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Implementation of Lean Manufacturing to Reduce Hold Types of Mission Case Products using DMAIC and KAIZEN Approach

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ABSTRACT

Company in this research is a manufacturing company engaged in the automotive industry that produces transmissions for four-wheeled vehicles. This research was conducted at the ALMC department which specializes in producing Mission Cases. In carrying out this Mission Case production activity, it is still found that there are Hold defects or pending parts because the quality does not meet the requirements to be flowed in the assembly process. The types of defects are kizu (berets), dakon (dented due to impact) and atsukon (dented due to scrap.) As a result, the company has to incur additional costs to repair the part (overprocess) so that it can be transferred to the assembly process. The purpose of this research is to minimize the Hold defects by implementing lean manufacturing through DMAIC and KAIZEN approaches. The identification of waste in the production line is carried out using value stream mapping tools and the Hold defect problem analysis stage is solved using DMAIC tools. The results of this study are expected to minimize smallpox hold with the implementation of lean manufacturing

Key Words:, DMAIC, KAIZEN, Lean Manufacturing, Six Sigma.

1. INTRODUCTION

The rapid development of the automotive manufacturing industry in Indonesia has spurred every automotive manufacturing business actor to improve the quality of the products they make, in order to satisfy customers who buy their products. Companies that produce products with low quality will certainly not have a place in the hearts of consumers. This resulted in low sales volume and decreased company profits. It has become a consequence, if the company expects its products to be accepted in the market, of course it must maintain its quality. According to [1-13] Product quality control is a control system that is carried out from the initial stages of a process to the finished product, and even to distribution to consumers. Companies that have high process capability will be able to produce little or no defective products. Process capability is a critical performance measure that shows the process is able to produce in accordance with product specifications set by management based on customer needs and expectations. In an effort to improve quality in a company, it must first know the level of process capability that the company has, this is intended to determine the extent to which the final output of the process can meet customer needs, so that by knowing the level of process capability it can be used as a basis for control and improve the quality of the measured output characteristics. According to [14-24] Lean Six Sigma is a quality control method which is a combination of Lean and Six Sigma which can be defined as a business philosophy, systemic and systematic approach to identify and eliminate waste or non-value-added activities. -value-added activities) through radical continuous improvement to achieve a six sigma level of performance, by channeling

products (materials, work-inprocess, output) and information using a pull system from internal and external customers to pursue excellence and perfection by producing only 3.4 defects for every one million occasions or operations.DMAIC is a method used in six sigma to pursue excellence 3.4 defects for every one million opportunities (6 Sixma). while kaizen is a continuous improvement effort that involves everyone to achieve the goals or goals that have been set by top management in the company. The company is a car transmission manufacturing company founded in 2002, located in Cikampek, West Java. The company produces various transmission variants for certain types of cars. An example of the product can be seen in Figure 1 below.

Figure 1 The Product

As one of the veteran manufacturing companies, The company in carrying out its production activities still often encounters process failures that cause product defects. In the data for the last 4 months below (table 1.1), a total of 133 pieces of Hold defects were found on Mission Case products.

Table 1 Data on Hold Mission Case Defects in 2021

Month	Reject Hold Mission Case (PCS)
8	29
9	25
10	31
11	48

From the data in table 1 above, if it is described again, the types of Hold Mission Case defects for the last 4 months can be seen in the graph of Figure 2 below.

