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## Application Of Six Sigma Methodology To Improve the Product Quality Of Moldings Plastic (Case Study: PT Mega Technology Batam)

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**Abstract** Competition in the business and industry increase significantly encourages companies to develop thoughts to obtain effective and efficient ways and save costs in achieving the determined goals and objectives, Six Sigma method is one of an excellent method to increase productivity and pressing the number of defects to target 3.4 failure of opportunity for each transaction of goods and services products. Six sigma approach was implemented in this research. The objective of this research is to improve the product quality and to analyze failures or defect of Cover Coffe Maker Product. This research implemented six sigma approach starting from define, measure, analysis and improve stage. Data processing by using Check Sheet, cause diagram, histogram, pareto chart, run chart, and control chart, and scattered diagram to solve the problem of work faced. The result of the research shown that PT Mega Technology Batam currently has the total average disability is 197464 pcs with percentage of 5.99% and total DPMO 59929,39 equal to Sigma Level 3.1. The causes of Cover Coffe Maker's disability are the Operator or the machine interpreter does not have a good attitude, the absence of training on every new employee, the employee repeat the same mistake, not using original material and standard from a predetermined company, Not having enough experience during machining operation, At the time of the molding process does not adjust the temperature or humidity following the Parameters on the machine and the Mold standard, does not follow the quality without tolerance. In conclusion, The Six Sigma implementation resulted in a significant increase of product quality.

**Keyword :** Six Sigma, Quality Control, DMAIC

### 1. Introduction

PT. Mega Technology Batam is engaged in Plastic injection, Molding Repair and secondary



Process. Manufacturing Industry can not be separated from the production process of Molding especially companies based on technology using sophisticated machines and supported tools.

Problems arising from these factors will have an impact on the customer and the company's management as well as the company's quality management system. The high defect rate that exceeds the KPI (Key Performance Indicator) limits set by the company is an issue that needs to be solved.

2. By using Six Sigma approach, it is expected that Molding Department can quickly find the main cause of high defect and can work on improvement measures. Six Sigma that serves as the controller of the production process focusing on customer satisfaction, the higher the target of Six Sigma achieved the better the performance of the company's production system.[4]

3. Based on the above background, then the issues raised in this research is directed to answer the problems about how to increase the quality product of Cover Coffe Maker in order to achieve on-time delivery.

## 2. Method

The research was conducted at PT Mega Technology Batam, at Jalan Engku Putri, Citra Buana Part III Lot 10, Batam Center, Batam City. Quantitative data in this research is the total output of production and defects of product in the period of October 2017.

Qualitative data in this research is data in the form of information about the types of defects of products in companies causing the defect Product, and this data was obtained from interviews and direct observation in the company PT Mega Technology Batam.

The research process was done by applying DPMO (Defect Per Million Opportunity) calculation and Sigma value of each defect rate calculation to find root cause and find solution of each problem causing high defect.

The method used in this research is Six Sigma methodology. According to Gaspersz in post of Journal of Industrial Systems Engineering Vol.3, No.2, 2014, p2, Six Sigma is a method of control and quality improvement applied by Motorola since 1986. Six Sigma is a form of quality improvement towards target 3, 4 defect per million opportunities (DPMO) for each product either goods or services in an effort to reduce the number of defects.[1]

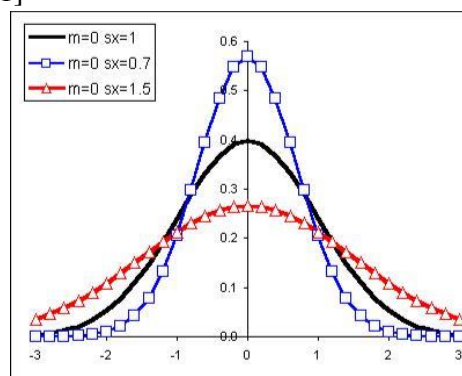


Figure 1. Six Sigma

According to Pande Six Sigma has a meaning that is almost perfect goal in meeting customer requirements, Six Sigma is a method or technique of control and dramatic quality improvement which is a new breakthrough in the field of quality management. [3]. Meanwhile, according to Syukron that in applying Six Sigma method require stages of implementation consisting of five steps that is known by method of DMAIC or Define, Measure, Analyze, Improve and Control. [4].

