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Lowering Customer Claim &; Ng Ratio on Jack Bracket Part Using Lean Six Sigma-DMAIC Method at PT. XYZ

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ABSTRACT: PT. XYZ is a manufacturing company that produces *Sub Assembly* products for two-wheeled and four-wheeled vehicles. Broadly speaking, the stages of the *Jack Bracket* production process consist of five processes, namely *the sharing* stage in the Raw Material *Line*, *the Stamping* process *in the Small Press* Line, *the Spot Welding Stage in the Welding Assy* Line and the Checking Stage in *the Final Inspection Line*. This research was conducted at *Line Assy Welding* where the *Line* produces *Jack Bracket parts* and *Line Final Inspection*. Based on NG *Outflow &; NG Ratio* data in the period July to December 2023, *57 pcs of spot defects were* obtained and the number of *internal process defects* was 32,325 PPM which is equivalent to sigma level 3.3. After applying the six sigma method, the number of *NG Customer Claims* is nil (0 pcs) and the level of product defects can be reduced to 7,500 PPM which is equivalent to sigma level 4.

KEYWORDS: Jack Bracket, PPM, Sigma Level, Seven Tool Quality.

I. INTRODUCTION

PT. XYZ is a company engaged in the manufacture of four-wheeled vehicle parts. In making four-wheeled vehicle parts, a process called *stamping press*, *Welding*, and *Assy Spot Welding is* carried out. This *stamping* press process is carried out using a *press machine* with a power of hundreds or even thousands of tons and for the *welding* process of PT. XYZ uses Injection Molding, while for the *Assy Spot Welding* process itself uses *Gun Spot* and *Jig Fixture* as production process tools. In the production process at *Line Assy Welding* there are still many types of defective parts, this is caused by many factors including the material used, the machine used, the working method, the environment and the humans themselves. Of the many parts produced in the production process, it will potentially be sent to *customers* if quality control at PT. XYZ is not good. Common defect forms that occur in the process at *Line KS* include, *Welding Under Cut*, inappropriate dimensions, *nut* not center, hole *not* center, spot burst, dented panel due to *Gun Spot* miss, and *spot welding* free. The shape of the product that does not conform to specifications can also be classified as defective. Non-conformity of products with specifications set by the company can occur due to various things.

PT. XYZ has a policy that production results will be re-examined 100% in the QC (*Quality Control*) section and classified into three criteria, namely: OK, NG *(Not Good)* and *reject*. Goods that are classified as OK will be sent to the logistics department and then distributed to automotive companies. For parts classified as NG, they will be sent to the *hand work* section and then repaired, while for parts classified as *reject* will be directly disposed of in the reject *part disposal* box. *Repair* activities and disposal of *parts* that are in vain because *of reject* is a form of waste.

Based on preliminary research conducted by Putri, Annisa, Tri (2023), it is known that the number of DPMO in Panel Door Fuel Filler products is 17,630.56 DPMO. This number when converted to the six sigma table, is at a sigma level of 3.60. This is still far below the company's standard target which targets to be at the sigma 6.0 level with a total of 3.4 DPMO. This value needs to be reduced because the more *defective* parts are produced, the more losses that must be borne by the company to carry out the *repair* process for NG parts *and for materials that are wasted due to rejected parts*.

In this study, we will discuss and analyze the plan to implement *Six Sigma* in the *KS model part* produced by PT XYZ. *The resulting parts* are products that are prone to defects during production. For this reason, with the implementation of the *Six Sigma* method, it is hoped that quality control at the company can be better and the target of 6 sigma can be achieved and there are no *customer claims*.

II. RESEARCH METHODOLOGY

2.1. Thinking Framework

The initial stage carried out in this study is to determine the frame of mind, namely the search for internal problems found in the company and the problems faced by the company today that will be researched to help solve problems in the company.

2.2. Determination of Research Objectives

The next stage is to determine the objectives of the research, while the objectives of this research are as follows:

1. Identify the type of part with the highest defect rate in the *line assy JACK BRACKET*
2. Looking for the cause of the *defect*
3. Know the company's sigma level
4. Determine follow-up efforts to reduce the number of defects with the *six sigma method*

2.3. Literature Study

Literature studies are carried out by reading books related to existing problems with the intention of finding theories that support in studying problems, collecting data, processing data, analyzing problems, drawing conclusions and arriving at decision making. This literature study is important so that the research objectives can be achieved.

2.4. Preliminary Study

Preliminary studies are carried out with the main aim of collecting various information needed in the implementation of research. This needs to be done, considering that relevant information can support the success of research, especially because the results of this preliminary study can be a reference, both in the context of introduction and formulation of hypotheses. In relation to the formulation of hypotheses, through this preliminary study can be collected various theoretical information and facts, both general and scientific facts.

2.5. Data Collection

At this stage data collection is obtained from one or several research subjects covering one or several time periods either days, weeks, months, or years based on actual data. Data collection was obtained based on audit data for the period January - June 2023 at PT. XYZ. At this stage the data collection technique that will be used by the author is to go directly to the location of the production department of PT. XYZ.

Then collect the necessary data, look for books related to the topic to be discussed as a basis for analyzing the data obtained from the company to be researched so that it can be used as a theoretical basis to solve problems contained in PT. XYZ.

2.6. Data Collection Methods

When viewed from the understanding of data collection methods according to experts, data collection methods are in the form of a statement (statement) about the nature, circumstances, certain activities and the like. Data collection is carried out to obtain the information needed in order to achieve research objectives.

This research is short and temporary so that the data needed should have been estimated in advance and be actual. The data in question is variable defect data of Jack Bracket products to be used as problem solving material. There are several methods used to collect data relevant to the problem under study. The research in this Final Project uses the *Field research method*, which is a research method carried out directly at the location where the research is carried out.

2.7. Observation

A method of data collection by observing directly the course of the activities of the object under study.

