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Dmaic Method Approach (Define, Measure, Analyze, Improve, Control) For Analysis Of Product Disability In Sandal Smes In Cileunyi

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ABSTRACT: *Sandal's UKM in Cileunyi produce sandals products which are supplied to hotels in Bandung. Quality is one thing that must be prioritized during the production process. Defects in the product are one of the risks obtained when producing sandals. Quality that does not meet this standard is a waste. This study has purposed to analyze the broken products so it can have the result for improvement that can decrease the quantity of broken products. This analysis use DMAIC (Define, Measure, Analyze, Improve, Control) method. Define phase produces factors that cause product failure and the classification of value added activity and non value added activity in the production process. Measure phase There are 3 causes of product defects, including: the results of inappropriate embossing as much as 47.95%, the results of improper cutting as much as 33.60%, and the results of screen printing strap not as much as 18.45% which shows the results of sigma level Sandal's UKM is 3,39 σ and. Phase analyze is a causal analysis of factors that cause product defects using fish bone. The improve phase is in the form of recommendations for improvement using the 5 S method. And in the control phase which is in the form of control and supervision of the implementation of the recommendations for improvements made at this Sandal SME, so that it is expected that sigma values can increase and product defects can be reduced.*

Keywords*: Six Sigma, DMAIC, VSM, 5S, Fish Bone, CTQ*

I. INTRODUCTION

Bandung is a city that is famous as a complete city tourist destination. Beside that being a tourist destination, Bandung is the provincial capital with 3.7 million population. Community activities enter from outside are very busy one after another. This makes the basis for increasing of hotels rent in the city of Bandung, both on holidays and on weekdays.Hotel'slipper is one of the complete room products given to consumers who rent hotel rooms themselves.

Sandal's UKM in Cileunyi produces sandal that are used in hotels. Currently, Sandal UKM supplies to 3 hotels in Bandung and Jatinangor. One of the hotels becomes consumers is "Hotel X". As UKM that produce products, SME are required to produce good quality products and produce products in a timely manner as agreed with the Hotel. This Hotel Slippers product is made with a Make To Order system, this is because the specifications of the sandals that ordered have differences, such as the thickness of the sandals, the type of sandal material, the design of the sandals, and the hotel identity screen printing on the sandals. At present, the quality of sandals produced is felt to be not optimal, especially for hotel slippers that are supplied to "Hotel X", due to the amount of reject ± 9% of the amount produced. The amount is certainly very large and cause losses for Sandal's UKM, because rejecting products will be discarded and not used

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anymore. Products that do not meet this standard include: the results of emboss that is not proper, the results of cutting that do not fit, and the results of screen printing on a strap that is not clear. The DMAIC method (Define, Measure, Analyze, Improve, Control) was chosen because this method can be used as a quality controller, which results in any factors that cause disability in the resulting sandal product.

II. RESEARCH METHODOLOGY

This research took place at Sandal's UKM at Cileunyi. Production data and decays in the period July 2019 to December 2019 were used to analyze the decay's product in sandals using the DMAIC approach. DMAIC is a process of continuous improvement towards the six sigma target. DMAIC eliminates unproductive process steps, and focuses on new measurements, the application of technology for quality improvement towards the Six Sigma target. The stages in this study include:

1.1 Define

This stage is the first stage in Six Sigma. Define, which is to formally define targets for process improvement that are consistent with customer demand or needs and the company's strategy. At this stage the Current State Value Stream Mapping (VSM) will be conducted. VSM is all activities (both value added and non value added) needed to process a product through two main streams, namely: (1) production flow from raw materials to customers and (2) design flow from concept to implementation. Value stream mapping is also a method of mapping to map value streams (value streams) in detail to find the presence of waste and find the causes of waste and offer the right way to eliminate or at least decompose it. At this stage, VSM aims to find out how the material flow, information flow, and the production stage that is passed to produce these sandals.

