

IMPLEMENTATION SIX SIGMA AND DATA MINING TO IMPROVE DIE CASTING PRODUCTION PROCESS AT PT. AB

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ABSTRACT

PT. AB is well known as a manufacturing industry which operates in motorcycle industry. The quality measurement has become the most important substance in this industry. As a result, the purposes of this research are improving the quality control and reducing the defect percentages in die casting production. This research using Six Sigma methods, which have 5 Steps. There are: Measure, Analyze, Improvement, and Control (DMAIC).

In the define phase, obtained that the production per month which has the largest percentage of defects in PT. AB is a cylinder component KYZ which have 5.06%, while its specified limits only 3.36%. Therefore, further treatment is needed. The second phase is measure, which does the calculation control map p and u. The results of the measurements obtained for 15,356 DPMO value with sigma level of 3.66.

In the Analyse phase, the analysis used to use cause and effect diagrams, Failure Mode and Effect Analysis (FMEA), and data mining for decision tree. The most dominant issue is form of disability flow line. For the improvement stage, the results obtained for the response of each of these failures by conducting operator training, Standard Operating Procedure (SOP) and the standardization of QC PASS by using data mining method, which obtained if then rule that can be received in the Quality Control (QC). This implementation should be obeyed by casting machine operators.

In the control phase, the calculation of control maps p and u done to compare the results after implementation. Sigma level after doing the implementation. The results of the measurements obtained DPMO values of 13 221 and sigma level of 3.71. The increase in sigma level is 0.05.

Keywords: Six Sigma, FMEA, Decision Tree.

1. INTRODUCTION

PT. AB is a company engaged in the motor industry in Indonesia. This company is a manufacturing and distribution of motorcycles. From all the products, the largest production with the highest percentage of disability is die casting production process with product type KYZ cylinder component. To produce good quality, PT. AB should be able to reduce the percentage of defects generated. Repairs were carried out by PT. AB is an attempt to satisfy customers by producing products according to demand and in a shorter period of time with the best results. To improve the quality of this, the use of six sigma approach method that aims to minimize variation and control processes and make continuous improvement.

PT. AB die casting production process is done at the beginning of the production

process. The study starts from January to early February 2013 the number of samples taken on the product type KYZ cylinder component of 84 541 units. The issue at PT. ABM is due to the high occurrence of disability is 14 281 units on the type of product components KYZ cylinder in the month of January - beginning of February 2013. It had need rework and lead to higher production costs thus inhibiting the production process. Minimum standards flaw allowed the company is 3.36%, while the actual percentage of defects that occur at 16.8%. Companies need to make improvements with six sigma method to identify the type of defect and determine the factors causing high so as to reduce the disability occurs.

The purpose of this study is to search the level of sigma company before and after doing the implementation, Provide

suggestions for improvement by data mining in PT.AB.

2. LITERATURE STUDY

1. Six Sigma

Six Sigma is a comprehensive and flexible system for achieving, sustaining and maximizing business success. Six Sigma is uniquely driven by a strong understanding of customer needs, disciplined use of the facts, data, and static analysis and careful attention to manage, repair, and re-embed business processes to achieve the benefits, such as cost reduction, increased productivity, growth market share, customer retention, cycle time reduction, defect reduction and development of products / services (Pande,2002). Jang (2009) proposes a six sigma methodology based on data mining for effectively and efficiently processing massive data in driving six sigma method. It was applied in hot stove system in Korean Steel Company.

2. Failure Mode and Effect Analysis (FMEA)

FMEA is a systematic activity that identifies and evaluates the failure rate (failure) potential exists on the system, product, or process especially on the roots of the function of the product / process on the factors that influence the product / process. (Manggala, 2005)

3. Data Mining

Data mining is the process of automatically discovering useful information in large data repositories (Tan, 2006).