2.8. Data Processing and Data Sufficiency Test

Processing comes from the word processing which means to do, strive to become another or more perfect item. Processing means the process, way, act of processing. Data means true and real information or description of real material that can be presented. Data are empirical facts collected by researchers for the benefit of solving problems or answering research questions. Research data can come from various sources collected using various techniques during research activities. Joko Subagyo formulated the definition of data as all information both derived from documents, and in other forms for research purposes. So, data processing is the process, way, act of processing all information for the purposes of research that is organized (systematic) planned.

2.9. Data Sources

The research was conducted by conducting field observations *(Field research)* to obtain variable *defect Jack Bracket data* at PT. XYZ.

2.10. Time and Place

Data collection will be carried out from January 3, 2023 to January 17, 2023. where data collection is carried out at PT. XYZ is located in Bekasi city located in GIIC Area.

2.11. Calculation using *Lean Six Sigma Method*

There are key aspects that need to be considered in the application of the *Six Sigma* (DMAIC) concept, namely:

1. Define stage

The initial stage is to find the type of problem that will be used as a *project*, it can be in the form of voice of customer (VOC), voice of process (*VOP)*, voice of business *(VOB) then describe it in the form of a SIPOC diagram* (Supplier, input, output, customer).

2. *Measure Stage*

Measurements that must be carried out in the *measure* stage are determining the type of defect (CTQ) *Critical To Quality*, classifying the type of defect using the *paretto chart* DPMO calculation, conducting measurement system analysis (MSA), process capability analysis and determining sigma values.

3. Analyze Stage

Analyzing a problem that causes defects in *Jack Bracket* products, which occur in the field using *Ishikawa* diagrams with the aim of obtaining factors that cause defects and finding solutions for corrective actions to the problem, in this

case focused on 4M (machines, methods, materials and people)

4. Improve *Stage*

The stage of improvement efforts is based on the results of the analysis of the *Jack Bracket problem.*

5. Control *Stage*

The stage of controlling the results of improvement, this stage is assisted by a check sheet as a tool to record and control the results of improvement, monitored continuously.

2.12. Analysis of Data Processing Results

Analyze the results of the data that has been processed in order to draw conclusions from the data that has been processed. After the stages of preparation, data collection and processing have been carried out, then analysis and discussion are carried out. At this stage of analysis, *a fishbone diagram or known as a fishbone diagram* is used.

2.13. Conclusion and Advice

Contains conclusions from the results of the analysis that has been done, and provides solutions that can be considered for application

In this data processing, data adequacy tests will be described, and data processing with the concept of *six sigma* (DMAIC). The data adequacy test aims to determine whether the number of observations made can cover the entire population characteristics (objects observed) and to determine the amount of data that has been taken whether it is sufficient or not for the purposes of further data processing, namely to calculate DPMO and sigma level values. In this study the type of data used is the continuous data type.

3.1. Define Phase

The first step of this phase is to determine the type of problem, where in this study it is known that VOC is in the form of *a Claim from the Customer*. Then after knowing what became the VOC, the next step is to form a *project team* or known as *Project Charter*, as shown in Table 4.1 below:

PT. XYZ Project Charter	LSS	Project Type	Project Number:
		Six-Sigma	LSS_Project charter_001
	Project Name	Reduce NG Flow out & NG Ratio Part Bracket Comp. Jack dari 57 pcs menjadi 0 pcs & 1,94 % menjadi 0,57% pada akhir Mei 2018	
Problem Statement	Dari data bulan Januari 2023 s/d Juni 2023, NG Flow out ke Customer untuk Part Jack Bracket sebesar 57 pcs dengan NG Ratio di prosess internal mencapai 3,23 % jauh dari target yang di tentukan yaitu: 0 pcs Flow out & 0,57 % NG ratio. Hal ini mengakibatkan meningkatnya cost untuk mengganti part yang di claim dari customer & Cost dari proses produksi karena banyak part yang NG		
Goal Statement Objective	Menurunkan NG Flow out & NG Ratio Part Jack Bracket dari 57 pcs menjadi 0 pcs & 3,23% menjadi 0,57% di akhir Mei 2018		
Scope What's in / What's out	Part Jack Bracket di line KS		
Project Metric "Y"	Data Claim Customer & NG Ratio di bulan Januari 2023 (6 bulan)		
Project Areas	Line KS		
Project Risk	Akan membutuhkan waktu untuk trial di proses sehingga dapat menyebabkan stop line di proses (mengganggu proses produksi sehingga output berkurang)		

Project Milestones - planned dates				
Define [START]	Measure	Analyze	Improve	Control [END]
2/1/2023	1/2/2023	1/3/2023	2/6/2023	Juli-October 2023

Project Measures & Goals , Estimated / planned Benefit					
Metric Y	Unit	Base Value	Goal Value	Financial Benefit	Benefit Category
COPQ Part Jack Bracket Tahun 2023	Rp	151,674,252.00	84,000,000.00	67,674,252	Medium Saving
				-	
				-	

Figure 4.1 Lean Six Sigma project charter

In this case the function *of the project charter is to provide information about the background of the* project, problem statement, statement of objectives, scope, list of benefits / benefits, project implementation schedule and outline of the project objectives themselves. All of that is the basis for consideration to continue *the project* or canceled, if the decision is continued then the agreement between management and the project team can be related.

Then after creating a *project charter*, the next step is to determine the *project.* In this study there are four *projects* proposed, including:

1. *Reduce NG Internal Door Comp fuel filler*
2. *Lowering Customer Claim &; NG Ratio in Jack Bracket*
3. *Reduce Production Process Loss Time* in SU2iD Line
4. *Reduce Time waiting to document* surat jalan

In making decisions to choose which of the four *projects* above will be run first, of course, by considering the costs incurred compared to the results / benefits obtained from the *project*, researchers use the *Benefit & Effort Analysis* method, which is the method used in *six sigma*. Figure 4.2 shows the *Benefit & Effort Analysis* graphs of the four *projects* proposed by management.

