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Analysis of Quality Improvement of Camshaft type K50 on the Reamer Process using DMAIC and FMEA Methods

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ABSTRACT

The company of this research is one of the largest auto and motorcycle parts manufacturers in Indonesia. To support the productivity of demand from customers, Company is divided into 2 plants, namely the Cikarang plant and the Karawang plant. While the production process is divided into several departments, one of these departments is production. In its duties, production functions to control production targets that have been set by the company and minimize rejects from production, with one of them producing K50 type Camshaft parts. Because in the Camshaft K50 part there are still many rejects, it is necessary to make improvements in the work process in order to create good effectiveness and efficiency. The percentage of reject reamer types that do not enter the pitch is 83%, drill blows 9%, and drill breaks 8%. Improving the quality of the K50 Camshaft is done using the DMAIC method. The purpose of this research. At stage D (Define) what is done is to determine the Critical to Quality (CTQ) to find out what are the physical quality characteristics of the Camshaft K50. In the M (Measure) stage, measurements are made using a Pareto diagram to find out the highest frequency of defects which later need improvement. The expected result is to minimize product rejection.

Keywords: Defect, DMAIC, Quality, Six Sigma, VSM.

1. INTRODUCTION

In the industrial world, product quality or quality is one of the keys to success in a company. A product that is produced is good or bad, the product can be identified by the existence of control activities that refer to improving the quality of the product produced. This is based on the consideration of an increasingly selective consumer assessment in choosing a product to be used. Activities in a production process that uphold the control of a product produced will be profitable for the company, because at the time of production one of the things that can be suppressed with quality control is reject products which can be suppressed to the lowest level. In addition, the work effectiveness of employees can do a good job and do not waste time making repairs to products that are considered inappropriate or rejected.

The purpose of quality control is to quickly investigate the causes or shifts in a process such that an investigation of the process and corrective action can be taken before too many nonconforming units are produced [1-15]. Quality control is the most important thing in the world of production, because good quality control and good product quality make it easier for companies to market their products. This is done so that consumers feel confident that the product offered is a good product. In every production process carried out, the production department always tries to prevent events that are out of control so that they don't happen again on another day. The management usually only takes temporary precautions, while the problems that exist in production will continue to exist in every process in the company. Therefore, to take preventive and corrective actions, it is necessary to have the cooperation of all parties involved in the company's organizational structure on an ongoing basis.

In assuring product quality, the company will always try to carry out quality control activities for the products produced, starting from raw materials to make products, processes and finished products that are marketed. By maintaining product quality, a company will be able to compete with its competitors in controlling the market and attracting consumer interest because it is one of the important values for a company that produces products with high quality and affordable prices [16-25].

In the process as one of the companies engaged in the field of automotive components. In producing these products, the company always strives to provide the best for customers in terms of quality and product quality. At this time the Company is required to always maintain the quality of the products produced because consumers are increasingly selective in choosing products and the emergence of competition from similar companies.

The objective company is a company engaged in manufacturing in the manufacture of components for two or four-wheeled vehicles. The types of products produced are 2W Automatic Transmission Gear Shaft & Camshaft, 2W Automatic Transmission Gear & Shaft, Planetary Assembly, Differential Assembly, Ball Joint Assembly, Hub Clutch, and 4W Camshaft. This research focuses on the 2W Transmission Camshaft product because this product accounts for the largest defect among other products.

Figure 1 Camshaft K50 Before Reamer

From the results of [26-36] with the title Quality Control: Selected Problem-Solving Techniques that good quality control will produce products that meet consumer standards continuously. One of the main purposes of consumer specifications is to define what is a problem and what is not a problem for consumers. This is very important in an effort to build consumer confidence in the products produced by the company, so that the company's image will be good. Quality control in addition to affecting the quality that meets the standards, will also result in lower product prices. Due to the reduced number of damaged or rejected products, the costs incurred due to the rejected products will be reduced. By reducing costs caused by product damage or rejection, the company has improved its performance so that it can continue to survive and compete with other companies.

One of the efforts that must be made by the company to be able to minimize rejects in the Reamer process, namely by controlling the Reamer process to ensure the quality of the products produced. So that there is an effort to try to solve the problem above is the DMAIC and FMEA methods which are expected to evaluate, improve, and improve the quality of the resulting product.

