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Quality Control of Head Cylinder Products Using the SevenTools Approach at PT Otomotif Indonesia

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ABSTRACT

PT Otomotif Indonesia is a Japanese manufacturing company. Company management continues to strive to improve the quality of products produced, including cylinder heads. Quality control is something that needs to be done in a company to minimise the occurrence of defective goods. The research was conducted in the machining section of the cylinder head manufacturing process. The highest cylinder head production percentage was 0.88% in November 2023. This research aims to minimise the occurrence of defects by applying the Seven Tools method. Seven Tools is a methodology consisting of seven quality control instruments: Check Sheet, Stratification, histogram diagram, Pareto diagram, scatter diagram, control chart, and Fishbone diagram. After data processing using the seven tools method, 5 errors were identified, the biggest being pen-matching errors. The 5W+1H method was used when analysing the Fishbone diagram and making recommendations for improvement.

Keywords: Quality Control, Cylinder Head, Seven Tools

Introduction

PT Otomotif Indonesia is a manufacturing company operating in the *automotive industry*. One of the items produced by PT Otomotif Indonesia is the cylinder head, which is the *engine* used in *Matic* and *Sport* motorbikes. PT Otomotif Indonesia is a global company that prioritises the quality of its production. This has been proven in the products produced and product quality is the keyto the company's success in reaching the international market. This company supplies its products to various countries, especially *Head Cylinder* spare parts, which are the main components of making motorbikes. In addition, the company also has a primary focus on customer satisfaction with the quality ofthe products produced. However, it cannot be denied that a decrease in the quality of each company must occur, so there is a need for quality control in the company. Defective products occur due to several factors that cause the product to become faulty or *Not Good* (NG)[1], [2].

Every company must carry out quality control to maintain the quality of its products according to company standards or customer needs. Products made with excellent and accurate quality control can meet the quality requirements set by the company. Every company must have problems with product quality in the form of *defects* that occur during production. PT Otomotif Indonesia in the *Head Cylinder* product *Machining* process, there are several *defects*, namely scratches in the *SpringSeat* area, *Blong Bearings*, and broken *tools*. Based on observations, the Spring Seat defect is the highest contributor to Head Cylinder product defects.

In the *Machining Head Cylinder* production process, there are still *Not Good* (NG) products in the form of *scrap* pinched by the press machine in the *Spring Seat* area. Therefore, it is important to know the various factors that cause errors in the process so that improvements can be made to reduce damaged goods. This study aims to determine the factors that cause defects and propose an approach to reduce product defects using the *Seven Tools* method. Table 1 shows information about defective products that occurred in July-December 2023 and where the defect rate increased in this company.

Table 1. Number of defects from July to December 2023

Month	Production Quantity (PCS)	Defect Type (Unit)					Total Defect	Presentase Defect	Target Defect
		Spring Seat	Bearing Blong	Chamfer Oval	Tool Patah	Space Arm Sempi			

						t			
Jul-23	16.520	40	25	15	35	10	125	0,75%	0,70%
Aug-23	16.960	35	25	25	45	6	136	0,80%	0,70%
Sep-23	16.120	43	17	25	30	15	130	0,80%	0,70%
Okt-23	17.000	49	8	32	36	10	135	0,79%	0,70%
Nov-23	17.360	55	15	25	40	19	154	0,88%	0,70%
Des-23	16.900	47	10	32	39	20	148	0,87%	0,70%
Total	100.860	269	100	154	225	80	828		

Source: Company data, 2023

Table 1. Shows that Production for *Head Cylinder* products every month from July to December 2023 in the *Machining* department has decreased in quality until the end of the year with a total of 100,860 components tested, as many as 100,032 components have good quality and 828 components are classified as defective. Defective products in the Spring Seat section are the most common, with a total defect of 269 Pcs. The types of defects that occur and the most in Figure 1. below.

