the formula:

$Wn = wsxp$

P = adjustment factor finishing process bootm cover part of

$+0.11$ p = 1 or p = 1:11

Then the normal time is as follows:

$Wn = 57\,832$ sec / finishing x $1:11 = 64.19$ sec / finishing

3.   Calculating Standard Time

Standard time is the normal time given leeway. Calculating the standard time using the following formula.

$Wb = Wn (1 + L)$

L = allowances or allowance provided to workers Finishing Process Part Bottom Cover is 30%

WB = Wn (1 +% leeway)
WB = 64.19 (1 + 30%)
WB = 83 452 sec / finishing
Changes in raw time before the usage of tools or manual labor and the use of tools after work.
1.   The standard time manually = 132.06 seconds
2.   The use of standard time working tools = 83 452 seconds
3.   Decrease time = 48. 6 seconds

Analysis Map Right Hand and Left Hand Design Results

Table 6.Movement of the Left Hand - Right Hand In Part Bottom Cover Finishing Process Using Work Aids

LEFT HAND	DISTANCE (CM)	TIME (SECONDS)	TIME (SECONDS)	DISTANCE (CM)	RIGHT HAND
Total	235 cm	57 seconds	64 seconds	295 cm	Total

Based on the maps left hand - right hand at 5:11 table shows the results obtained when the movement of the right hand and left hand still has time to wait, but very little is 7 seconds compared to the movements performed prior to use work tool. This suggests a very significant time change is a decrease in working time by 23 seconds prior to using the tools of work.

CONCLUSION

Based on the observation and analysis of the results of research on the process of finishing the design tools cover the bottom part.it could be concluded that:

1.   Mistakes made by the operators in doing the job analyzed by foka-yoke is movement of the hand is not balanced and not optimal in performing work in accordance with work instructions due to cover the bottom part and the plastic rolls are not in a fixed position. By because it is necessary tools to facilitate operator working at his job.
2.   The design of tools designed to work with a model canoe and anthropometric data body standing elbow height 105.51 cm and 4:26 cm diameter hand grip that is in accordance with the needs of operators or customer requirementconducted through a survey using a questionnaire. CR is then divided by category attractive, one-dimentional and must be based on the sharing of satisfaction canoe models.

The size of the table is designed to be in accordance with the specification part

a)   The place is designed to be sebadan roll foam with a plastic wrap
b)   Designed 95 cm high table of 10 -20 cm below the standing elbow height of the average worker
c)   Points can be designed part in ride and lowered by using additional tools with the system up and down buttons
d)   Place plastic wrap with a table designed sebadan
e)   Place plastic wrap made of iron pipes.
f)   Order table is made of iron pipes
g)   Tablecloths made of rubber

From the results of the working prototype implementation of the proposed tool then have made observations and field observations on the use of direct aids wrapping process. Changes in raw time before the usage of tools or manual labor and the use of tools after working 36.4%.

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