Entropy formula is (Kusrini,2009):

$$\text{Entropy}(S) = \sum_{i=1}^n - p_i * \log_2 p_i$$

S : The set of cases

A : features

n : The number of partitions S

p_i : The proportion of the S to S1

Gain formula is :

$$\text{Gain}(S,A) = \text{Entropy}(S) - \sum_{i=1}^n \frac{|S_i|}{|S|} * \text{Entropy}(S_i)$$

S : The set of cases

A : Attribute

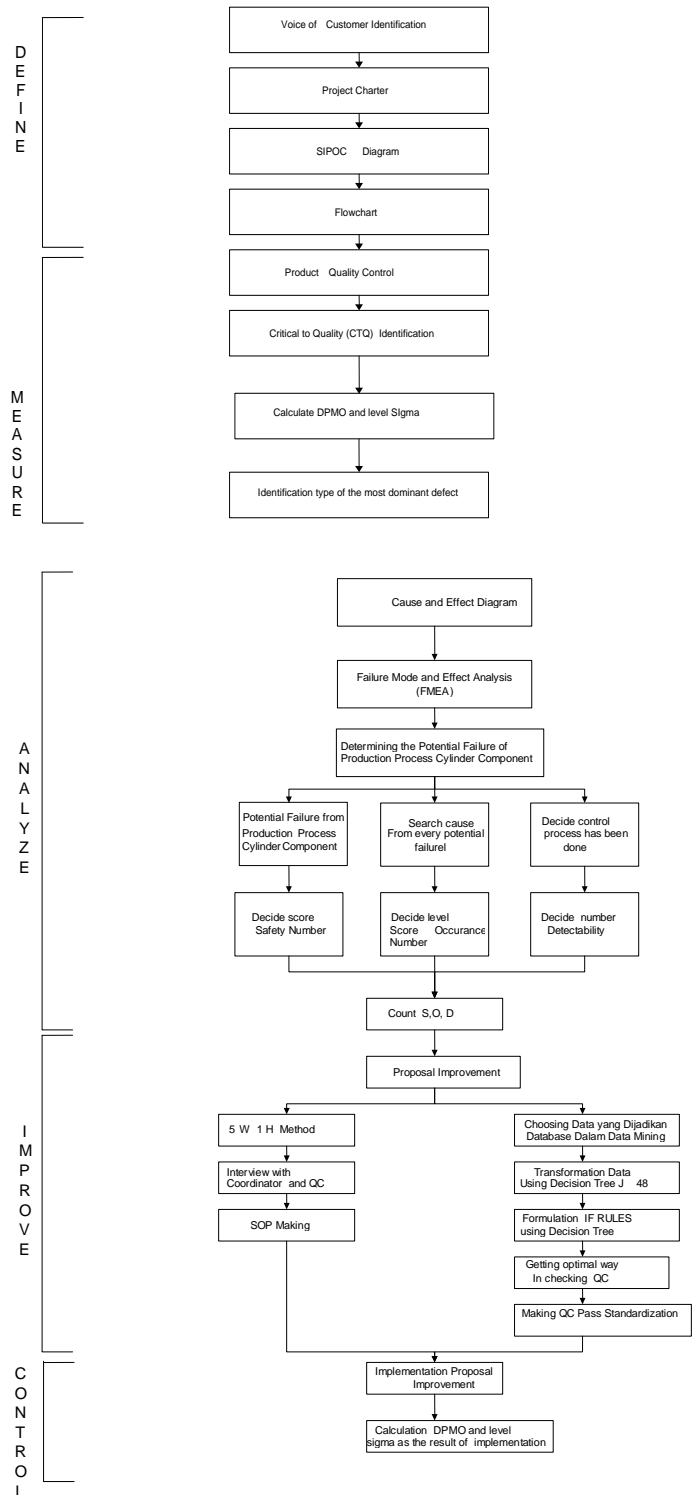
n : Total partition attributes A

$|S_i|$: The number of cases in the partition to -i

$|S|$: The number of cases in S

(Kusrini, 2009)

3. RESEARCH METHOD



4. RESULT AND ANALYZE

DEFINE PHASE

PT. AB is an industrial manufacturing company that motors along with spareparts, one of which is a cylinder component. Products of this type of cylinder components chosen as the product to be observed due to this product is the highest production at PT. AB.