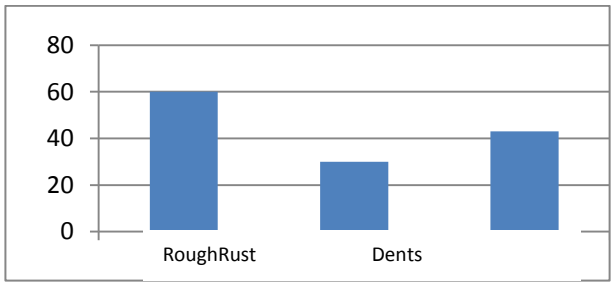

Figure 2 Graph of Hold Mission Case Types of Defects

The problem of Hold defects in Mission Case products certainly made the management of The company became frustrated because apart from requiring additional processes to repair (non-valued added), it was also found that a quality management system had been implemented at The company is not powerful enough to dramatically eliminate the Hold type defect of Mission Case products. Based on these problems, The company needs to analyze and find the right method to dramatically eliminate Hold defects in Mission Case products.

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From the research conducted by [24-30] with the title Implementation of Lean Six Sigma in Quality Improvement by Reducing NG Drop Defective Products in the HL 4.8 Product Final Test Machine. It is explained in the research that the method used is lean six sigma. The Lean Six Sigma method tries to combine the concepts of Lean Manufacturing with Six Sigma. Six Sigma itself uses the process sequence define, measurement, analysis, improvement and control (DMAIC) in solving problems. The concept of Lean Manufacturing is included in the define stage. Hologram Laser 4.8 (HL 4.8) is one of the electronic component products that is widely used in electronic products, such as CD/DVD readers, Blue ray, barcode readers, fiber optics, and so on the productivity of this product is one that cannot meet the company's management targets. The production yield was only 92.17% of the management's target of 98.8%. The level of sigma value was also only at the level of 1.4482 and the percentage of NG Drop was only 0.62% during January-December 2013. Improvements were made with Lean Six Sigma, production yields rose from 92.17% to 99.88%. Sigma level rose from 1.4482 to 2.9730. NG Drop's percentage of defective products decreased from 0.62% to 0.036%.

Then based on research conducted by [31-34] with the title Implementation of the DMAIC-Six Sigma Method in Quality Improvement in Small and Medium Industries: Case Study of Spring Adjuster Product Quality Improvement at PT. X, explained that continuous improvement really needs to be done by every company including PT. STL. One of the effective approaches and methods is DMAIC Six Sigma which has succeeded in improving the quality of spring adjuster production at PT. STL from 83.23 defects per 300 units to 15.14 defects per 300 units. This repair involves employees who understand and technically master the spring adjuster production process.

From the background above, the writer will analyze the causes of the Hold Mission Case defects in The company and its improvement steps by implementing lean six sigma based on DMAIC and kaizen methods.

2. RESEARCH METHOD

The data processing methods used in this research are DMAIC and KAIZEN.

A. DMAIC

DMAIC (Define, Measure, Analyze, Improve, Control) is a data-based six sigma method using statistical tools to pursue an advantage of 3.4 failures from one million opportunities

a. Define

At this stage, the defect which is the most significant cause of production failure is determined. then proceed with the determination of CTQ (Critical to Quality) with the aim of knowing what kind of product the customer wants

b. Measure

Analyzing the sigma level and (DPMO) Defect Per Million Opportunity of the company

DPO Calculation

Knowing the DPO (Defect Per Opportunities) is a measure of failure that shows the number of defects per opportunity

DPO = (total defect)/(Potential .CTQ output)

DPMO calculation

Calculating DPMO (Defects Per Million Opportunities) is a measure of failure that shows the number of defects per million opportunities.

DPMO = DPO x 1,000,000

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c. Analysis.

At this stage, identify the causes of quality problems by using a causal diagram (Fisbond diagram). Cause-and-effect diagrams are used to maximize the success values of the company's product quality level by minimizing the risk of failure.

d. Improve

It is a six sigma stage by measuring, recommending improvement reviews, analyzing and then taking corrective actions that have been found in the analyze stage using KAIZEN tools, namely; Five-Step Plan (5R), Five W, and One H, and Five-M Checklist (Man, Material, Method, Machine, Money)..

e. Control

This is the last operational stage in a Six Sigma quality improvement project. At this stage the procedures and results of quality improvement are documented to be used as standard work guidelines to prevent the same problems or old practices from being repeated.