### 3. Analysis Result

#### 1. Define

In the define stage, we can see that the average number of product defects is 6%. Calculated from the number of Cover Coffe Maker rejected in October 2017. The formula is the number of defects per number of Cover Coffee Maker output.

$$\%defect = \frac{No\ of\ Defect}{output} \quad (1)$$

**Table 1.** Proportion Defect Cover Coffe Maker

Week	Output	No of Defect	Percentage
1 <sup>st</sup>	912089	58348	6.40%
2 <sup>nd</sup>	775527	53582	6.91%
3 <sup>rd</sup>	763631	35905	4.70%
4 <sup>th</sup>	843697	49629	5.88%
<b>Total</b>	<b>3294944</b>	<b>197464</b>	<b>6.0%</b>

#### 2. Measure

Measurement is the second phase of the Six Sigma concept. In this phase, we will analyze some of the analysis to determine the condition of product processes and what problems are faced prior to the improvement by using Six Sigma methodology. This stage uses the Critical to Process (CTP) reference that has been defined in the previous define stage.

**Table 2.** Percentage defect

No	Production Process	No of Reject	Percentage
1	Machine Adjust Mould	32746	42,85%
2	Moulding Proses	26219	34,31%
3	Material	11328	14,82%
4	Packing	6135	8,03%
<b>Total of defect</b>		<b>76428</b>	

**Table 3.** Sigma level

Deskripsi	Week I	Week II	Week III	Week IV	TOTAL
Finishing		77552			
Product	912089	7	763631	843697	<b>3294944</b>
Defect	58348	53582	35905	49629	<b>197464</b>
Ppercentage	<b>6,40%</b>	<b>6,91%</b>	<b>4,70%</b>	<b>5,88%</b>	<b>5,99%</b>
DPMO	65971,83	69091,08	47018,78	58823,25	59929,39
DPO	0.06397	0.06909	0.04702	0.05882	0.05993
Sigma Level	<b>3.0</b>	<b>3.0</b>	<b>3.2</b>	<b>3.1</b>	<b>3.1</b>

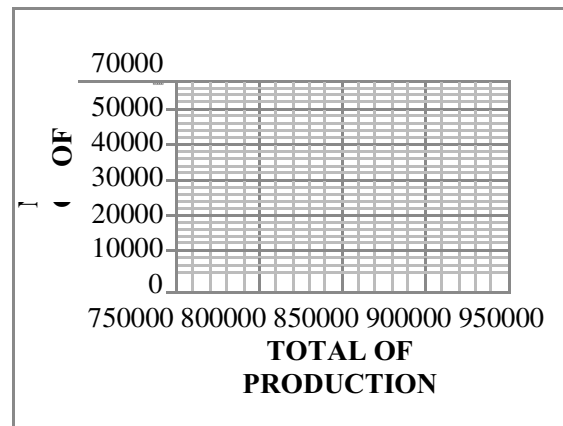
From the calculation shown in Table 3 above, the production of Cover Coffe Maker of PT Mega Technology Batam has an average level of Sigma (Sigma level) of 3.1 with DPMO value of 59929.39 for a million Production. This is certainly a huge loss if not handled because more and more products that fail in the production process would result in too much loss in the company of PT Mega Technology Batam because in calculating the value of Sigma in the company of PT Mega Technology Batam is the amount of sigma level only 3.1 then this can be concluded that the lower the Sigma value the more the number of defects and vice versa the higher the level of Sigma the lower the number of defects of an existing product.

#### 3. Analyze

At this stage the analysis and identification of the causes of the problem to overcome the causes that exist. Six Sigma tools used in this phase are Check Sheet diagrams, causal diagrams, histograms, pareto charts, run charts, control charts, and scattered diagrams. The final result to be obtained from this stage is in the form of information or statement about the cause of the defect in Part.

**a. Check Sheet****Table 4.** Check Sheet Defect

No	Type of Defect	Defect categories			
		Machine Adjust Mould	Mould Proses	Material	Handle Process/ Operator
1	Flashes	√			
2	Over Cut				√
3	Short Mold	√			
4	Scratches		√		
5	Flowmark/ Black Dot	√			
6	Oily/Dirty		√		
7	Shortage Qty				√
8	Over Qty				√
9	Demage/Broken		√		
10	Gas / Burn Mark	√			
11	Shadow/Shining	√			
12	Warp/Silver	√			
13	Pin / Sink Mark				
14	Discolour/Yellowish			√	
15	Hight Gating				√
16	Mix Part				√
17	Flow/Parting Line	√			
18	Chip Off		√		
19	Stress Mark		√		
20	Ink Stain			√	
21	Drag Mark	√			
22	Dim Out Spec	√			