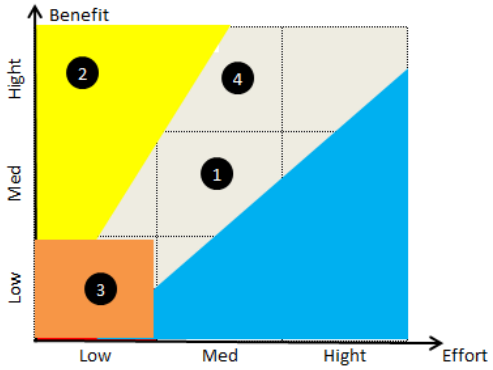


Figure 4.2 ***Benefit &; Effort Analysis***

5. The selection of *projects* to be executed will greatly affect the success of a *project*. Based on the *Benefit & Effort Analysis* graph as shown in figure 4.2, researchers chose *project number 2 (Lowering Customer Claim &; NG Ratio in Jack Bracket)* on the grounds that the *benefits* obtained are high *(hight)* while *the effort is* low (low). This means that if *project* No.2 is realized, the profits obtained by the company are high with low *improvement* costs .

After determining the *project* to be realized, the next step is to create a SIPOC diagram. The function of this SIPOC diagram is to visualize VOCs and also to start seeing the relationship between *output* and process input. Table 4.1 is a SIPOC diagram of the *Jack Bracket production process*

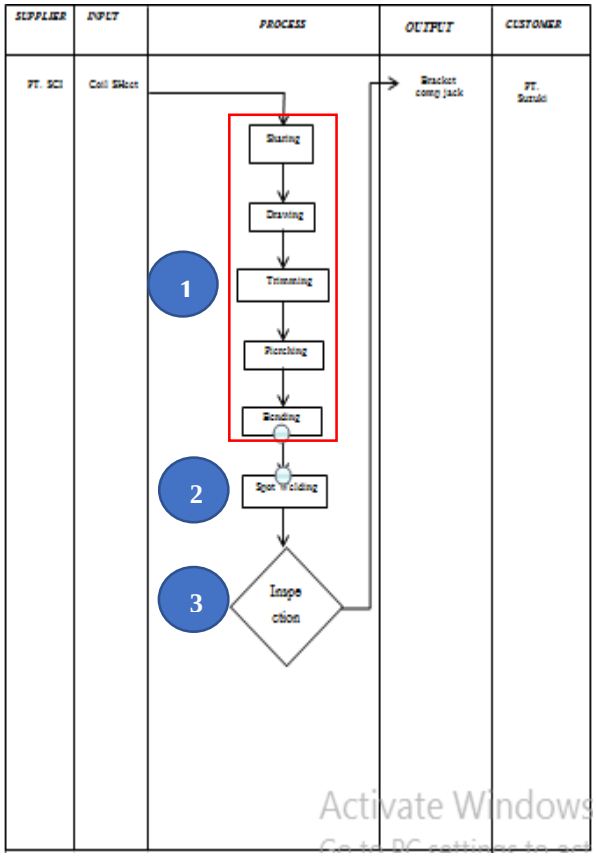


Figure 4.3 SIPOC Jack Bracket Diagram

Based on Figure 4.3 it can be seen that there are three main processes in making *Jack Bracket parts, including the* stamping *process,* spot welding *process and the last is the* final inspection process *with* input *and* output *along with* the customer. The last step in the *define phase* is to create an *activity master plan, Figure 4.4 shows* the project activity master plan.

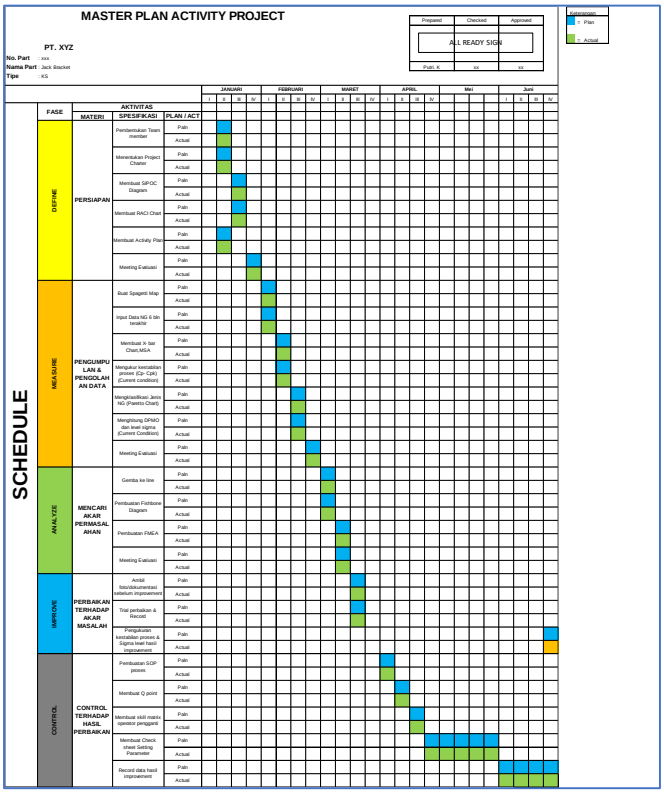


Figure 4.4 ***Master Plan Activity***

3.2. Measure Phase

The *measure* stage is the second stage of DMAIC. At this stage, quantitative data calculations are carried out to find out how the condition of product quality in the company will then be calculated at the *sigma level* value of the company itself. Figure 4.5 is a graph of *customer claims* for the period January to June 2023.

