

24 Product Quality Control Using the Six Sigma method

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Product Quality Control Using Six Sigma Methods and Seven Tools in the PDL Shoes Industry

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Abstract— CV Yunanda is one of the companies whose manufacturing process is in the form of shoes and sandals, CV Yunanda has one of PDL's main products in the field of leather footwear. The problem with this company is a production defect. Based on these problems, the purpose of this study is to determine the extent of the defects, determine the underlying causes of defective products, and make recommendations for improvement to reduce the number of defective products. This study uses *seven tools* and *six sigma methods* to identify the key factors that cause defective products and identify corrective actions to be taken based on the underlying factors. The results showed that there were 4 types of product defects, namely 13% *overlapping skin defects* and 11% *flexed skin*, 10% *wrinkled skin*, and 7% *scratched skin*. The proposed solution is to control, inspect and perform maintenance on machines or equipment used in the production process, establish SOPs for each machining area, and improve human resources through training and improvement of the work environment.

Keywords: Defect; Quality; Six Sigma; Seven Tools; Shoes.

I. INTRODUCTION

The competition that occurs brings every actor industry to increase the value the quality of the product produced In addition companies must make products that match consumer desires so which can increase competition between industries manufacturing other. Age is getting progressing and continues to grow every year as well as a company must be able to grow and can face tough competition. Every company must be able to highlight the quality

of products and can compete with the competition which tight [1]. Consumers always hope for a product that received a quality that corresponds with what want and expected. A competition that is strictly this which later will differentiate products from one another, is seen from the aspect of the quality product itself [2] . The number of products equals the variance in price and packaging product that attracts the consumer. Therefore company must anticipate the competitive market by favoring quality product that is guaranteed and according to the expectations of consumers. Because quality is a key company in getting the trust of consumers [3] .

CV.Yunanda is a company that is engaged in industrial manufacturing and produces leather shoes and sandals which is located CV. Yunanda implementation of production uses system *make to order* with activities produce as many goods as 2000-8000 pairs of shoes every month to achieve a target of the company, the most important part of CV. Yunanda is the Production department Department of production is a part which charge of the managing process production. A quality product contained in CV. Yunanda it is known that there is a variety type defect that less good that affects the quality of the company target company *defect* produced by production includes among others, item damage to product shoe leather such as product scratches, *overlap*, *product bent*, and shoe product wrinkled [4] Product *defects* contained in the production department required efforts to improve product quality to meet product quality in the hands of consumers to consumer satisfaction and in order to fulfill existing production targets [5] .

In activity production required the determination of a strategy to reduce the level of defects product produced [6] there are several that cause *defects* from kinds of as

employees who lack skills and experience [7]. To the of product defects it is necessary to have an analysis regarding deviation that occurs in-process production and search for the cause defect product that [8] . In addition to that is also needed strategy improvement as efforts to minimize defective products so that defective products do not repeat be well received by consumers[9]To improve quality control product which is currently running research conducted by using method *Six sigma Seven tools* [10] The reason election method is as improvement which measures quality performance with having continuous improvement which can reduce pass *defect* on product and able to improve quality of production [11] Method implementation *Six sigma* in the identification step to the formulation of the problem i and solving existing problems i using the "DMAIC" approach (*Define , measure , analyze, Improve , Control*) [12,13]

The use of the *seven. method tools* function as *statistical process control* that has the advantage of being able to know the analysis of deviations that occur during production activities and can analyze the level of quality of products that have been completed and are ready to be marketed into the hands of consumers or product *finish good* [14] . Product quality measurement using *Seven tools* and *Six sigma methods* is expected that results that can become means

improvement quality and able to reduce product defects, especially in-process production. Because process production which pays attention to quality will yield a product that is free from damage [15]. The result of repair has various forms such as the reduced occurrence of defective products before will be processed so can sort material that is *good quality* and does not have abnormal , so that the firm can provide quality that conforms to standards and has an advantage for compete, has a *value* which more than manufacturer other shoes and has confidence is more than customers and able to avoid from wasting so that costs production unit affords pressed and price product can become competitive.

II. METHOD

Output results production total whole product PDL shoes on CV Yunanda from September 2021 to December 2021 with a maximum standard of *defect* on CV Yunanda of 3% so that you can see the *defect status* of the product that is lacking or inappropriate for the quality that has been standardized according to company regulations. Therefore, it is necessary to increase the optimization of the results of the work carried out to minimize the *defect value* of DPL's shoe products. This research uses the six sigma method followed by seven tools. Data collection was carried out in the period September-December 2021.