Therefore, in order to minimize the occurrence of product rejects, researchers using the DMAIC method to analyze quality will be able to find out what the main quality characteristics are desired by customers which will then be measured in terms of production process performance in terms of DPMO (Defect Per Million Opportunities) level and Sigma level where if it reaches 6 Sigma, the failure rate is 3.4 failures per one million chance. By using the DMAIC method, it will also analyze what factors are the root causes of problems from the emergence of reject products so that they can determine the appropriate corrective action to improve the quality of the product. And at the Improvement stage, the FMEA method is used to solve the solution of the problem, because the method is relevant to find out the factors causing the largest product rejects, so that corrective actions can be taken to reduce the number of rejects. Finally, at the Control stage, control or monitoring is carried out on the new standards that have been set. With the increase in the quality value of these products, the company will automatically be able to compete more in the market.

Table 1 Production and Reject Reamer Camshaft K50 Data Data April – November 2021

Month	Total Production	Rejection of Product			Total Rejection (Pcs)
		Reamer	Drill no Match	Broken Drill	
April	21.085	170	27	23	220
May	37.980	189	20	30	239
June	42.150	278	31	19	328
July	43.825	298	22	28	348
August	38.825	227	33	17	277
September	43.720	251	29	21	301
October	30.800	237	16	34	287
November	44.715	277	39	11	327
Total	303.100	1.927	217	183	2.327

The Reamer process is the process with the highest percentage of rejects and this process is quite a highlight.

2. Method

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The steps involved in data processing and analysis are as follows:

1. Identification of Product Manufacturing Process

The first step in the research is to understand how the Camshaft K50 production process occurs from raw materials to finished products.

2. Data Collection

The data collection needed in conducting this research includes data on the amount of production and data on reject products in the Reamer process for the April - November 2021 period, as well as observation and interview data to determine the causes of rejects so as to be able to provide solutions to the company.

3. DMAIC Method (Define, Measure, Analyze, Improve, Control)

a) Define

At the define stage, problem identification is carried out, starting with defining each type of reject that occurs in the Reamer process, then continuing with the determination of CTQ (Critical to Quality) with the aim of knowing what kind of product the customer wants.

b) Measure

At this stage, the DPMO (Defect per Million Opportunities) value and SQL (Sigma Quality Level) value will be determined, and yield calculations will be made to determine the probability of the product not being rejected in the Reamer process. Then the DPMO value is converted to the Six Sigma conversion table to find out the sigma level

c) Analyze

In the analyze stage, the first thing to do is to look for the dominant type of reject that occurs in the Reamer process using a Pareto diagram, after knowing the dominant reject that affects it, an analysis of the cause of the rejection is carried out using a fishbone diagram. To find out the cause of the dominant reject, interviews were conducted with production operators and Quality Control operators.

d) Improve

This improve stage is the stage of repairing the problems that have been found and explained in the analyze stage using FMEA (Failure Mode Effect and Analysis). FMEA analysis was performed with an FMEA spreadsheet. For each problem, the RPN value is sought, then the RPN value is arranged from the largest to the smallest value. The RPN value is the result of the multiplication of the severity, occurrence and detection values for each cause of the problem.

e) Control

The control stage or control stage is the last stage in the DMAIC method. The main goal at the control stage is to control the existing process so that problems that arise in the old process do not recur. The control phase carried out is only a proposal to be implemented by the company.

3. RESULT

Define stage

At this stage, the tools used are to create a SIPOC diagram and determine the CTQ of the K50 camshaft reamer product reject. The SIPOC diagram is made in order to know the process that is run from raw materials to produce a product. While determining the CTQ is done by determining the characteristics of the product quality of the K50 camshaft reamer. The following are the results of the SIPOC and CTQ diagrams.

SIPOC Chart

a) Supplier

The raw materials used in the K50 reamer production process are imported from various local suppliers and some even use imported raw materials. The raw materials include part formers, decom pins, and bearings.

b) Input

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The marketing party will do monthly forecasting and have a production target number for the next month. Errors in inputs that have an impact on the product will occur if the forecasting or production target from the Marketing side misses, whether there is excess or lack of production.

c) Process

The process of preparing raw materials in the manufacture of Camshaft K50 there are several processes. The process flow is the Machining process which includes Lathe-Keyway-Milling, then the parts are burned in the process.