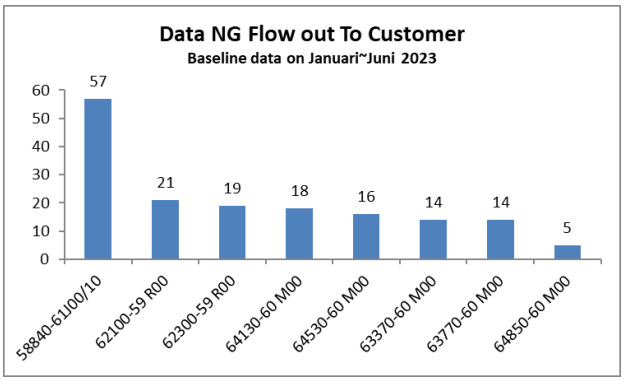


Figure 4.5 ***NG Flowout data graph to Customer***

In this *measure* phase, several calculations will be carried out using the help of *minitab soft ware*, researchers in this

case use *minitab software version 16*. Some calculations that will be carried out, including the following:

a. Determining *a Paretto Chart*

Figure 4.6 below shows that the highest type of defect is spot welding loose with a total of 238 or in percentage of 49.5%. This type of defect will be discussed and corrected to reduce or eliminate the type of NG.

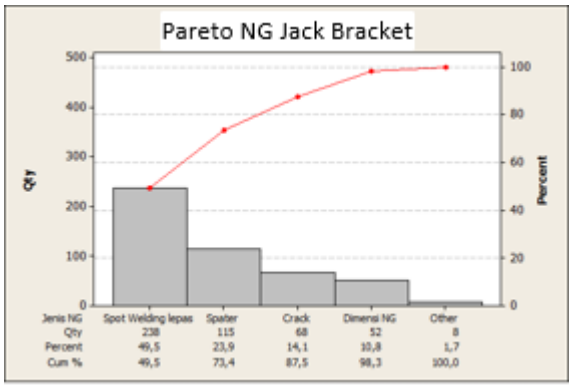


Figure 4.6 *Paretto chart NG Jack Bracket*

b. *Measuring System Analysis* (MSA)

Measurement system analysis (MSA) is mandatory before then conducting a process capability analysis. With the analysis of the measurement system, it will be known whether or not the measurement process in the company itself. This is intended to obtain valid and accurate data against the measurement process.

The data used is the measurement data of the tagane test process on the Jack Bracket as shown in Table 4.1 below:

Table 4.1 Jack Bracket tagane test data

RunOrder	Parts	Operators	Diameter
1	Jack Bracket 4	Operator A	4,5
2	Jack Bracket 1	Operator A	4,51
3	Jack Bracket 2	Operator A	4,52
4	Jack Bracket 3	Operator A	4,51
5	Jack Bracket 5	Operator A	4,72
6	Jack Bracket 4	Operator B	4,51
7	Jack Bracket 5	Operator B	4,72
8	Jack Bracket 2	Operator B	4,52
9	Jack Bracket 3	Operator B	4,52
10	Jack Bracket 1	Operator B	4,51
11	Jack Bracket 3	Operator A	4,51
12	Jack Bracket 5	Operator A	4,72
13	Jack Bracket 4	Operator A	4,5
14	Jack Bracket 2	Operator A	4,52
15	Jack Bracket 1	Operator A	4,51
16	Jack Bracket 3	Operator B	4,51
17	Jack Bracket 1	Operator B	4,51
18	Jack Bracket 4	Operator B	4,5
19	Jack Bracket 2	Operator B	4,52
20	Jack Bracket 5	Operator B	4,72

The data above is data that has been randomized randoom, the method used in MSA itself uses the Gage R &R method with the 5-2-2 technique, which means there are 5 samples, measured by 2 operators and measured 2 times. The result of the calculation is as follows:

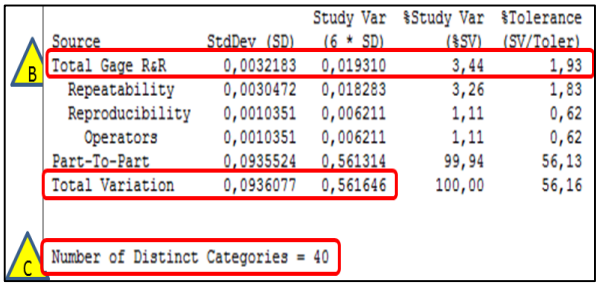


Figure 4.7 Gage R&R calculation result

To see the analysis chart from the calculation above, click the *window* then select *Gage R&R for diameter*. Figure 4.8 shows a graph of the results of *Gage R&R* calculations using *minitab 16 software software*.

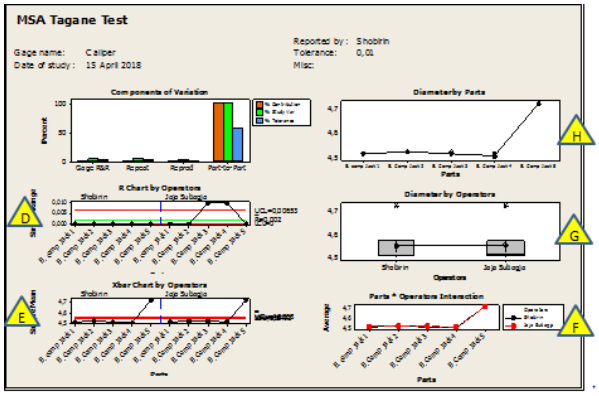


Figure 4.9 Gage R&R Graph

Here's how to read the results of the *Gage R&R calculation:*

a. *% Contribution*

99.88% of the total variation in measurements is due to differences between *parts*. This is said to be very good when the *% Contribution* for *part to part* is high, the system can distinguish *part from* part *well*.

b. *Total Gage R&R:*

% Study Var = 3.44

% Tolerance = 1.93

The difference between *% tolerance* and *study var is reasonable, because* the tolerance range *(1.0) is wider than the total* study var *(0.561646)*

c. *Number Of Distinc Categories:*

Here the *number of distinc categories* is 40, which defines the system as very capable of distinguishing between *parts*

d. *R-Chart:*

From the *R-chart* above, it shows that Operator A is more consistent in its measurements, it is proven that there is no data that deviates from the control limit, while Operator B is less consistent with the measurement results seen in parts number 3 and 4

e. *Xbar-Chart*:

In the above data there is only one data that is out of control, this indicates that the *variation part to part* is smaller than the variation caused by the measurement system

f. *Operator By Part Interaction*:

It can be seen that the graph above the lines are squeezed together and the average of the parts is quite varied so that the differences between parts are quite clear

g. *Diameter Measurement By Operator:*

Showing a horizontal line between Operator A and Operator B, it shows that the consistency of their measurements is good

h. Measurement *diameter By Parts*

Individual measurements are almost the same in each *part* and the differences between parts are clear

c. Calculating Cp-CPK *(Process Capability)*

After the measurement system analysis is carried out and it is known that the measurement system in the company is good, the next step is to calculate Cp-Cpk or the stability of the Jack Bracket production process. The data used is *Tagane test* data with 30 pcs sample parts.