1.2 Measure

Measure is measuring the performance of the current process (baseline measurement) so that it can be compared with the targets set. Some things done in this stage are: determining the dominant defect which is CTQ (Critical to Quality). CTQ is a tool commonly used to decompose or decompose customer requirements that are broad enough to be quantified requirements and are easier to process. The CTQ that have been calculated is the type of reject that affects the quality of the sandals produced, then measures the total DPMO value and the sigma level. DPMO is one of the process capability assessments to measure how well a production process is. Other process capability assessments include DPU (Defects Per Unit), Z-score (Sigma Level), Cp and Cpk.

1.3 Analyze

Analyze is analyzing the causal relationships of various factors that are studied to determine the dominant factors that need to be controlled. At this stage the tools used to analyze, search for and find the cause of the problem of note on the sandals are using the Pareto diagram of the defective product produced and the Fish Bone diagram. Regarding statistical process control, Fish Bone diagrams are used to show the causative factors and the quality characteristics (consequences) caused by the causal factors (Gasperz, 2003).

1.4 Improve

Improve is to optimize the process using analyzes such as Design Of Experiment (DOE) and others, to find out and control the optimum conditions of the process. At this stage, the application of the 5S concept is used as a proposed improvement to reduce the some defects in sandal products. 5S is an intensive method of structuring and maintaining work areas originating from Japan that is used by management to maintain order, efficiency, and discipline at work sites while enhancing overall company performance.

1.5 Control

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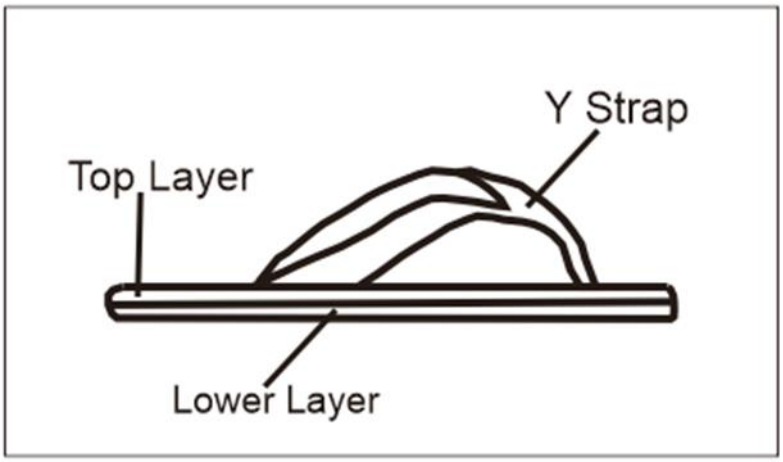
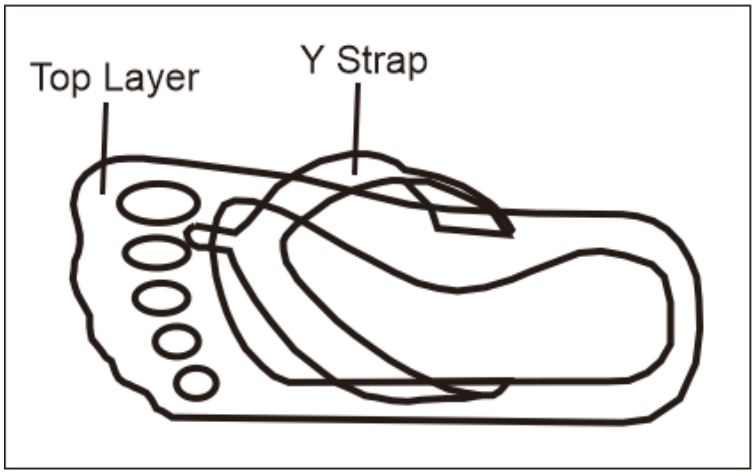
This stage is the stage to control the process that has been improved. Control can be done using tools that have been used or with other tools. The control used for this problem is to carry out continuous monitoring of improvements made, and test the results of the improvements that have been applied.