In the selection of products that will be handling the problem be based interviews to the company PT. AB. Cylinder type cylinder component that is manufactured KYZ component type, component type KPH cylinder, and the cylinder component type kzl. The selection of products into the

handling of this issue based on historical data obtained percentage of defects in August 2012 - October 2012.

Identification Production Process that Becomes Troubleshooting

In general stages in the production process KYZ cylinder component there are three stages. The production process is carried out in a sequence that is a melting stages, stages of casting, stages of finishing. Identify parts production into the cylinder handling KYZ component is based on interviews conducted at the PT. ABM and retrieval of historical data at each stage of the production process.

Table 1. Number of Defects in Production Process: Die Casting Products Cylinder Component KYZ

Month	Amount Production	The number of defect (Unit/Month)	Percent Defect (%)	Melting	Casting	Finishing
August	118219	4407	3.73	0	4145	262
September	171963	7107	4.13	0	6851	256
October	38440	1607	4.18	0	1405	202
Total	328622	13121	12.04			
Average	109540.67	4373.67	4.014			

Identification Voice of Customer

Product that was produced by PT. AB must have quality that fit to standard and fit to customer requirements. Something that has to be done to maintain product quality is to do research, development and check in production process in production floor. From historical data from August– October 2012, knows that the biggest defects is process casting

Project Charter Declaration

Project Charter Declaration is a tool used to document the purpose and parameters of the beginning of a project, providing the initial delineation of roles and

responsibilities, outlines the project objectives, identifies the main stakeholders, and establishes the authority of the project manager. It serves as a reference for future projects authority. Project charter can be seen in Figure 3.

Diagram SIPOC (Supplier – Input – Process – Output - Customer)

Diagram SIPOC is a tool used to outline the scope of the process improvement initiative (often as part of a Six Sigma improvement project). When it is used as part of the Six Sigma methodology, it is usually implemented as a part of the measuring phase of the DMAIC process

<i>D</i>		<i>Project Charter</i>	
Project Title			
Implementation Six Sigma to Improve Quality and Reduce Failure			
Bussiness Case			
Data percentage of defects period August 2012 – October 2012 indicates that the product <i>cylinder component KYZ</i> has the largest percentage of disability. Total percentage of disability is largely generated from casting.			
Project Statement			
Problem Statement			
The main problem that caused the high percentage of defects in the process <i>casting</i> is a variable defect. The resulting failure will cause the product to fail reprocessed (<i>rework</i>) yang subsequently used as raw materials.			
Opportunity Statement			
If the problem can be minimized in the finishing process, it will obtain some benefit:			
1. Minimizing the number of defective products			
2. Reduce the time and cost wasted			
3. Increasing the level of sigma			
Goal Statement			
The objectives to be achieved through this project is to improve the quality of products <i>cylinder</i> , Component <i>KYZ</i> to minimize the causes of defects / failures so as to improve customer satisfaction about the expected product specifications.			
Constraint & Assumption			
Constraint		Assumption	
In carrying out this project the limitations – constraints that can not be avoided, ie members project can not provide a fully time so it can only provide 50% of time from waktunya untuk mengerjakan proyek ini.		If the problems in the process of printing paper product <i>cylinder component KYZ</i> can be finished, this solution can be assumed to also be used for problems in the process of casting defects to the other product.	
Project Scope			
The focus of this project is the process casting of product casting cylinder component <i>KYZ</i>			
Project Schedule		Signature	
Project implementation schedule is:			
<i>Define: Des 24th – Des 28th</i>			
<i>Measure: Jan 14th – Jan 29th</i>		Champion	Process Owner
<i>Analyze: March 11th – March 27th</i>			
<i>Improve: April 11th – April 15th</i>			
<i>Control : July 15th</i>		Team Leader	Team Member