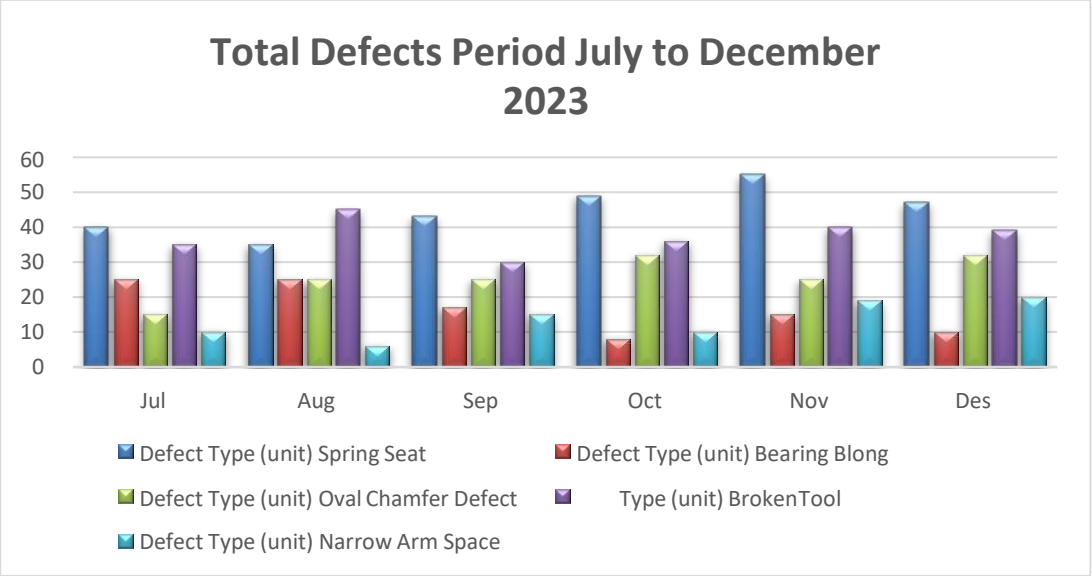

Figure 1. Number of Cylinder Head Product Defects

From the results of research conducted through the data obtained, defective products in the *Spring Seat* section are the most common. This is caused by several factors that trigger defects. One of the quality control methods applied in this study is the Seven Tools method to evaluate the defects that occur and improve quality at PT Otomotif Indonesia. The objectives ofthe research conducted at PT Otomotif Indonesia are as follows:

1. To identify the types of *defects* and measure the defect rate in *Head Cylinder* products.
2. To determine the factors that influence the occurrence of the largest *defects* in *Head Cylinder*
3. products.
4. How is the application of product quality control carried out by the *Seven Tools* method?

Quality control is an activity to ensure whether the policy in terms of quality can be reflectedin the final product/service. In other words, quality control is an effort to maintain the quality of the goods produced so that they are according to the product/service specifications that have been determined based on company policy. [3]–[6]. Product quality control is a control system carried out from the beginning of the manufacturing process to the finishedproduct, quality control is carried out to maintain the quality of the products produced so that they become products that are according to the wishes of the company [7]–[11].

The purpose of quality control must lead to several goals to be achieved so that consumers can be satisfied using the company's products and services in a way that the price of the company's products can be kept as low as possible, and planned by the company,[12]–[16].

The production process is said to be good if the process produces products that meet

predetermined standards. However, in reality, various obstacles often result in products being considered defective. Therefore, quality control is necessary so that companies can correct errors or obstacles in the production process. One of the quality controls that can be applied is Seven Tools.

Product quality is the main focus of the company. The company's goal is to produce productsor services that customers want. The product desired by the customer is a good quality product. Whether or not the products' quality depends on the supervision carried out from the beginning of the process to the finished product. From the producer's perspective, product quality is included in the company's internal evaluation, while consumer evaluation includes evaluation from outside the company.[17]–[20].

According to [21]–[23] Seven Tools or also called seven quality controltools, are essential tools used to fix quality problems and control quality in a production process. The following are seven tools used in quality control.

Seven tools are used for statistical process control. They can assist in establishing process capability by measuring the variation of the products produced and graphically allowing the establishment of a process that is within or outside the control limits.[24]–[27].