III. RESULTS AND DISCUSSION

At this stage will be explained from the results of data collection and data processing. Here is one example of sandals produced by UKM's Sandal, namely:



Picture 1 Top Pedestal "Hotel X" Sandal Products



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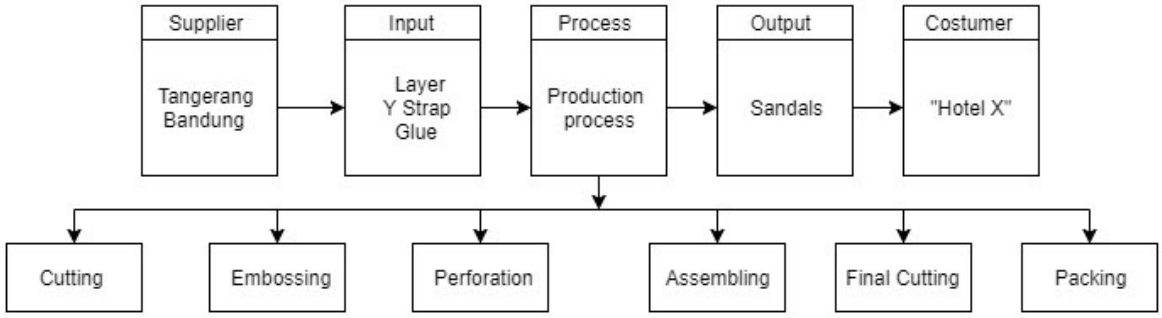
Picture2 Side View of "Hotel X" Sandal Products

This is SIPOC diagram of the process of making sandals at Sandal's UKM in Cileunyi:



Picture 4 SIPOC Diagram Sandal Products

a. Define

At this stage the VSM Current State is made, it aims to find out how the material flow, information flow, and the production stage through which to produce these sandals. The following is a description of the Current State VSM on "Hotel X" sandal products:

The raw material used is sent through 3 different suppliers. First is a pedestal supplier from Tangerang, the second is a sandal strap supplier from Bandung, and the third supplier is a glue supplier from the city of Bandung.

1. The first step is checking the raw material received from the supplier of the base material that comes in the form of sheets with a size of 120 x 220 cm, the maximum time required is 20 minutes. Checking is done so that there is no lack of raw materials or damage to raw materials, after the raw materials are declared good then prepare tools for measuring and cutting raw materials into 2 parts for the base and bottom base to be measured then each material is cut to ± 15 width cm. The preparation time is 10 minutes, after all is ready, measurements will be made according to the production plan, that is, the measurement time is 30 minutes after being measured and patterned, then the cutting process takes 120 minutes. The total time needed for the cutting part is 180 minutes and is done by 2 operators and there is no shift.

2. The next step is embossing. This stage is the printing activity of sandals that have been patterned according to size and there will be a pattern for the flip holes using a machine that has a heat of around 80 ° C with a pressure of 7 bar / 7,105 Pa. This part is done by 1 operator and there is no shift. First the operator prepares the machine, which is to wait for the machine to heat up and prepare the printing tool with 60 minutes, after it is ready, then the embossing process will take 120 minutes. Next, the results of embossing return to the cutting process are intended to make the sandals into small parts. Cutting time after embossing process is 115 minutes. The total time needed for the embossing process is 295 minutes.

3. Perforation is the next step in the process of producing sandals. This stage is done by 1 operator and there is no shift. After the embossing and cutting process will be made perforating according to the results of the embossing and only perforating the bottom part of the sandals or the orange part by using a hammer and iron tools such as nails by beating into the existing part of the pattern. The time needed is 60 minutes, after the whole then the next process is the installation of a strap that will be inserted into the hole. Before installation the operator will prepare the tool and strap in the preparation warehouse takes 30 minutes, after all is ready, the operator will install the strap by using a tool such

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as a small iron to help insert the strap which has 3 holes and takes 120 minutes. The total time needed for the process of punching and installing the strap is 210 minutes.