**b. Scattered Diagram****Figure 2.** Scattered Diagram

## c. Histogram

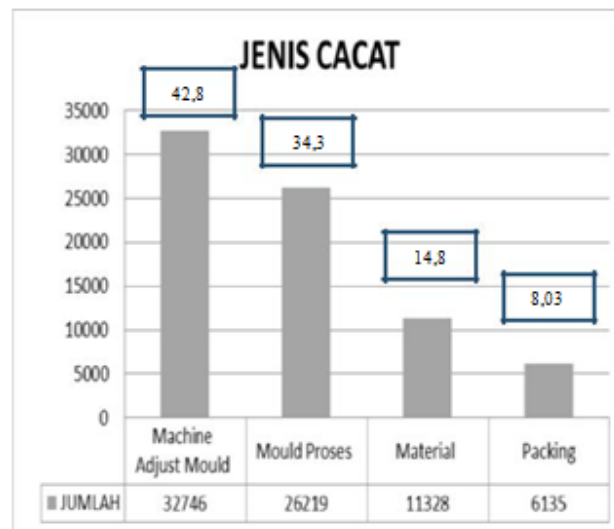


Figure 3. Histogram Diagram

## d. Pareto Diagram

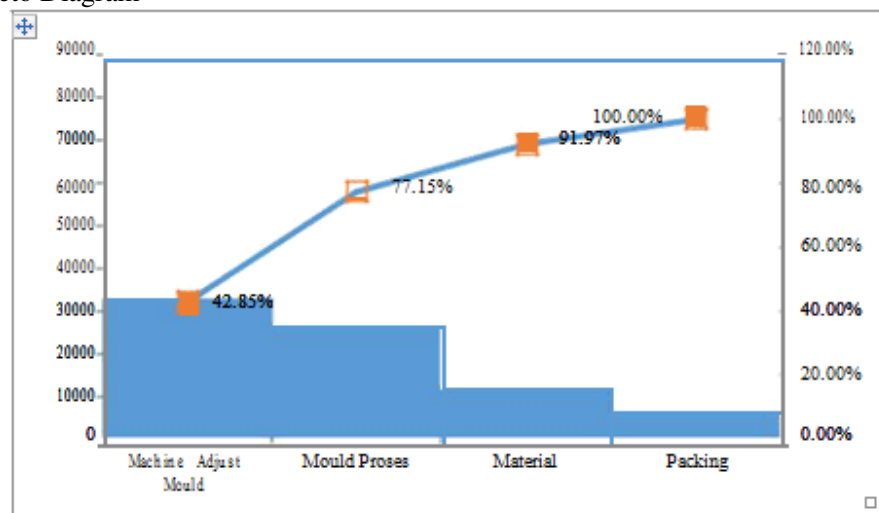
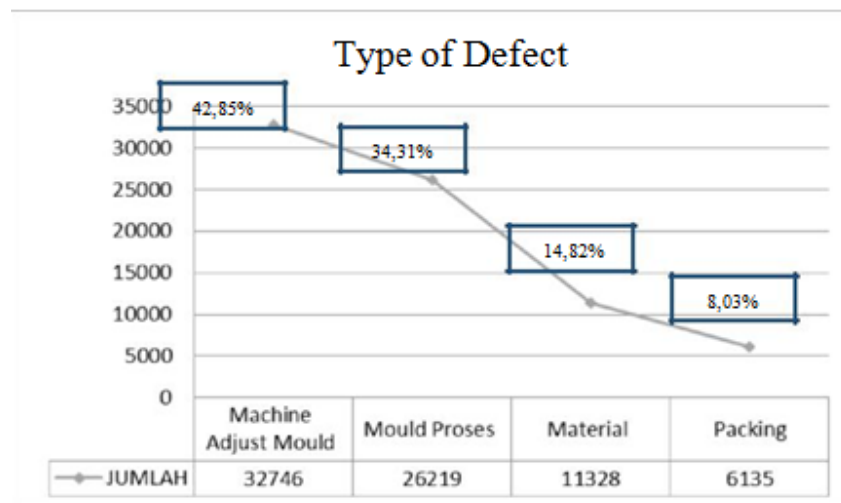
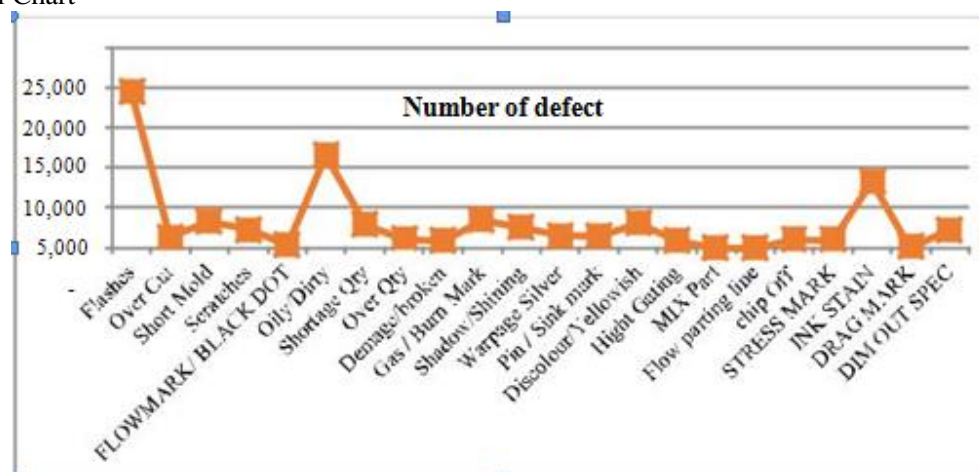