Research Methods

This research was conducted at PT Otomotif Indonesia within the scope of the Machining department production process with the object of research on Head Cylinder model B6H products, with the primary data collection method using interviews with production leaders and observations made by the author. While secondary data collection is carried out by studying literature and taking production data and the number of defects that occur in Head Cylinder production from July to December 2023.

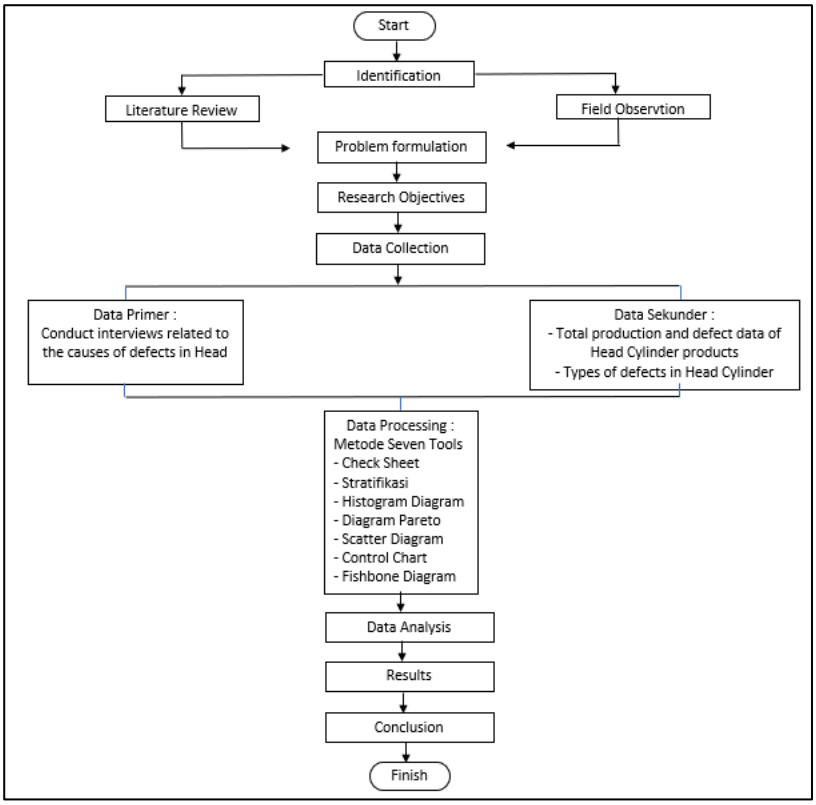

Figure 2. Flowchart of Research Flow

Check sheet

Check Sheet is a tool used in this study to simplify and simplify the recording of cylinder headproduct failure data. The check form contains defect information by classifying the types of defects and counting the number of defects and is easy to analyse.

Stratification

Stratification is a technique for grouping data into certain categories so that the data can describe the

problem more clearly, making it easier to conclude. The categories formed includedata related to the environment.

Histogram Diagram
Histograms are graphical charts whose purpose is to determine the percentage of product defects based on data and identify the most frequent types of defects. Histograms can provide information about quality issues and support decision-making without the need for additional analysis.

Pareto Diagram
This research uses Pareto diagrams to identify the percentage of the most dominant defects. After knowing the main causes that must be eliminated, the improvement priority is set to determinethe priority or type of major defects to see large and small defects.

Scatter Diagram
A *scatter diagram* or scatter plot shows the causation or proximity of two data sets. The problem information used in this method is determined by the results obtained in the field study.

Fishbone Diagram
Causal diagrams can be used to find the main cause of a failure problem at PT Otomotif Indonesia. *Seven* tools can be used to identify the root causes of defects to identify the main factors thataffect the quality of *Head Cylinder* products. The following deviation factors must be considered:
Human, Raw Materials, Machinery and Equipment, Working Method, Environment

Results and Discussion

At this stage, data analysis is carried out to find problems and determine the causes ofproblems. The following explains the application of the *Seven Tools* method to process data and analyse the root causes of PT Otomotif Indonesia's main problems to provide recommendations for improvements to minimise errors in cylinder head products.