4. The next stage after all the orange and white sandals are ready, the assembling process will be carried out. The assembling process includes the process of gluing between the bottom base with the top base of the sandals and press press which is done by 1 operator and there is no shift. The first step is the preparation of materials and tools such as glue and brushes to attach the glue to the sandals. The preparation time for this process is 30 minutes. After all is ready, glue will be applied to the two sandals by applying the brush using a flat and thin brush to the base of the two sandals after which the two bases are glued together. The time needed is 60 minutes. The next process is to do a press using a press machine by means of the sandals inserted into the press and a strong emphasis is made with the second goal that the sandals will blend together firmly and not be easily detached. the time required in this process is 40 minutes. The total time needed for the assembling process is 130 minutes.

5. The next stage is finish cutting, which is the process of cutting the remaining sandals that have been formed. The purpose of this stage is so that sandals are formed according to the pattern. This stage is done by 1 operator and there is no shift. The first process for preparing a cutting machine is different from the previous cutting machine. This machine will cut according to the mold that has been made and the mold has a sharp knife with the aim that the sandals are cut perfectly. The time needed at this stage for preparation is 15 minutes and for the cutting process is 60 minutes. The total time needed for the finish cutting stage is 75 minutes.

6. The last stage is packing, this stage is done by 1 operator and there is no shift. The packing is done by arranging sandals with a pile pattern, a stack of 20 pairs of sandals which are then put into a large clear plastic with the contents of 1 plastic 5 piles of sandals and then the goods are ready to be sent to consumers. The total time required at the packing stage is 45 minutes.

Based on the Current VSM described, 935 minutes or 15.58 hours were obtained to produce these sandals in one production per batch. It can be concluded that during the production process, there is still a lot of ineffective time. This waiting time adds to the time needed to complete the sandals order. The amount of non value added is 450 minutes.Value added and Non Value Added (NVA) activities in the production process will be explained in **Table 1.**

Table 1 Identification of VA (Value Added) and NVA (Non Value Added Activity) Making Sandals

No	Activity	Activities	Times (Minutes)	VA/NVA
1	*Cutting*	*raw material checking*	20	VA
		Preparing material and tool	10	NVA
		raw material measuring	30	VA
		Cutting	120	VA
2	*Embossing*	Preparing *emboss machine*	60	NVA
		Embossing	120	VA
		Cutting	115	VA
3	Pelubangan	Perforation process	60	VA
		Preparation*strap*installation	30	NVA
		*Strap*installation	120	VA
4	*Assembling*	*Assembling*preparation	30	NVA
		Gluing on the top and the bottom of the layer	60	VA

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		Pressing process	40	VA
5	*Finish cutting*	Prepared	15	NVA
		Cutting	60	VA
6	*Packing*	*Packing*	45	VA

(Source: Collecting Data)

b. Measure

Measurement at this stage is done by determining CTQ (Critical to Quality) which is the type of reject that affects the quality of the sandals produced. Data collection is done by taking data on the number of products inspected and the number of reject products found during July 2019 to December 2019.

Table 2 Number of Sandals Checked and Number of Sandal Reject

Month	Number of Verification (units)	*Reject* Amounts (unit)
July	3380	296
August	4080	409
September	2340	241
October	4560	205
November	3390	341
Desember	3470	389
Total	21220	1881

(Source: Collecting Data)

From the result's *reject* above there are 3 kinds of*reject* that affects the quality of sandals. The number of rejects from the 3 CTQs:

Table 3 *Reject* Total Each Type

Month	Embossing results do not match (unit)	Incorrect cutting results (units)	The screen printing strap does not match (unit)
July	100	102	94
August	270	100	39
September	108	83	50
October	99	87	19
November	175	99	67
Desember	150	161	78
Total	902	632	347

(Source: Collecting Data)