Based on the results of the data adequacy test which states that the 30 pcs sampled have met or represent the population of parts produced by *Jack Bracket*, then with that data will be calculated the stability of the process using a station tool in the form of *minitab 16 soft ware*. Because the data type used is the continues data type, the calculation of process stability uses *Normal Capability Analysis.*

1) Calculating *Process Capability (Current Condition)*

The data used in the process capability calculation are shown in Table 4.5 below:

Table 4.2 Data *Tagane (Before Improve)*

SAMPLE	STANDARD	ACTUAL
1	5 ± 0,5	5,00
2	5 ± 0,5	4,51
3	5 ± 0,5	4,50
4	5 ± 0,5	5,21
5	5 ± 0,5	4,51
6	5 ± 0,5	4,69
7	5 ± 0,5	5,06
9	5 ± 0,5	4,51
10	5 ± 0,5	4,52
11	5 ± 0,5	4,51
12	5 ± 0,5	4,50
13	5 ± 0,5	4,53
14	5 ± 0,5	4,32
15	5 ± 0,5	4,42
16	5 ± 0,5	5,09
17	5 ± 0,5	5,28
18	5 ± 0,5	4,45
19	5 ± 0,5	4,50
20	5 ± 0,5	4,23
21	5 ± 0,5	4,45
22	5 ± 0,5	4,50
23	5 ± 0,5	4,49
24	5 ± 0,5	4,50
25	5 ± 0,5	4,49
26	5 ± 0,5	5,50
27	5 ± 0,5	5,23
28	5 ± 0,5	4,45
29	5 ± 0,5	4,53
30	5 ± 0,5	4,00

The results of the Cp-Cpk calculation can be shown in Figure 4.9 below.

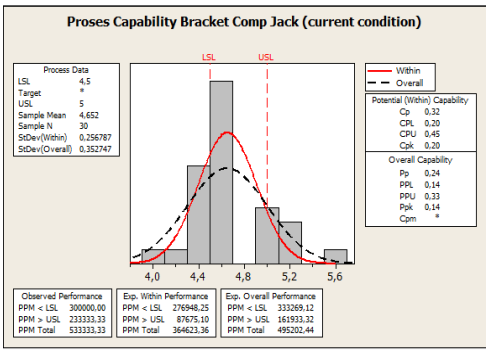


Figure 4.9 *Cp-CPK (Before Improvement) Charts*

2) Calculating *Capability Process After Improvement*

After *improvement* is made to the problem of *loose spot welding*, then recalculate the *process capability*. The

data used is *Tagane test* data with sample parts of 30 pcs of production after repair, as shown in Table 4.4 below:

Table 4.4 *Data Tagane test (After Improvement)*

	Tagane Tes
1	5,0
2	5,0
3	5,6
4	5,1
5	4,9
6	4,9
7	5,2
8	5,2
9	5,0
10	5,0
11	5,0
12	5,0
13	5,0
14	4,8
15	4,8
16	4,96
17	4,99
18	5,00
19	5,07
20	5,06
21	5,12
22	5,11
23	5,14
24	5,18
25	5,77
26	5,26
27	5,15
28	5,16
29	5,14
30	5,32

Figure 4.11 shows a graph of the results of the calculation of Cp-Cpk after repair.

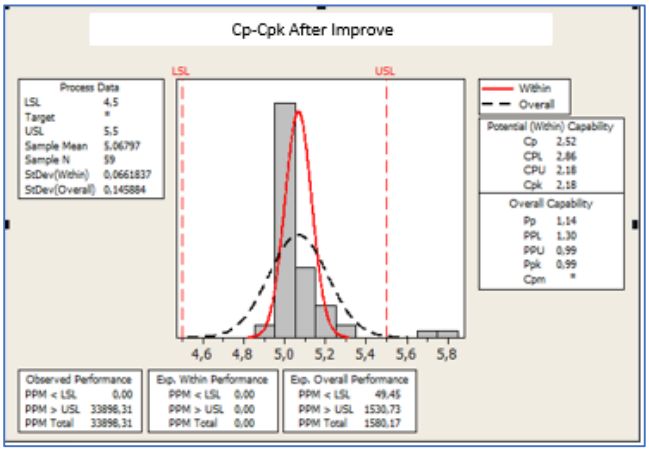


Figure 4.11 *Cp-CPK (After Improvement) Graph*

d. Calculating PPM and *Sigma Level Values*

In *Six Sigma*, two methods are known to calculate the *sigma level* value, namely by converting the DPMO value and converting the PPM value. The DPMO technique is used if there is more than one process that causes *defects* in one part, while the PPM technique is used when it is known which process causes defects. In calculating the sigma level value, researchers use the PPM technique because it is known that there is one process that causes *Jack Bracket defect* parts (*Spot welding* off), namely in the *spot welding process.*

1) Calculate *the sigma level value (current condition)*

To calculate the *current sigma level* value , the data used are the number of NG *parts* for the period July to December 2017 (seen in Table 1.2) and the amount of production in the January-June 2023 period (seen in Table 4.5) below:

Table 4. 5 Total production of *Jack Bracket* parts January to June 2023

MOON	Jan	Feb	Mar	Apr	May	Jun	Total
QTY (pcs)	2520	2640	2280	2640	2640	2160	14880

Source: Production Data (Production Dept. of PT. XYZ 2023)

The calculation formula is:

PPM = (Total NG)/(Total production) x 1,000,000

= 481/14,880 x 1,000,000

= 32,325.27 PPM

Then the PPM is converted into a sigma *level table*, obtained for the number of PPM of 32,325.27 equivalent to a sigma value of 3.3. The *sigma level value is still far below the company's target, which is at the sigma level 6.*

2) Calculating *the sigma level value (After Improvement)*

After improvements were made to the *Jack Bracket production process*, there was a drastic decrease in the number of *NG Ratios* in the production process, as shown in Table 4.8 below:

Table 4.6 NG Ratio *data* for the period 02 to 30 July 2023

NG Type	July 2023				Sum
	W1	W2	W3	W4	
Spater	2	1	3	2	8
Crack	1	1	1	1	4
NG Dimensions	2	2	1	0	5
Minus trimming	0	0	1	0	1
Spot off	0	0	0	0	0
Sum	5	4	6	3	Total 18

Source: Data NG (Dept. QA PT. XYZ 2023)

With the production amount as shown in Table 4.7 below:

Table 4. 1 Production data for the period 01 to 30 July 2023

July 2023	W1	W2	W3	W4	Sum
Qty	600	600	600	600	2400

Source: NG Data (QA Dept. 2023)

So to calculate PPM & *sigma* level value, the formula can be used as in the previous calculation, namely:

$$PPM = x\ 1{,}000{,}000 \frac{Jumlah\ NG}{Jumlah\ produksi}$$

$$= \frac{18}{2400} x\ 1.000.000$$

= 7,500 PPM

Then the PPM value is converted using the sigma level table *and the* sigma *level value is 4.00.*

3.3. Analyze Phase

In this phase, an analysis of the problem of loose spot welding *will be carried out* , the *tools* used include fish bone diagram / ishikawa (fish bone diagram), *Fault Tree Analysis* and *Failure Mode Efect &; Analysis* (FMEA).

1. *Ishikawa / Fish bone Diagram*

In the *fish bone diagram, 4 aspects of the cause of* the problem of spot welding *will be discussed,* including aspects of *material, man, machine &; method,* then each of these aspects will be looked for the causative factors. Figure 4.12 shows a *fish bone* diagram of the loose spot welding problem.

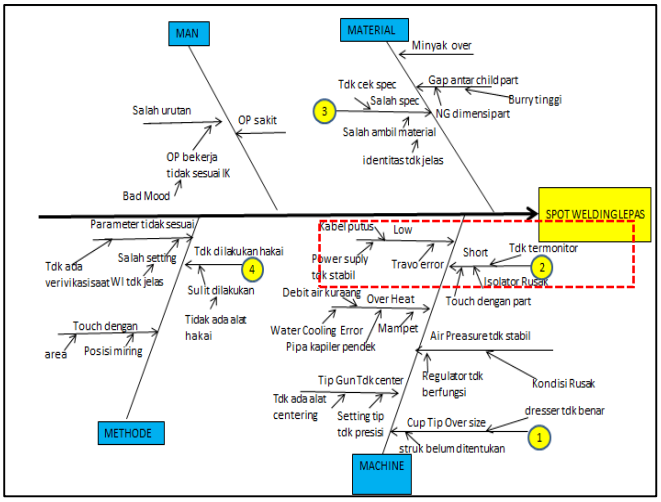


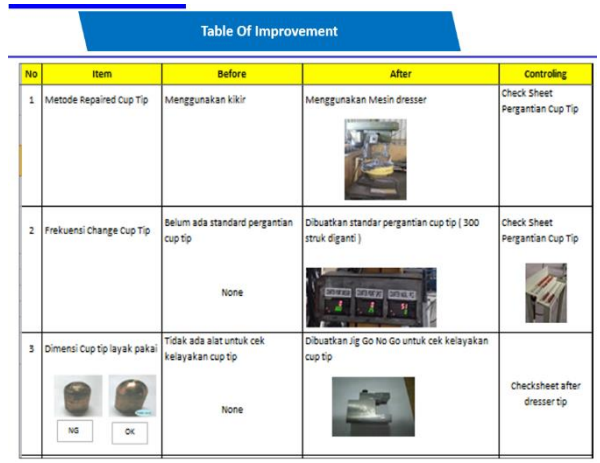
Figure 4.12 Fishbone diagram spot welding loose

In making this *fish bone* diagram, researchers use brain storming techniques, which means involving all related *stakeholders*, from operators to manager levels so that many factors are obtained that cause the problem of loose spot welding to occur. Of the many factors, then an evaluation will be carried out and selected the most influential factors which will later be corrected or improved. The explanation of *the fish bone above will be discussed in Chapter V.*

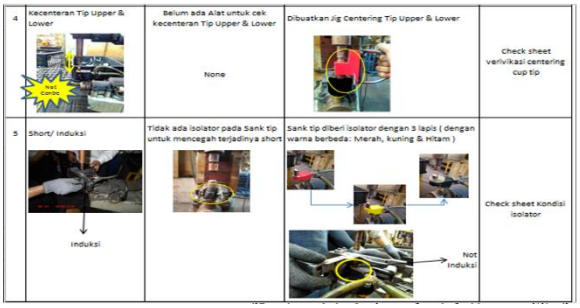
2. *Five why Analysis*

After an evaluation of the factors that cause the occurrence of *spot welding* off, then *a why-why analysis* or commonly known as 5W. 5W is intended to dig information about the cause of the problem deeper so as to find the root of the problem. Table 4.12 shows *the why-why analysis* of *fish bone* above:

Table 4.12 Five Why Analysis



No	Why-1	Why-2	Why-3	Why-4	Why-5
1	Cup Tip Over Size / aus	Over stroke / pemakaian	Tidak ada kontrol pergantian cup tip	Belum ditentukan frekuensi pergantian cup tip	Belum ada Aturannya/ WI
2	Short	Holder touch dengan jig	Isolator terkelupas/ rusak	Tidak dilakukan periodik	Tidak ada kontrol terhadap kondisi
3	Salah Spec Material	Salah ambil material	Identitas material tidak jelas	Tag usang dan kotor (sulit di	Area penyimpanan raw material kotor
4	Hakai test tidak dilakukan (A.T.A)	PIC sulit melakukannya karena menggunakan pahat	Alat hakai rusak	Dipakai untuk merepaire part yang bukan semestinya	PIC kurang paham fungsi dari alat hakai itu sendiri



3.4. Improve Phase

In this phase, improvements will be made to the dominant factors that cause spot welding to take off. Based on the fishbone diagram seen in Figure 4.13, it is known that there are many factors that cause the occurrence of loose spot welding, including the following:

1. Man Factor

For the human factor itself, improvements will be made to operator performance by conducting periodic supervision according to a predetermined schedule.