Flowchart/Process Diagram
The flow of the Head Cylinder production process from raw materials to finished products isdivided into several processes, as for the overall process can be seen in Figure 3.

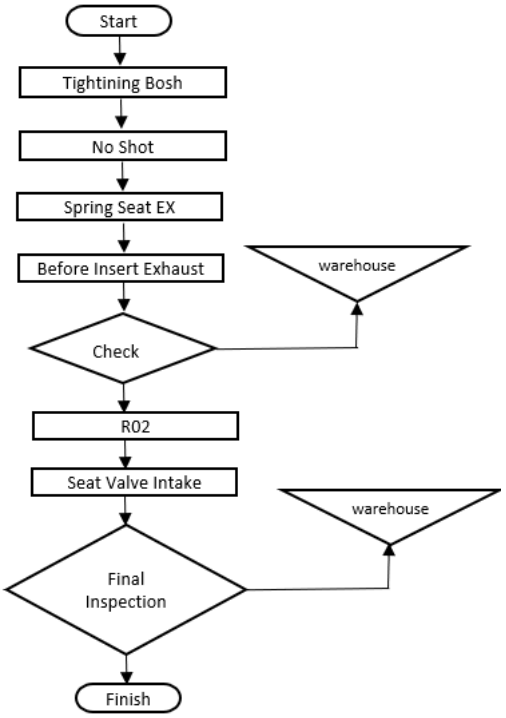

Figure 3. Cylinder Head Production Process Diagram

Check Sheet

A defective product inspection sheet was introduced in the cylinder head production process at PT Otomotif Indonesia. A summary control form was then prepared within one month. The date of the summary inspection sheet for defective products is shown in Table 2.

Table 2. Recapitulation of *Check sheet* data July - December 2023.

Month	*Defect* Type					
	SpringSeat	BearingBlong	Oval Chamfer	Broken Tool	NarrowArm Space	Total *Defect*
July - 23	40	25	15	35	10	125
Aug - 23	35	25	25	45	6	136
Sep -23	43	17	25	30	15	130
Oct - 23	49	8	32	36	10	135
Nov - 23	55	15	25	40	19	154
Dec -23	47	10	32	39	20	148

Stratification

Using the information contained in the cylinder head products about the type and number of cylinder head defects, the data can be classified into smaller, similar groups for clearer detection. The classification of cylinder head products is based on 5 types of defects, where the largest defect in the *Aggregate* data is the Scratch defect type in the *Spring Seat* area. The other four defects are: *Oval chamfer*, Narrow *arm space*, *Bearing Blong*, and *Tool* broken. Table 3 is the result of data distribution.

Table 3. Product Stratification of *Cylinder Head*.

Product Defect Type	Total Defect (Pcs)
Spring Seat	269
Bearing Blong	100
Chamfer Oval	154
Broken Tool	225
NarrowArm Space	80
Total	828

Histogram Diagram

The product failure data is then processed in the form of a histogram to determine the characteristics of the failure data. The histogram plot is shown in Figure 4.

From Figure 4. It can be seen that the frequency of *Head Cylinder* production defects at PT Automotive Indonesia in the last 6 months has fluctuated. It can be seen that the highest point of the *Head Cylinder* production *defect* is scratch in the *Spring Seat* area, with a *percentage of* 32%, and the lowest *defect* is the narrow *Space arm defect* type with a *percentage of* 10%.