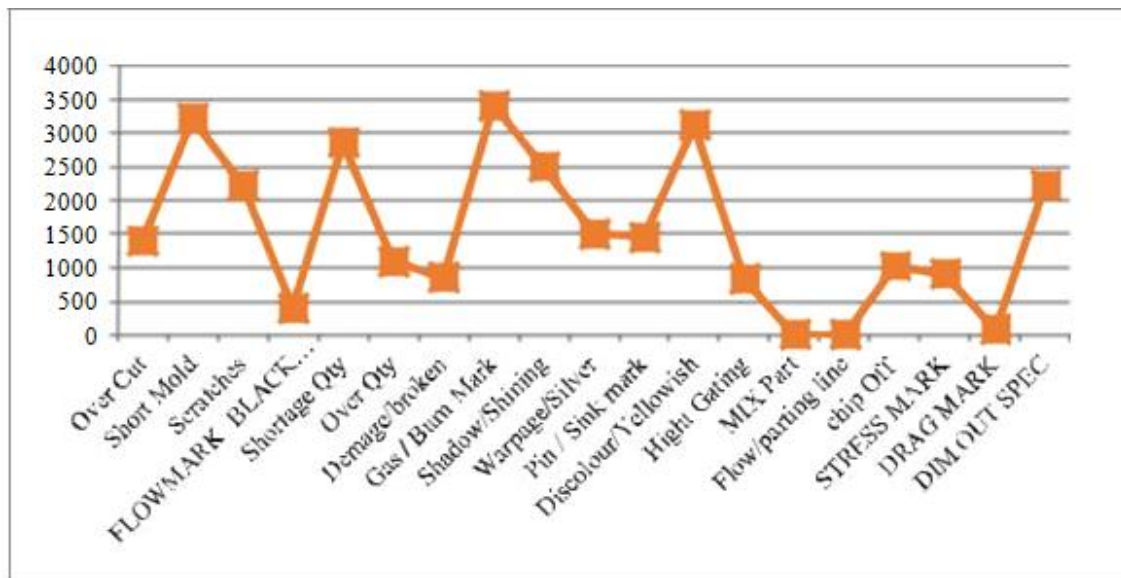
Figure 4. Pareto

## e. Run Chart

From the below Run Chart also show that more disability defect on Machine Adjust Mold with the number 32746 Pcs and followed by disability of Flashing, Short Mold, Flowmark / Black Dot, Gas / Burn Mark, Shadow / Shining, Warpage / Silver, Flow, Drag Mark, Dimension Out of Spec.