Table 1.
Monthly Outcome Product Achievement

No	Month	Target Global	results /day	Note.
1	September	5000	192	Not Achieved
2	October	7000	196	Not Achieved
3	November	4000	201	Not achieved
4	December	5000	226	Not achieved

Significantly the assessment of the achievement indicators of shoe products described in table 2. is as follows:

Table 2.
Description of Shoe Performance Indicator

Month	Order	Week	Reject
September	5000 Install	1	39 install
		2	55 install
		3	47 install
		4	51 install
October	7000 Install	1	49 install
		2	44 install
		3	59 install
		4	44 install
November	4000 Install	1	43 install
		2	39 install
		3	61 install
		4	58 install
December	5000 Install	1	41 install
		2	64 install
		3	59 install
		4	62 install

III. RESULTS

Six Sigma Method

A. Define stage

In analyzing the *six sigma method*, an initial stage is needed to define the value of *product defects*,

so the first step is to collect analytical data related to *the percentage of defects product* as in the table. 3 as follows:

Table 3.
Percentage of PDL Shoe Defects for September - December 2021

Period d e / Sunday	Amount Product	Amount Product Disabled				Total Disabled	Percentage
		Skin	Skin	Skin	Skin		
		Overlap	flexed	Wrinkled	Scratched		
September							
I	1450	10	9	12	8	39	2.69%
II	1285	11	18	22	4	55	4.28%
III	1380	18	7	13	9	47	3.40 %
IV	885	13	17	15	6	51	5.76%
TOTAL	5000	52	51	62	27	192	3.84%
October							
I	1830	13	14	10	12	49	2.68%
II	1745	16	15	8	5	44	2.52%
III	1695	28	13	11	7	59	3.48%
IV	1730	15	12	9	8	44	2.54%
TOTAL	7000	72	54	38	32	196	2.80%
November							
I	1254	18	14	17	12	61	4.86%
II	484	5	15	8	5	33	6.81%
III	9 01	28	13	11	7	59	6.54%
IV	1361	15	12	13	8	48	3.52%
TOTAL	4000	66	54	49	32	201	5.03%
December							
I	1 349	16	14	16	12	58	4.30%
II	677	16	18	13	15	2	9.15 %
III	1 558	16	13	11	7	47	3.01%
IV	14 16	21	12	15	11	59	4.16%
TOTAL	5000	69	57	55	45	226	4.52%

In Table.3 the most dangerous level of defects occurs in November as big at 5.03%, as well as the level of product, lowest occurred in month October at 2.80%. height product of 5.03% should be overcome and minimized, as evidenced by the level of product disabled. Lowest as big as 2.80% with this thing a company in implementation should be capable carry out the process production with a defect level of 2.80%.

During production activities, CV Greece implements the minimum level of existing defects with a set policy limit maximum standard damage amount of 3%.

The results of the analysis are related to the table.3 regarding the reason the product is disabled among others :

- The Material in a *warehouse* is not arranged neatly.
- No existing process Inspection on pile

material which was not enough noticed before production activities as well as the *handling process* on sewing machines that are lacking thorough.

- Determination of measurement activities that are not adapted to the pattern of process *cutting* often occurs as a mismatch with measurement caused by shoe pattern.
- Error installation on accessories on shoe type in division *Assembling*.
- In the sewing process, it occurs in the *upper part* (finished goods) because of an error that occurs in the process of webbing and inner.
- Strouble* machines are often constrained causing problems when merging *upper* activities and *inner*.

Inspection on the level of product quality is carried out by classifying *defective products*

and OK products, so it is hoped that *product* defects can reach consumers. Examiner product goods and disabled conducted with the number of samples, as well as the placement of the actual limit of each product in the quality assessment.