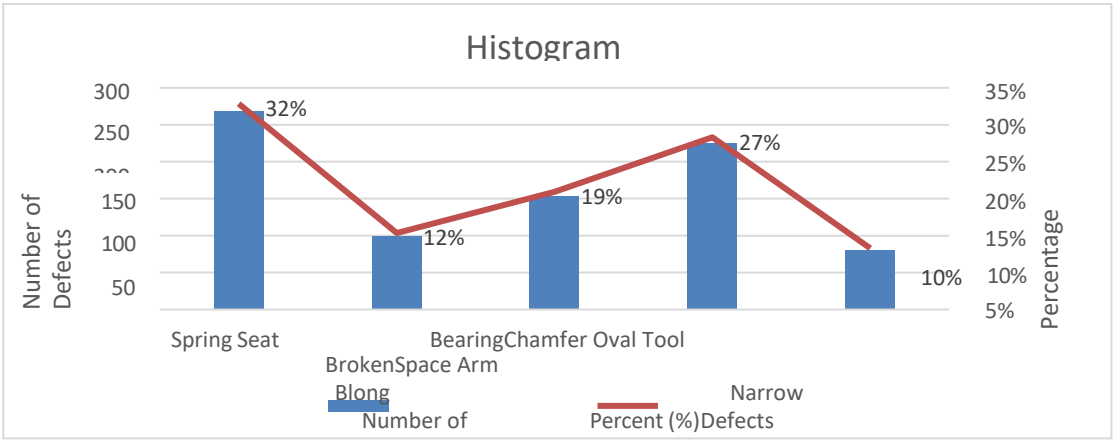

Figure 4. Defect Comparison Histogram

Pareto Diagram

The Pareto chart illustrates the order of fault types from largest to smallest as shown in Figure 5.

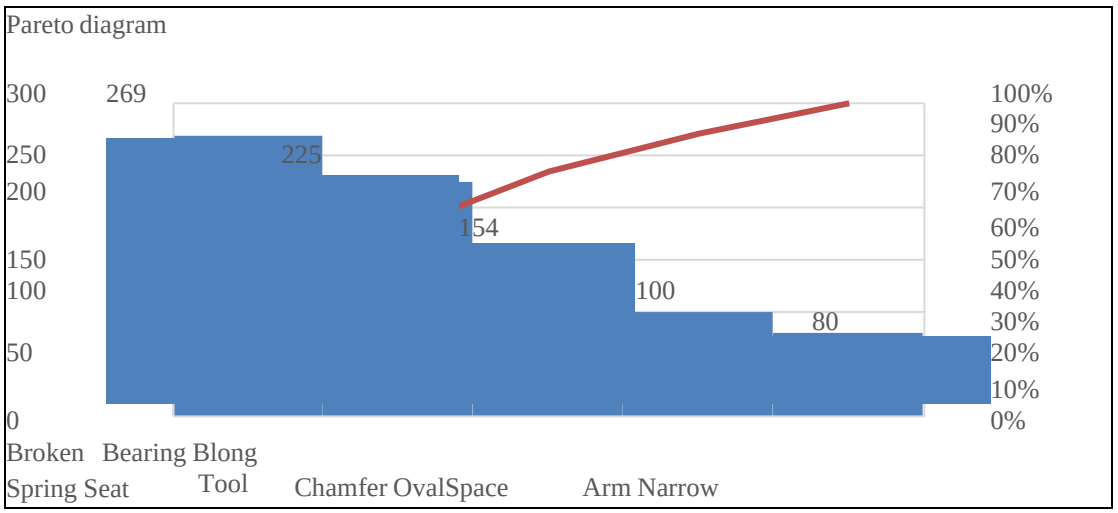

Figure 5. Pareto Diagram

The Pareto diagram in Figure 3 shows that depending on the order in which the fault types occur, these faults have varying frequency levels, with a percentage of 269 for the *Scratch Spring Seat defect* type, 225 pcs for the Broken *Tool defect* type, 154 pcs for the *Oval Chamfer defect* type, 100 pcs for the *Bearing Blong defect* type, and 80 pcs for the Narrow *Space arm defect* type.

Scatter Diagram

To find out whether there is a relationship between the number of *highlights* produced (X) and the number of defects (Y), a scatter diagram was made. The data was further processed using *MSExcel*. The processed data is then presented as a scatter *plot* incorporating the image in Figure 6.