Tabel 4 *Reject*Percentage

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CTQ	*Reject*Total *(unit)*	*Reject*Percentage (%)	Cumulative*Reject* (%)
Embossing results do not match (unit)	902	47,95	47,95
Incorrect cutting results (units)	632	33,60	81,55
The screen printing strap does not match (unit)	347	18,45	100,00
Total	1881	100,00	

(Source: Collecting Data)

$$Percentage\ of\ Reject = \frac{Total\ of\ Reject\ (unit)}{Sub\ Total\ Reject\ (unit)}\ x\ 100\%$$

$$Percentage\ of\ Embossing\ results\ do\ not\ match = \frac{902}{1881}\ x\ 100\% = 47{,}95\%$$

Table 5 DPMO Calculation Results and Sigma level Recapitulation

Month	Number of Verification (units)	*Reject*Total *(unit)*	*CTQ*	*DPO*	*DPMO*	*Sigma*
July	3380	296	3	0,029	29191	3,40
August	4080	409	3	0,033	33415	3,34
September	2340	241	3	0,034	34330	3,33
October	4560	205	3	0,015	14985	3,68
November	3390	341	3	0,034	33530	3,34
Desember	3470	389	3	0,037	37368	3,29
Total	21220	1881	3	0,030	29548	3,39

(Source: Collecting Data)

$$DPO = \frac{Total\ of\ Reject\ (unit)}{Total\ of\ Examination\ (unit)\ x\ CTQ}$$

$$DPO = \frac{1881}{21220\ x\ 3}$$

$$DPO = 0{,}029548 \sim 0{,}03\ unit$$

$$DPMO = DPO\ x\ 1000000$$

$$DPMO = 0{,}029548\ x\ 1000000$$

$$DPMO = 29548\ unit$$

$$Sigma\ Value = normsinv\left(\frac{1000000 - DPMO}{1000000}\right) + 1{,}5$$

$$Sigma\ Value = normsinv\left(\frac{1000000 - 29548}{1000000}\right) + 1{,}5$$

$$Sigma\ Value = 3{,}387 \sim 3{,}39\ \sigma$$

From the sigma calculation results above, it shows that Sandal's UKM in Cileunyi produce a sigma level of 3.39 3,. This means that the process capacity produces 3.39 defective products from one million opportunities.

c. Analyze

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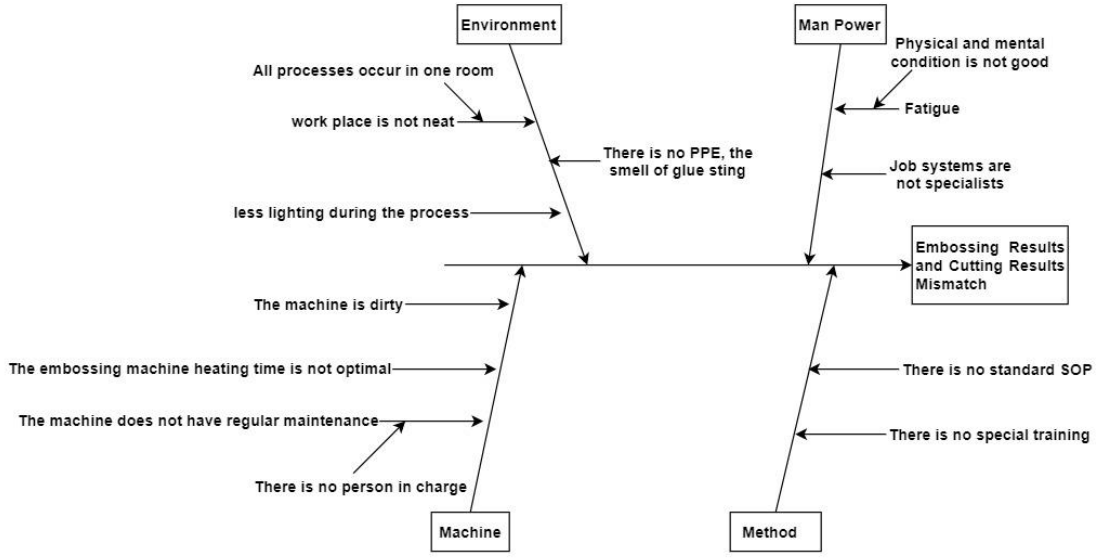
After collecting and processing data to find the main factors that cause the existence of products that are rejected, the results obtained reject product factors derived from the results of an inappropriate emboss that is equal to 47.95% and the results of cutting that is not appropriate that is equal to 33.60%. The results of inappropriate embossing in the form of a lack of pressure carried out during the emboss process, so the results are not visible, or not neat and in the form of the emboss machine temperature used is not optimal so as to produce emboss results that do not meet the requirements. Unsuitable cutting results are produced from the finish cutting process, where when laying and using a knife is not in accordance with the results of the emboss, so there are parts of the emboss that are cut off. To identify the cause and effect of the results of embossing and cutting results that are not appropriate, then identified using fish bone. Here are the results of identification using fish bone:



Picture 3 *Fishbone* Diagram emboss result andimprecise cutting result

d. Improvemente

Based on the conditions of the production process and the reasons for the existence of reject products, the following are recommendations for improvement to Sandal's UKM using the 5s method:

Tabel 6 Improvement Recomendation Based on 5S

Concept	Improvement Recomendation
Seiri/ Concise	- Separating goods and tools needed for work - Make a list of what tools are needed during the work in progress
Seiton/ Neat	- Perform cleaning after finishing work - Make equipment storage areas - Store equipment that has been used to the place of origin of storage that has been provided - Make a dividing line between the storage area of raw materials, and finished products - Create a dividing line for each area of the production process
Seiso/ Clean	-Make a clean picket schedule and appoint one employee as the person in charge -Provides the necessary room cleaning equipment

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	-Provides machine cleaning tools, such as brushes. In order to facilitate cleaning the machine
Seiketsu/ Treat	-Make a procedure for cleaning the machine, so that the tool to be used is always clean -Making procedures for maintenance of production machinery
Shitsuke/ Clever	Disseminating information on 5S and the rules made in implementing 5S. Ensuring 5S is running well in UKM, by conducting periodic checks

(Source: Collecting Data)

e. Control

The control that can be carried out on this Sandal's UKM is by continuously monitoring the improvements made, and evaluating the results of the improvements that have been implemented, so that the UKM themselves can find out whether the improvements made have a positive impact on the recorded products produced or no.

IV. CONCLUSIONS

Sandal production process on UKM in Cileunyi includes several processes, namely the process of cutting, embossing, punching and strap installation, assembling, final cutting and packing. The production process there are still a number of activities that are considered ineffective. The results of the DPMO calculation are 29548 units, which means there will be a chance of product defects of 29548 units from the process failure per one million opportunities, with a sigma level of the x hotel sandals production process of 3.39 s. There are 3 causes of product defects, including: the results of inappropriate embossing as much as 47.95%, the results of improper cutting as much as 33.60%, and the result of screen printing strap which is not as much as 18.45%. Factors that cause the results of inappropriate embossing and cutting derived from human factors in the form of physical and mental conditions that are not good and work that is not specialized, method factors include the absence of special training of employees during machine operation and the absence of standard SOPs that are enforced, machine factors in the form of a dirty machine at the time of operation, there is no engine maintenance schedule, the engine heating process is not optimal and there is no person in charge of the machine, and environmental factors in the form of a production process that occurs simultaneously and mixed in one room, a messy work area, and the lack lighting during the production process. The proposed improvement for reducing the number of flip defects in UKM in Cileunyi is by applying the 5S concept to simplify and reduce Non-Value Added activities in the production process. This recommendation is based on the results of observations made directly to Sandal's UKM in Cileunyi. Implementation of the Proposal must be accompanied by continuous supervision during production activities so that the level of sigma can be increased and product defects can be reduced.

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