B. Stage Measure

Activity This *measure* is carried out to determine the DPMO score and *sigma* value which is useful for measuring and determining

the value of sigma capabilities in the company. Assessment is carried out according to output result *defects* in units of *Defects Per Million Opportunity* (DPMO). The duration of data collection activities for level inspection *defects* calculation started from step first defining the *control chart* (P - *Chart*). Calculations directly performed could view in one period first the following :

Table 4.
Sigma. Capability Output Values

No	Production quantity	Number of defective products	Proportion	CL	UCL	DPO	DPMO	Percentage Yield	Sigma
September I	1450	39	0.027	0.039	0.055	0.0090	8966	99.10	3.87
September II	1285	55	0.043	0.039	0.055	0.0143	14267	98.57	3.69
September III	1380	47	0.034	0.039	0.055	0.0114	11353	98.86	3.78
September IV	885	51	0.058	0.039	0.055	0.0192	1909	98.08	3.57
October I	1830	49	0.027	0.039	0.055	0.0089	8925	99.11	3.87
October II	1745	44	0.025	0.039	0.055	0.0084	8405	99.16	3.89
October III	1695	59	0.035	0.039	0.055	0.0116	11603	98.84	3.77
October IV	1730	44	0.025	0.039	0.055	0.0085	8478	99.15	3.89
November I	1254	61	0.048	0.039	0.055	0.0162	16215	98.38	3.64
November II	484	33	0.068	0.039	0.055	0.0227	22727	97.73	3.50
November III	901	59	0.065	0.039	0.055	0.0218	21828	97.82	3.52
November IV	1361	48	0.035	0.039	0.055	0.0118	11756	98.82	3.77
December I	1349	58	0.043	0.039	0.055	0.0143	14332	98.57	3.69
December II	677	62	0.091	0.039	0.055	0.0305	30527	96.95	3.37
December III	1558	47	0.030	0.039	0.055	0.0101	10056	98.99	3.82
December IV	1416	59	0.041	0.039	0.055	0.0139	13889	98.61	3.70
Amount	21000	815	Average	0.039	0.055	0.0150	14533	98.55	3.71

Based on results from processing data above value from I (DPMO) of 8966 where can be interpreted that every one million orders package goods *have a* defect of 8966 *defect* products. For each value of capability sigma company's average value is 3,87 sigma which

means that the company is needed there is increased quality in-process production and product is produced.

C. Analyze Stage

Advanced stages in improvement quality deep step control level defect product or

can find out the cause occurrence of the *defect* porosity, carried out analysis cause effect using 5 factors:

1. Human Factor

Saturated, is a factor which is caused by work which is repeated Fatigue and lack of concentration, actually, factor this is caused by factor work physical which is caused by because there is factor pressure in work so in does work worker will quickly feel tired and as a result of this fatigue also will cause every worker to become less concentrated in doing work.

2. Raw Material Factor (Material)

Raw material is not good, because in selection raw material skin or in sorting raw material less done with good, and also in hadling less right.

3. Method Factor

The method that used is not accurate, only performs inspection at the end of process production by separating product both and defective without there is repair directly.

4. Environmental factor

The air temperature high, due to lack of roof cover sun rays at every station factory.

5. Engine Factor

The press machine for combining the upper and the inner does not operate optimally because the machine is old and worn out.

After causes occur defects are found in the process operation manufacture shoes type PDL, the stage next is to determine the cause is dominant from the five main factors. As for the step that did, namely with analysis of cause-effect on workforce involved in process production of shoes type PDL

D. Improve stage

This stage is the stage in making an improvement plan repair will do through the implementation of kaizen with matrix 5W+ 1H. This plan will be compiled according to questions that are in the matrix with giving answers, that make it easier for a factory to carry out and to carry improvement quality and can help minimize defects to product shoes type PDL.

Table 6.
Repair Plan Matrix (5W + 1H)

No.	Dominant Cause	Who	What	Where	when	Why	How
1.	Inspection no regular	Man	Conduct regular inspections of the production division	The process of processing raw materials until the finished goods are good	When the activity operation takes place	For minimize product disabled	- Mapping of quantities, and production activities and rescheduling - Direct inspection of activities that are considered prone to defects)
2.	Sew not enough neat	Man	Out collar stitch broken-down	Department sewing	When sewing Upper	The sewing process is too sideways	
3.	Upper disabled	Upper Material	disabled		When operator hold needle noton purpose about Product	Operator not careful and stuckneedle	-Improve accuracy skills for employees - The use of needles should be more observant for employees

DepartmentAssembling

E. Stage Control

The final stage of the approach to DMAIC is controlling. This stage has not been carried out or is implemented in the scope of the company, so that is given in this stage to party company is advised to always review the project's repair which is currently done. In this stage need there is a record or history of repair data so can

do a comparison whether the process can is better than with process repair before. Some of the tools that can use to do this are a *check sheet*, performance baseline, *quality report*, map *control*, and documentation.