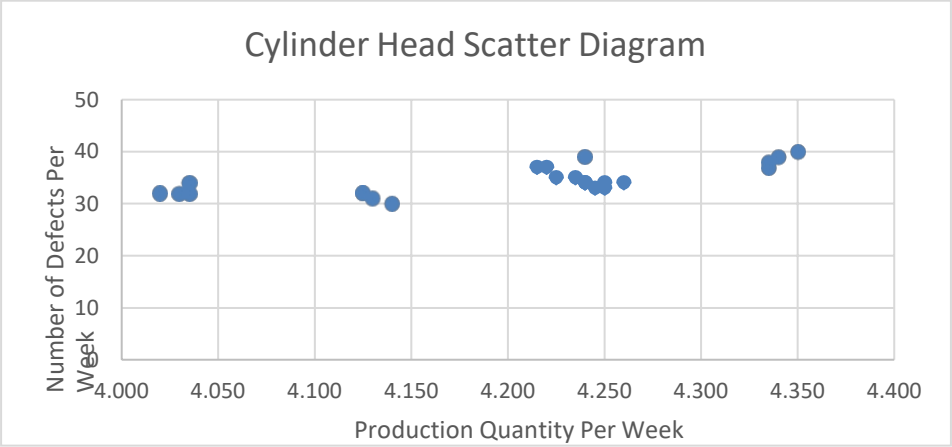

Figure 6. Scatter Diagram

From the scatter diagram above, we can conclude that this variable occurs in the distribution of points on the scatter diagram, which does not move up or down, but is randomly distributed. The random distribution of this scatter can be used as reference data to show that the amount of cylinder head production does not affect the number of defective products.

Fishbone Diagram

The cause-and-effect diagram, also known as a fishbone diagram, is one of seven tools used to analyse the root causes of problems at PT Otomotif Indonesia. In this paper, the *Fishbone* diagram problem is based on the number of defects in the *Cylinder Head* production process. Based on these problems, the root causes of the problem are analysed to find out the root cause of the problem and then consider what corrective actions can be taken to overcome the problem.

The search results for possible causes of the problem are presented below asa cause-and-effect diagram, shown in Figure 7.