Figure 3. *Project Charter Declaration* Produk *Cylinder Component KYZ*

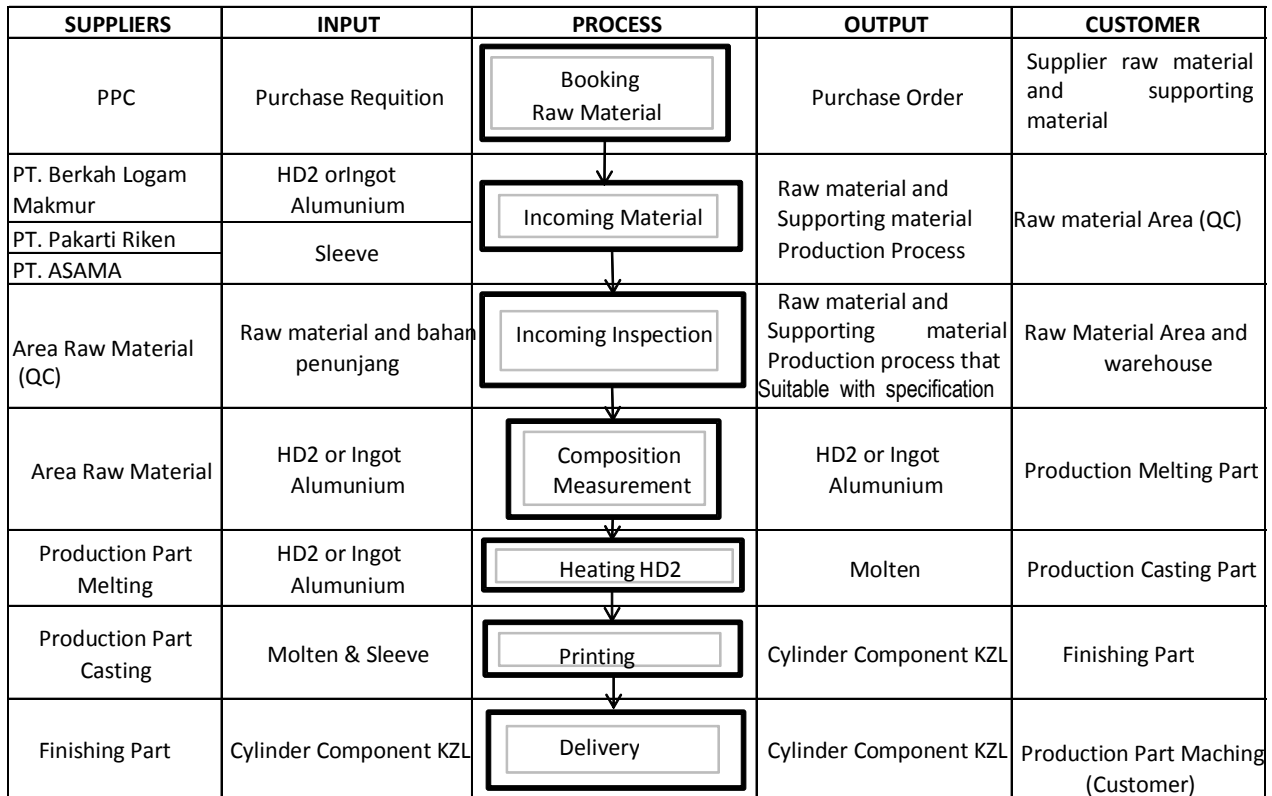


Figure 4. Diagram SIPOC (Supplier – Input – Process – Output - Customer) Produk Cylinder Component KYZ

MEASURE PHASE

CTQ (Critical To Quality)

CTQ (Critical To Quality) is a measurable characteristic of the product / process performance standards or specification limits that must be met in order to meet customers satisfaction. This are some of the CTQ attributes for characterizing defects in the production process KYZ cylinder components:

Table 2. Type Defects in the Production Process Attributes Cylinder Component KYZ