3. RESULT

Analysis of Causes of Hold Defects with DMAIC and KAIZEN

The problem that is discussed in this study is the hold (waste) defect in the Mission Case product which causes rework (waste) that does not provide added value. So the aim of this research is to minimize the Hold defect with DMAIC and KAIZEN approaches.

Define

There are 3 types of Hold defects that are the focus (critical to quality) in an effort to minimize Hold defects in Mission Case products, namely kizu (berets), dakon (impact dent) and atsukon (inward dent). From the results of the analysis that Kizu's defects contributed 45.1% of the total Hold's defects, followed by Dakon 30.1% and Atsukon 24.8%.

1. Kizu

Based on these data, it can be concluded that the kizu defect is a type of defect that is difficult to control and requires serious treatment.

2. Dakon

The data show that dakon defects are not that difficult to control. This can be seen in the trend of Dakon defects showing a decline. This is due to pure dakon defects from operator negligence who collided with the workpiece with other workpieces.

3. Atsukon

Like Kizu's defect, the Atsukon defect percentage data below shows an upward trend. So it needs serious handling to eliminate this type of Atsukon defect.

Measure

1. Sigma Level

The parameter that is used and becomes the benchmark in the implementation of lean manufacturing in this study is the sigma level. The following is a graph of the six sigma level values specifically for Hold defects (kizu, dakon and atsukon) for the September-December period as follows.

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The graph above shows an increase in the value of the sigma level from September to October. Furthermore, from October to December the graph shows a downward trend in the value of the sigma level. This is of course a warning for PT. TJT, especially the ALMC department, there may be signs of a decrease in the sigma level in subsequent periods, so improvements need to be made to increase the sigma level value again as in October or even exceed it.

2. Relationship of Sigma Level and Defect Hold . Percentage

The relationship between sigma level values and the percentage of defects in hold follows the straight-line equation y = -374.21x + 5.2669.

Where ;

Y = sigma level value

X = The value of the percentage of defects Hold Mission Case products

From the linear equation above, it is found that every increase in the percentage of Hold defects 0.01% results in a decrease in the sigma level value of 0.0374 points. Or vice versa if each percentage of Hold defects decreases by 0.01%, it results in an increase in the sigma value of 0.0374 points.

Analyze

After knowing the place or process of the occurrence of the Hold defect in the Mission Case product, then an analysis of the causes of the Hold defect will be carried out from four perspectives, namely Human, Method, Machine and Material with Fishbond Tools.

The cause of the kizu and atsukon hold defects is due to the scrap sticking to the workpiece so that during the machining process defects occur. Then the Dakon type Hold defect occurs due to collision with other workpieces when pushed on the conveyor roller. So the effort to eliminate scrap before machining is the focus to eliminate kizu and atsukon defects. Meanwhile, efforts to eliminate dakon defects must avoid collisions with other workpieces.

Improve

After the improvement is done, then the results are monitored for 3 months to prove that whether the implementation of lean manufacturing using the DMAIC and KAIZEN methods has an impact on reducing Hold defects in Mission Case products. The results of the improvement activities can be seen in the table below.

Table 2 Types of Defect Hold

No	Period	Defect Hold (pcs)		
		Kizu	Dakon	Atsukon
1	January	9	0	4
2	February	7	0	2
3	March	4	0	2
Total		**20**	**0**	**8**

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Table 3 Mission Case Product Production Data for January – March Period

No	Period	Product Mission Case		Defect Percentage
		Amount	Defect	
1	Jan	60.000	13	0.02%
2	Feb	57.000	9	0.02%
3	March	36.000	6	0.02%
Total		**153.000**	**28**	**0.02%**

Based on the data in tables 2 and 3, determine the percentage of each type of Hold handicap as follows;

1. Kizu's Disability

If it is known the number of Mission Cases produced by PT. TJT during the period January – March 2021 is 153,000 pcs and the number of kizu type defects during that period is 20 pcs, then the yield is;

% Kizu Defects= (Total Number of Defects)/(Total Production)

% of Kizu's Disability= 20/153,000

% Kizu's Disability= 0.01%

When compared with the percentage of kizu defects before kaizen, which is 0.03%, this kaizen activity has the effect of reducing the percentage of kizu defects by 3 times.