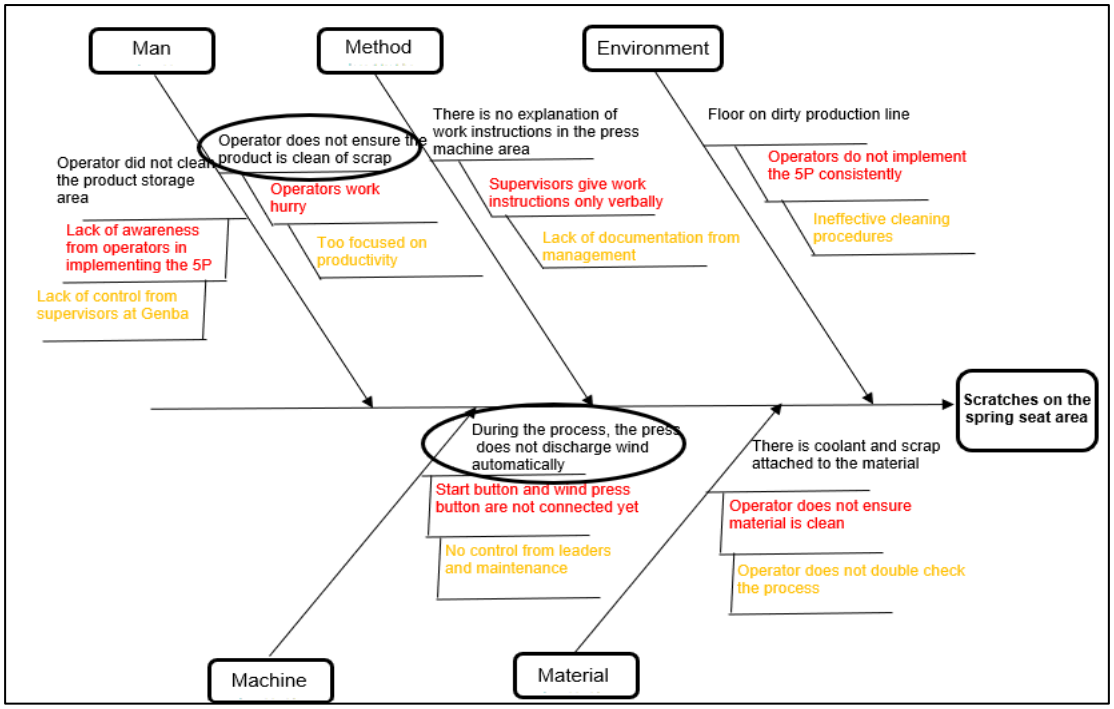

Figure 7. Fishbone diagram

Based on the results of the Pareto diagram analysis, it is known that the *Scratch* type *error* in the *Spring Seat* area dominates with the most significant *error*. The following improvement recommendations will be explained using 5W + 1H will be presented in the form of Table 4:

Table 2. 5W+1H Description

Element	Problems	What	When	Who	Where	Why	How
Man	Operator does not ensure the product is clean of scrap	Can cause scracth on the spring seat when the product is flowed into the press machine	During the press machine process	Production operator	Cylinder Head Production Line	Operators work in a hurry	Line PIC or production leader creates a Quality Check form once every 2 hours.
Method	No description of work instructions in the machine area	So that operators can understand the work process on the press machine	During the press machine process	Foreman	Cylinder Head Production Line	Lack of work documentation from management	Work instructions for the press machine area

Environment	Ineffective cleaning procedures	Causing the floor on the production line to still have oil splashes and Scrap	During the 5S process in the production line area	Foreman	Cylinder Head Production Line	Lack of effective 5S socialisation from Foreman and Production Leader	The foreman and production leader create a more effective cleaning procedure and then socialise it to production operators.
Machine	During the process of installing the Guide and Seat Valve, the press machine did not automatically release air	This causes Scrap that is still attached to the press machine area, and the product is not clean	During the press machine process	Maintenance Operator	Cylinder Head Production Line	Press the start button and the wind button is not yet connected	The operator proposes to improve the machine so that the press can automatically release wind during the process.
Material	There is coolant and scrap attached to the material	Causes Scrap to stick to the material easily	During the Air Blow process	Production operator	Cylinder Head Production Line	Operators work in a hurry	Material that will flow to the following process must be clean from Coolant and Scrap

From the identification results using the *Fishbone* diagram and 5W + 1H above, it is known that the factors that cause *scracth* defects in the *Spring Seat* area of *Head Cylinder* products are the 2 most influential factors, namely human factors and machine factors.

Conclusion

Based on the results of research that has been carried out on the *Machining Head Cylinder* production process using the *Seven Tools* method, it can be concluded as follows: The results of the identification carried out at PT Automotive Indonesia based on the last 6 months using Pareto diagram analysis can be seen that the highest *defect* occurs in the type of *scratch defect*in the *Spring Seat* area with a *percentage of* 32% and the lowest defect is the type of narrow *Space Arm defect* with a percentage of 10%. Based on the analysis using the *Fishbone* diagram, several factors cause *scratch defects* in the *Spring Seat* area: Human factors are caused by operators working in a hurry and not ensuring the product is cleanfrom scrap. The Method factor is due to the absence of Work Instruction descriptions in the press machinearea the lack of training to operators. Environmental factors caused by ineffective cleaning procedures The machine factor is caused by the press machine not automatically removing the wind duringthe process. Material factors are caused by coolant and scrap still attached to the spring seat area. Quality control using the *Seven Tools* method is carried out to improve the Head Cylinder production process at PT Otomotif Indonesia. Using the *Fishbone* and 5W + 1H diagram methods the authors can provide suggestions for improvement to reduce and even eliminate defects in the Spring Seat area. So

that customers will be satisfied with the quality of products produced by PT Otomotif Indonesia. Then in terms of cost expenditure, it will also be less because there is no need to pay for the rework process.

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