**Figure 5.** .Run Chart**f. Control Chart****Figure 6.** Control Chart

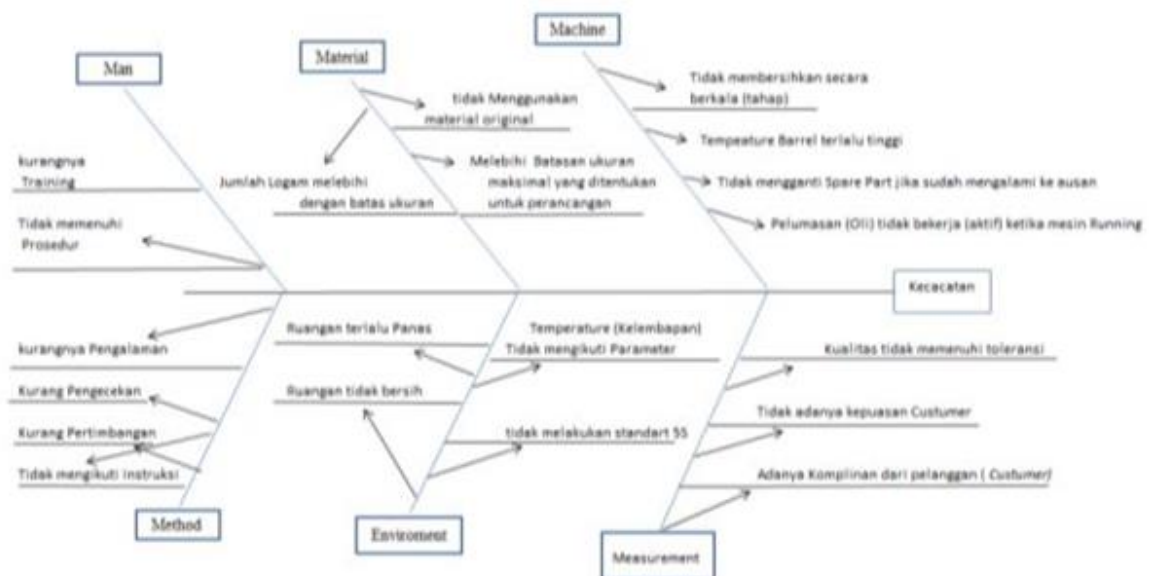
the above diagram can be seen the highest defects are flashes and followed by Oil, and Ink Stain, which is contained in the type of Machine Adjust Mold, Process Mold, and Material. then in the process of this disability if removed then the disability will be reduced by the number of defects that are not too much like the diagram below:



**Figure 7.** Control Chart

Based on data processing using Control Chart can be seen there are many very high defects then in this case need to take corrective action so that high defect can be eliminated to reduce defect it hence need to be analyzed by using Fishbone.

**g.** Cause and Effect Diagram



**Figure 8.** Fishbone

**4. Improve**

After knowing the root cause of the high part disability, then the next step is to determine a proposed improvement for each cause that exist. Proposed improvement is done by doing training with Superintendents, supervisors and Leaders. The training is aimed to get a proper repair proposal and can be applied by the company so as to reduce the percentage of defect in the production process of Cover Coffe Maker. From the root causes are then incorporated into the 5W-1H improvement formula that is:



**Table 5.** 5W-1H

Cause of defect	5W-1H	Description
Man	<i>What</i>	<i>Moulding</i>
	<i>Why</i>	Training
	<i>Where</i>	<i>Yard</i>
	<i>When</i>	<i>All Shift</i>
	<i>Who</i>	Leader
	<i>How</i>	Lack of training for operators
Machine	<i>What</i>	<i>Moulding Machine</i>
	<i>Why</i>	Old and not maintained well
	<i>Where</i>	<i>yard</i>
	<i>When</i>	<i>All Shift</i>
	<i>Who</i>	Technition
	<i>How</i>	Not preventive maintenance
Environment	<i>What</i>	<i>Cover Coffe Maker process</i>
	<i>Why</i>	Lack of light and hot weather
	<i>Where</i>	<i>Yard</i>
	<i>When</i>	<i>All Shift</i>
	<i>Who</i>	<i>Superintendent/Supervisor</i>
	<i>How</i>	Limited no of light, no win protection

#### Causes Defect

- 1) Lack of discipline in cleaning is a major factor in the occurrence of defective Cover Coffe Maker products.
- 2) Lack of supervision and limited work tools, especially tools such as Cutter, Hand Glove, Magic Sponge, Solder and so on make operator difficulty in cleaning between layers of Cover Coffe Maker Products.
- 3) Lack of maintenance Molding machine also causes the machine to become unstable resulting in nonstandard and defective Product Result.
- 4) Lack of supervision in selection, inspection and maintenance of raw materials also affect the final product results.
- 5) Lack of observations made before, during and after production can also affect product inspection results.
- 6) Supervisor and leader less to supervise (control) on the work of his men the operator.
- 7) The skills (skills) of operators that still need to be improved with the training.

#### 4. Conclusion

Based on the results of the analysis of the discussion that has been done, It can be concluded as follows: (1) PT Mega Technology Batam currently has the total average disability is 197464 pcs with percentage of 5.99% and total DPMO 59929,39 equal to Sigma Level 3.1 where the highest cause of defect is 42.85 % caused by Machine Adjust Mould and followed by 34.31 % is Mould process (2). The causes of Cover Coffe Maker's disability are the Operator or the machine interpreter does not have a good attitude, the absence of training on every new employee, the employee repeat the same mistake, not using original material and standard from a predetermined company, Not having enough experience during machining operation, At the time of the molding process does not adjust the temperature or humidity following the Parameters on the machine and the Mold standard, does not follow the quality without tolerance. It expected that after implementation of the six sigma approach can continuously improve the level of sigma of the company.

#### 5. Acknowledgements

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