2. Material *Factor*

In material factors, researchers do not make improvements, because the material is considered not a factor that causes the occurrence of *loose spot welding* .

3. Engine Factor

Based on the results of analysis and trial *of fishbone* diagrams, this machine factor is the main cause of the problem of *loose spot welding*. Some factors include the *cup-*

tip repaire method which previously only used a manual file so that the stability of the cup tip diameter variations. From this variation then came the idea to standardize the diameter of the cup tip after repairing it by making a *dresser machine.*

Then regarding the change of cup tips, previously it was also not determined the frequency of changing cup tips, this caused the cup tip *to be over size* because it was too long to use, causing poor spot welding penetration. Based on the results of trials from the *project team,* the maximum *use of cup tips is 300 receipts, then a* counter spot is made *as a tool to control the use of* cup tips.

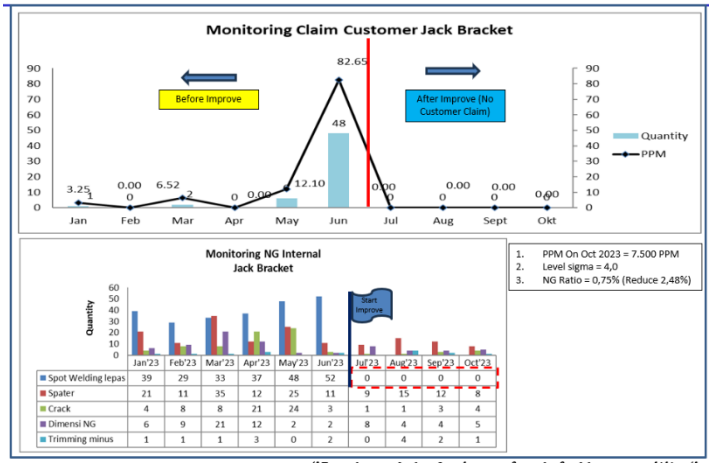
Then the condition *of the gun* on the machine where there is no *insulator* so that induction occurs between the engine and parts during the process is also the cause of the problem arises, for this the team added a 3-color insulator to identify the potential for induction. The purpose of adding a three-color insulator (red, yellow and black) is as a *warning* to the operator about the condition of the insulator on the machine. The red color is in the base layer, meaning "danger" or must be replaced immediately with a new insulator, the yellow *color is in the second layer, meaning that if the yellow insulator* is already visible then the operator must report to his superiors about it while the process can still run. Black color is in the outermost layer, this indicates the normal condition of the insulator.

3.5. Control Phase

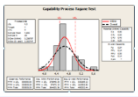
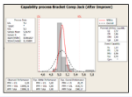
The control phase is the last phase of the six sigma method. In this phase, the results of the improvements that have been made by the project team will be monitored.

As seen in Table 4.1 of the RACI Chart, it is known that the person responsible for monitoring the results of this improvement is myself as the Responsibility or leader of this six sigma project.

Monitoring NG Flowout & NG Internal Jack Bracket (Y.2023)



Resume Of Benefit

ITEM	BEFORE	AFTER
1. Cp-Cpk	 Nilai Cpk = 0,30	 Nilai Cpk = 2,18
2. NG Flow out	Periode Januari~June 2023= 57 pcs	Periode July~October 2023= 0 pcs
3. NG Ratio	Periode Januari~June 2023 = 3,23%	Periode July~October 2023 = 0,75% (Reduce 2,48%)
4. COPQ (Cost of Poor Quality)	Rp. 151.674.252	Rp. 84.000.000 (Saving Cost=Rp. 67.674.252)
5. Level Sigma	Level Sigma 3,3	Level Sigma 4,0

III. RESULTS AND DISCUSSION

At this stage, an analysis of the calculation results in chapter IV will be carried out which includes sample adequacy tests and calculations with tools from the six sigma method with minitab 16 software tools. In the sample adequacy test that it is known with a sample number of 30, a confidence level of 95%, a degree of accuracy of 5%. With the calculation results where N'= 26, N= 30, it can be concluded that the defective sample of Jack Bracket products is considered sufficient, meaning that the sample is representative of the popolation or amount of production and the data can be continued as Jack Bracket defect research data.

Six sigma with DMAIC is carried out in solving defect problems in the Jack Bracket production process. This stage includes identifying product defect problems, creating team projects, making current company baseline measurements, processing data statistically, conducting analysis with brainstorming methods, making improvements and the last is controlling or monitoring the results of improvements that have been made.

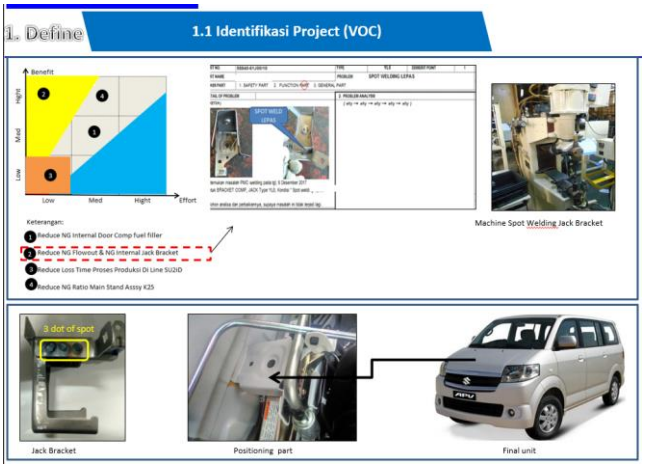
1. Define Phase

The define phase begins by determining the type of problem that occurs whether the type of VOC (voice of customer), VOP (voice of process) and VOB (voice of business). From the results of the clarification, the problems faced at PT. XYZ is categorized into VOC, because it involves claims from customers. From data from July 2017 to December 2017, it is known that the number of customer claims for Jack Bracket parts is 57 pcs and the NG ratio of the production process is 3.23%. This amount is very far from the target set by the company, which is 0 pcs s for customer claims and 0.57% for the NG ratio level of the production process.