No	Type of Reject	Type of Reject	Cause
1	Overhead/Undercut	Part proceeds truncated thin dies	Molten temperature is too high
			Temperature heat dies
			Less coating on dies
2	Cold Shot	Part is not fully charged	Molten temperature is too low
			Low Temperature dies
			Silicon content exceeds the limit
			Injection pressure is weak
3	Flow Line	Defects arise as a river channel	Drying dies less
			Casting temperature less
			Improper casting flow and constant
4	Soldering	Aluminum sticky on pin	Temperature dies is too high
5	Deformation	Deformation	Dies open too fast
			High-temperature molten
			Less coatings
6	Gompal	Deformation, chipped	Temperatures less
			Error when trimming
			Less coating during dies

7	Retak	Part porous and fractured	Temperatures less
			Error when trimming
			Less coating during dies
8	Misrunn	part is not fully filled	Molten temperature is too high
			Temperature heat dies
			Less coating on dies
9	Trouble small part	Area sleeve / bushing closed	Systems and poor gate design
			Filling ratio less
			low mold temperature
10	Pin Ejector	Defects chipped in areas ejector pin	Ejector pins are too loose
11	Pin Insert	Insert the pin bent and broken	Insert the pin is too big

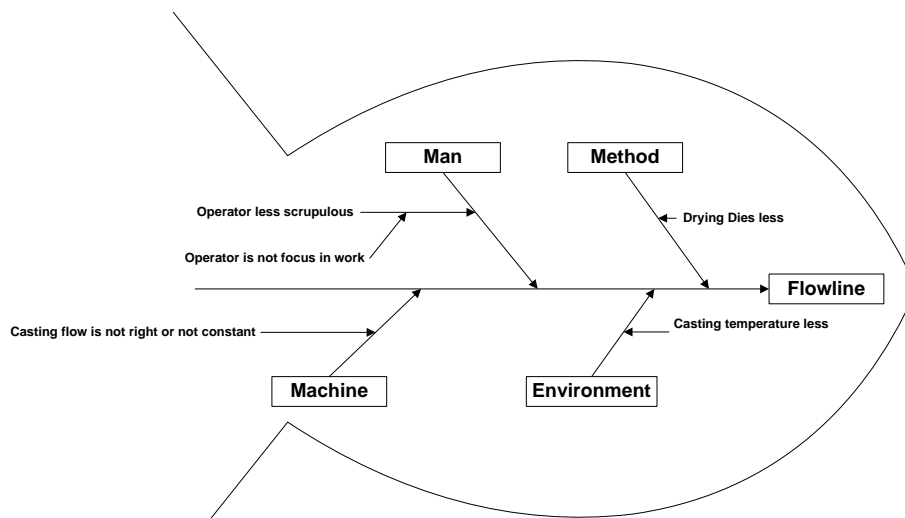


Figure 5. Cause-effect Diagram Flowline Defect

Sigma Level Calculation Results

Table 3. Sigma Level Calculation Results

Unit	84541
Opportunities	11
Defect	14281
Defect per Unit	0.16892
Total Opportunities	929951
Deffect per Opportunities	0.01535
Deffect per Million Opportunities	15356.7
Sigma Result	3.66

From calculation in Table 3 obtained that attributes of the sigma level was 3.66 *sigma*. This obtained that attributes of the sigma level had not reached the target of 6 sigma. It was needed for improvements to minimizing the number of defects in the company.

Identification of the Most Dominant Defects

Based on the results of observations conducted in January - February 2013, obtain the percentage of each type of defect that occurs in the process casting. Based on the percentage of all types of existing defects, types of defects that have the highest number is flowline.

ANALYZE PHASE

This is ishikawa diagram from flowline defects is in Figure 5.