2. Dakon's Disability

If it is known the number of Mission Cases produced by PT. TJT during the period January – March 2021 is 153,000 pcs and the number of defects in the type of dakon during that period is 0 pcs, then the yield is;

% Dakon Defects= (Total Number of Defects)/(Total Production)

% Dakon Defects= 0/153,000

% Dakon Disability = 0.00 %

When compared with the percentage of kizu defects before kaizen which was 0.02%, then this kaizen activity has an impact on the loss of dakon defects from Hold defects on Mission Case products.

3. Atsukon's Disability

If it is known the number of Mission Cases produced by PT. TJT during the period January – March 2021 is 153,000 pcs and the number of defects of the atsukon type during that period is 8 pcs, then the yield is;

% Atsukon Defects= (Total Number of Defects)/(Total Production)

% Atsukon Defect= 8/153,000

% Atsukon Defect= 0.0052 %

When compared with the percentage of atsukon defects before kaizen, which was 0.02%, then this kaizen activity resulted in a 4-fold decrease in the percentage of atsukon defects.

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The comparison of the percentage of Hold defects before and after kaizen can be seen in Figure 3 below

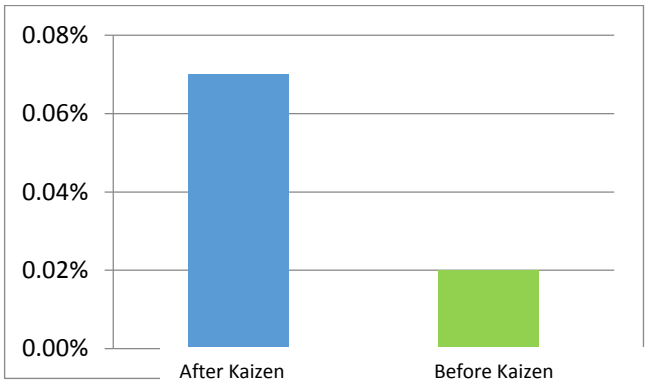

Figure 3 Comparison of Hold Defect Percentage

Control

Control is an effort to maintain product quality by controlling an integrated system consisting of machines, humans (operators), materials and methods. Each department works together in carrying out this control activity according to the portion and responsibilities that have been given. This control activity will be documented so that it can be used as evidence for further kaizen activities (continues improvement).

4. CONCLUSION

Based on the results of calculations and analysis of product quality control Mission Case at Company X that has been carried out in this study, the following conclusions can be drawn;

1. Factors that cause defects Hold at Company X is a machine factor where there is a lot of scrap on the conveyor, the material handling method (SOP) is not available, the Mission Case product material is soft so it needs special handling so it doesn't hit and the operator is less diligent in cleaning.

2. The DPMO value of the Mission Case product defect Hold for the period September-December 2021 before the Kaizen activity was carried out was 173.61 – 301.88 or the six sigma value was 4.9 - 5.07. After the kaizen activity is carried out, the results are monitored for 3 months (January 2021 - March 2021) then the DPMO value becomes 52.6 – 72.2 and the six sigma level becomes 5.30 – 5.38. From the expected sigma value target, Company X of at least 5.0 has been reached.

3. After analyzing with DMAIC and Kaizen methods, the proposed improvements can be given to Company X is to carry out 5S/5R (Concise, Neat, Clean, Treat, Diligent) activities, create and revise SOP documents and conduct training/training for machine operators, modify conveyor rollers and make modifications to work tables.

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