Seven Tools Method

1. Check sheet

A *Check sheet* in this research is used to classify the type of defects and the number of

defects [16]. *Check Sheet* form a sheet designed simply contains a list of things needed for recording data so that users can collect data easily.

**Tabel 7.
Accurately**

No	Month	Total Products	Total Defect	Percentage
1	September	5000	192	3.84%
2	October	7000	196	2.80%
3	November	4000	201	5.03%
4	December	5000	226	4.52%
	Total	21000	815	16.19%

2. Pareto chart

The Pareto diagram is one of the tools quality assurance used to find out the sequence problem biggest based frequency which got

from sheet Basically diagram. Pareto is a bar graph that shows problems based on a sequence number of events.

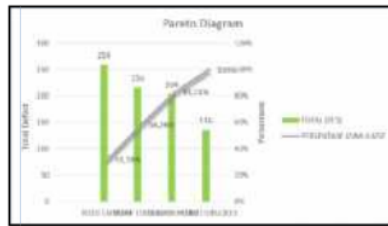


Figure 1. Pareto Diagram

3. Histogram

A histogram is a tool like a bar chart that aims to show the frequency distribution of defective products [17]. In the results of the research that is implemented into the histogram, it can be seen that the overlapping

skin has the highest distribution frequency value which indicates that the *overlap defect* is the highest type of defect at the defect level among other types of defects as shown in Figure 2.

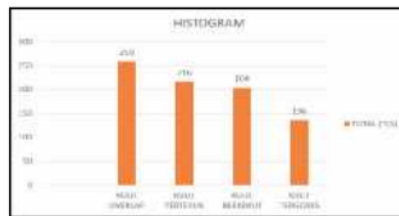


Figure 2. Histogram

4. Fishbone Diagram

The effect diagram or *fishbone diagram* is part of *seven tools* used to analyze the causes of problem main that occur. Problems-existing problems are then analyzed further for

obtained suggestions for improvements to the cause of a problem or competition and are commonly referred to as a *cause-and-effect diagram*.

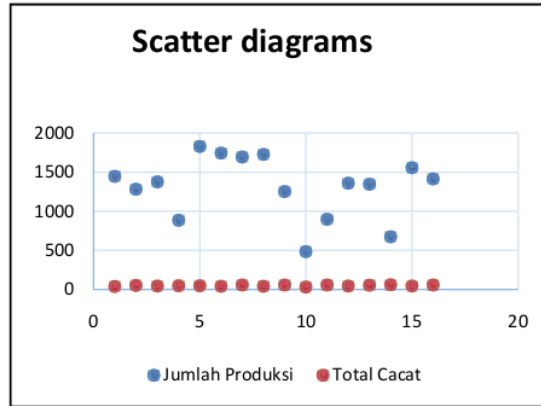


Figure 5. Scatter Diagram

7. Stratification

Stratification describes the attempt to categorize disability issues into smaller groups that are easier to evaluate [20].

The data grouping or stratification was carried out based on the types of overlapping skin

defects, flexed leather, wrinkled skin, and scratched skin on DPL brand shoes at CV. YUNANDA.

Table 9.
Stratification

No	Defect Type	Total (Pcs)
1.	Overlap Skin	259
2.	Bent Skin	216
3.	Wrinkled Skin	204
4.	Scratched Skin	136
	Total	815

IV. CONCLUSION

Based on the research that has been done, the following conclusions are obtained:

1. Defects Defects that occur during process production shoes PDL amounted to 815 pcs from total production amounted 21000 pcs result value with percentage defects product 4.0475%, where there are 4 types of defects, namely overlap defects of 259 pcs, skin defects bent by 216 pcs, wrinkled skin defects 204 pcs and scratched skin defects by 136 pcs.
2. Obstacles faced for CV. Yunanda from the human factor, namely operator working not according to standard, less skilled and not running SOP (Worker rationale standard).

3. To minimize the type of disabled product on PDL Shoes especially on defects which keep happening over and over again and in the same area, it is necessary to have a check er or double check in order not to escape *defects* again.

4. Proposed improvements obtained from this research are the use of *checksheet* cycle work, performing supervision to employees, and implementation of preventive maintenance machines which . I hope that can improve the performance of I on the maintenance of the engine, I add the blower.

Suggestion

As for the suggestions from this research are: It is necessary to carry out supervision routinely on process production to give

directions and input to an operator if work does not according to SOP. The next research, will discuss a defect which is dominant, only that is more detailed.

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