Heathreatment, then the Finishing process which includes Reamer-Cylinder-Finecam-Lapping-Bibiri, checked in the Visual Check process and finally the parts are assembled on the Assembling line.

d) Output

The output produced from the process is a Camshaft product.

e) Customers

PT. AHM is the main customer of PT. Mapin, and almost every type of part produced at PT Mapin is supplied to PT AHM.

CTQ (Critical to Quality)

Based on data obtained from January to August 2020, there are 3 types of rejects that often occur, namely the reamer does not enter the pitch, the drill fails, and the drill breaks. After knowing the types of rejects in the K50 camshaft reamer production process, then determining the CTQ value by determining the highest number of rejects from the existing reject types. The pie diagram shows the largest defect, which is reject dimensions of 83%.

Stage Measure

Based on the results of the overall DPMO calculation for the period from January to August 2020, the results obtained are 23,662.4, which means that there are 23,662.4 failures per million possibilities. And it is known that the SQL value from January to August 2020 is 3.5, meaning that the company has not implemented quality control properly because it is still far from the 6 sigma target. It can be seen below in the diagram 5.2 comparison of sigma values

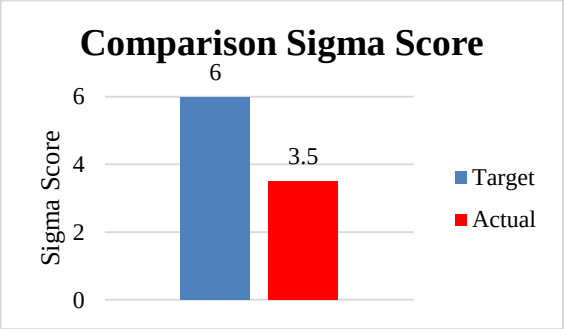

Figure 2 Comparison of Sigma Nilai Values

From the data in the diagram above, this sigma value has not been achieved because the actual achievement only gets 3.5 while the target to be achieved is 6 so there is a difference of 2.5 from the target that must be achieved. From the data in the diagram above, the sigma value has not been achieved from the 6 sigma target, the actual sigma value is only 3.5.

Analyze Stage

The third stage is the Analyze stage where this stage looks for what types of rejects occur most often (the largest) using a Pareto diagram and the largest reject type, namely the reject reamer does not enter the pitch with a percentage of 83%, then after knowing the results of the Pareto diagram, proceed to explain The cause of the biggest reject with the help of a causal diagram or fishbone, and the main factor that causes the reject is the engine factor.

Improve Stage

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The next stage is the Improve stage by using the FMEA (Failure Mode and Effect Analysis) tools to determine which are the priorities for improvement by looking at the largest RPN value in the FMEA table, and the cause of the reamer not entering the pitch with the highest RPN value of 441. means that it must be prioritized, namely distance and angel drill with unstable prefixes. And we also get recommended action from these causes, namely the Center and worn keyway pins.

Control Stage

The control stage is a proposal for companies that are used as research which is the last stage of the DMAIC method which contains proposals or recommendations in order to eliminate waste and reduce rejects. At this stage, control of the ongoing process is carried out by providing suggestions for improvements or improvements that have been given previously, namely:

1. Create a Scorecard to see the progress of the project from period to period.

2. Increasing the frequency of machine inspections, especially machines that are old and machines that are used every day. Some types of maintenance that can be done are:

- Preventive Maintenance

Preventive Maintenance aims to reduce the occurrence of machines that are damaged quickly when operating and the condition of machines that are always ready for process use.

- Spare Part Replacement

Regular replacement of spare parts is carried out according to the age of use to ensure the machine operates optimally.

3. Making special check sheets intended for process control, for example controlling machine jigs, jig inspections and daily check machines.

4. CONCLUSION

From the results of processing and analysis that has been done in previous chapters, the researchers can draw the following conclusions:

1. From the results of the identification or analysis that has been carried out, it is known that several types of rejects occurred.d in the production of Camshaft K50 at PT Mapin, namely reject reamer not entering the pitch, reject drill blong and reject drill broken.

2. From the results of the analysis, the main factor causing the rejection of the Camshaft K50 product which is known is the engine factor. Lack of machine maintenance where maintenance is carried out every day, resulting in decreased machine performance and reduced machine capability in the production process.

3. Designing improvements to the engine factor, considering that this factor causes the highest number of rejects. The proposed actions include increasing the frequency of maintenance on the reamer process machine, replacing spare parts regularly, and checking the machine before starting the production process.

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