After knowing the problems that occur then make a project charter in which there is a project team structure, a statement of problems that will be improved, the purpose of the project, the scope of the project, baseline data before improvements are made, benefits / benefits of the project, and the assessment of each team member.

Then in this phase also make a SIPOC diagram as an overview of the Jack Bracket part production process along with information about suppliers, inputs, processes, outputs and customers of the process.

In the define phase, a master schedule is also made for the implementation of all project activities. This is so that every activity is planned and can be followed up properly.



2. Measure Phase

The measure stage is a stage carried out to measure process performance before improvements are made so that the measurement system and the stability of the current production process can be known.

From the calculations that have been done, it is known that the measurement system carried out at PT. XYZ is good, as evidenced by the results of MSA calculations, namely, the value of study var is 3.44% and the total variation is 0.56. Table 5.1 below is an interpretation of the analysis according to AIAG.

Table 5. 1 Interpretation according to AIAG

%Tolerance % Studyvar	% contribution	System/results
< 10%	< 1%	Acceptable
10-30%	1-9%	Marginal
> 30%	> 9%	Rejected

Source: Adi (2018)

Based on the data processing that has been done, it is known that the stability of the Jack Bracket production process is still low, namely Cp of 0.32 while the minimum value of Cp is 1.0. After some improvements in the process, there was a change in the Cp value to 2.52. This means that the stability of the Jack Bracket production process is very good.

Then from the previous amount of PPM was 32,325.7 PPM or equivalent at the 3.3 sigma level after improving the PPM to 7500 PPM or equivalent to the 4.0 sigma level. This means that in one million products produced there will be 7500 NG parts.

3. Analyze Phase

In this analysis phase, researchers use fishbone diagrams with the results of the analysis of the causes of loose spot welding problems as follows:

a. Induction during the spot welding process
b. There is no standard frequency of changing the tip cup so that the tip cup diameter is over size
c. The cup tip repaire tool is still manual / uses a file so that the cup tip diameter is unstable after repairing
d. There is no tool to verify cup tip eligibility
e. No tool to detect cup tip centerness (upper &; lower)

4. Improve Phase

From the analysis that has been carried out, an activity plan is determined, including the following:

a. Installing a three-color insulator in the Jack Bracket spot welding machine
b. Create an insulator condition control check sheet
c. Trial and determine the standard frequency of changing cup tips (300 receipts)
d. Addition of counters and buzzers on spot welding machines to identify cup tips that are over process
e. Procurement of dresser machine for repaire cup tips
f. Procurement of pokayoke cup tips to verify cup tip eligibility
g. Procurement of jig centering cup tip
h. Control phase

In this phase, those who play a role in controlling and monitoring the results of improvements that have been made are project leaders and team members, as well as ranks from top management. The resume results of the improvements that have been made by the project team show that there is a very significant change in the CPK value, namely before the increase in the Cp value of 0.30 and after the improvement of the Cpk value to 2.18. These results show that the capability of the process after improvement is improving. In addition, in terms of NG Ratio, there was a decrease of 1.19%, from 1.94% to 0.75%. Then for the sigma value also changed from 3.3 to 4.0, this means that the process is getting better. The value of COPQ has also decreased, but researchers do not display the value of COPQ because the data is convidential data from the company itself.

IV. CONCLUSIONS AND SUGGESTIONS

4.1 CONCLUSION

From the series of activities carried out by researchers starting from the beginning to the end, researchers can draw the following conclusions:

1. Based on the results of data processing and analysis that has been carried out, the problems currently faced by PT. XYZ is about the number of customer claims on the Jack Bracket part. Within 6 months customer claims reached 57 pcs.

2. Besides customer claims, the NG ratio in the Jack Bracket production process is also quite high, which is 3.23%. This is very far from the target set by the company, which is 0.57%.
3. Then from the results of calculating the current sigma value of the company level, it is known that currently the sigma value of PT. XYZ is at 3.3 with a total PPM of 32,325 PPM.
4. Improvement efforts made to reduce NG flow Out &; NG Ratio in the Jack Bracket production process include eliminating the potential for induction by installing insulators in spot welding machines, determining cup tip change frequency standards, changing cup tip repair methods from using manual files to using dresser machines, making cup tip centering tools and adding counters in spot welding machines as cup tip detectors that are over size. The results of improvements that have been made by the project team are very effective, shown
5. with no customer claim for Jack Bracket parts in April 2018. In terms of NG Ratio, it also decreased, from 3.23% to 0.75%. For loose spot welding problems, after repairs are made, it does not appear, meaning that the NG Ratio value of 0.75% is a different type of problem from the Jack Bracket part.

4.2. ADVICE

Based on the conclusions that have been obtained, the author would like to provide advice to companies and other researchers who want to conduct research in the same field, including:
1. For companies, so that the Lean Six Sigma project team that has been formed so that a training agenda is carried out to improve the skills and knowledge of each individual in the team and make Lean Six Sigma the basis of the philosophy of PT. XYZ.
2. Then to achieve the NG Ratio target from the company, so that it continues to improve other types of NG in the Jack Bracket.
3. For readers, please note that Lean Six Sigma is a continuous improvement methodology which in its implementation is a team not an individual, so when you want to apply this methodology you must form a team project first.

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