This is the table FMEA *Cylinder Component KZL* product

Table 4. Table FMEA Dengan RPN

Process Function	Type of Failure of Process	The effects of the failure process	S	The causes of the failure process	O	Controls were performed	D	RPN	Mitigation Efforts
Casting Process	Flow line	Combustion Engine is not perfect	8	Less scrupulous operators	4	Supervision over the work of the operator	3	96	Conduct regular supervision and training
				Drying Dies Less	7	Sprying dies less	5	280	Establish sufficient spray settings
				Temperature Casting Less	8	Examination of the right temperature setting when starting	6	384	Set the temperature setting on the machine casting
				Improper casting flow and constant	8	Improper casting flow and constant	5	320	Define settings ejector casting machine appropriately

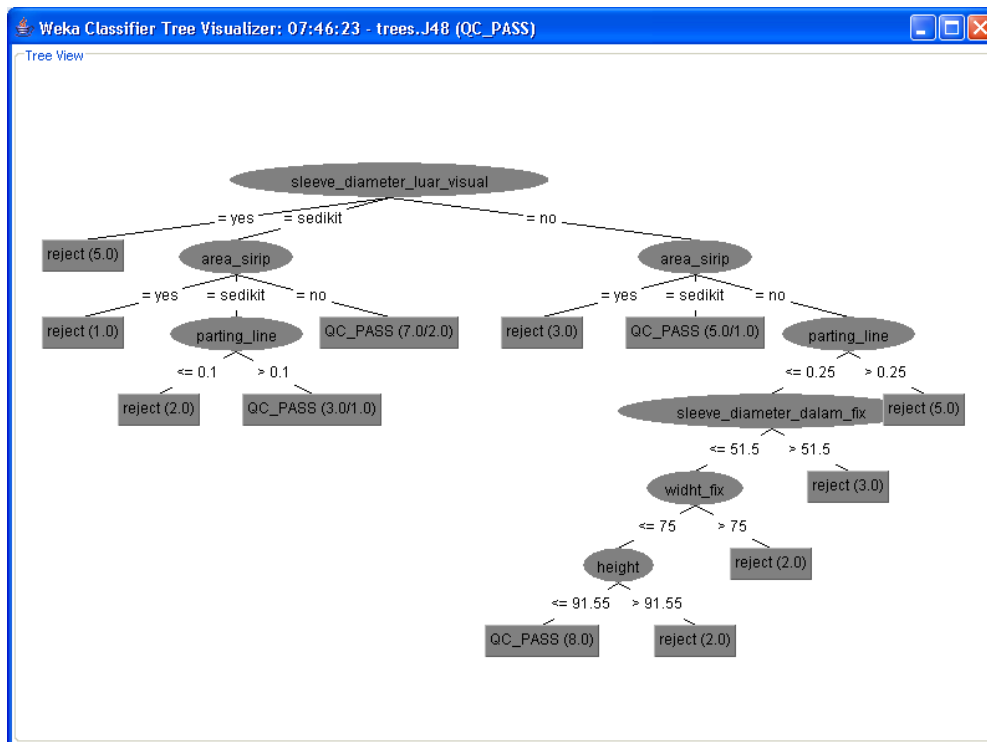


Figure 6. Proposal Decision Tree In WEKA Software

RPN value based on the highest grade intervals that require priority to handle in the process of overcoming failure. This is the main priority of failure modes obtained from the ranking of RPN:

1. Flowline defect with the absence of the type of failure in the form of precise temperature determination.
2. Flowline defect is a kind of failure with the lack of proper machine settings.

IMPROVE PHASE

Improvements Proposed By Making Decision Tree In Data Mining

This is a decision tree in Figure *software WEKA*:

The following are the results of calculations on data mining entropy value for the parameter "fin area" has the smallest value, so it can be deduced that the worst outcome, which can not be tolerated in the product is the presence of flowlines, undercut, or misrun value to the product component KYZ cylinder.

5. CONCLUSION

Based on the research, processing and analysis, it can be concluded that the DPMO value generated prior to implementation that is equal to 15 357 and the sigma level of 3.66. Results of observation and analysis, it was given a proposal to reduce the defects caused by the use of decision tree flowline .

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