Volume 16 No. 2
July 2024
ISSN : 2085 – 1669
e-ISSN : 2460 – 0288
Website : jurnal.umj.ac.id/index.php/jurtek
Email : jurnalteknologi@umj.ac.id

Jurnal Teknologi
UNIVERSITAS MUHAMMADIYAH JAKARTA

Optimization of Manufacturing Company's Production Process Using *Lean Six Sigma*

Dhea Fortuna[1], **Evi Yuliawati** [2,*]
[1,2] *Master of Industrial Engineering, Institut Teknologi Adhi Tama Surabaya, Jl. Arif Rahman Hakim, No. 100 Surabaya, Indonesia.*

*Corresponding author email: eviyulia103@itats.ac.id

Jurnal Teknologi use only:
Received 10 February 2024; Revised 17 April 2024; Accepted 13 July 2024

ABSTRACT

In the manufacturing industry, product quality is the main focus. Companies must ensure products meet quality standards. PT. Preshion Engineering Plastec Surabaya is a company that produces plastec supporting components. The object of this study is Yamaha emblem assy products. With Lean six sigma using DMAIC (Define, Measure, Analyze, Improve, Control) methodology to improve production processes. In addition, it improves the efficiency and effectiveness of the production process, improves product quality. The emblem assy product from CTQ shows that there are 4 defects that occur, namely outgoing rays, dirty, shin marks, and short mold. So that the DPMO (Defect Per Million Opportunies) value from January to March 2023 is 159784.715 with an average of 13315.39 and produces a sigma value of 45.0011 with an average of 3.75. Identification of the root causes of defects in Emblem assy products that are dominant with fishbone diagrams, namely dirty injection machines and material mixing machines, old machine age. It is hoped that further research can identify the factors that cause product defects with broader and more significant aspects to be used.

Keywords: Lean six sigma, Waste, Defect.

Introduction

Indonesia's manufacturing industry faces challenges due to the rapid development of technology. The industry is able to compete by focusing on the production of high-quality products. Production is usually carried out on a large scale using modern machinery and technology. Thus, in efficient mass production can increase productivity. Effective and efficient production processes are essential to ensure successful product sales.

According to Andriyany, productivity is a comparison between output with inputs [1]. If productivity rises it will increase efficiency (time, materials, labor) and work systems, production techniques and an increase in the skills of the workforce. Productivity focuses on how efficiently and effectively the production process is carried out to produce finished goods [2]. One way to increase productivity is to ensure strict quality control during the production process. This can reduce the rate of defective products and ensure that the resulting products meet established quality standards [3].

DOI: https://dx.doi.org/10.24853/jurtek.16.2.213-224

ISSN : 2085 – 1669
e-ISSN : 2460 – 0288

According to Kusrianto, it is stated that productivity is a comparison between the results achieved with the participation of labor per unit of time. The participation of labor here is the use of resources and is effective and efficient [4].

High productivity also has a positive impact on the company's profits and can help in achieving sustainable business growth. Therefore, manufacturing companies continuously strive to increase productivity with various efforts and continuous improvements [5].

Maintaining quality and performance that has become a priority for the production industry to obtain customer satisfaction, along with the increasing demand for products [6]. Companies must define, measure, analyze, make improvements, and control existing manufacturing systems to meet market competition. Different methods, approaches, and tools are used for continuous productivity and quality improvement [7].

PT. Preshion Engineering Plastec Surabaya is a company that focuses on *manufacturing industry*, located on Rungkut Industri Street VII / 4 Surabaya. A manufacturing company that produces various kinds of plastec supporting components with the main raw material plastec seeds. The object of this study is Yamaha Emblem assy products with the largest percentage of defects, which is 30%-40% in 2023. PT. Preshion Engineering Plastec is a supplier of many manufacturing companies including PT. Panasonic Lighting Indonesia, PT. Yamaha Electronic Manufacturing Indonesia, PT. Meshindo, PT. Nankai New Zealand.

Emblem assy is a product support component that functions to cover the sound component for an attractive appearance. In the Emblem assy production, the product will be considered defective if the product has fleshes, burnt (black dot), dirty or oily, weidline or scratch. This product is the most defective compared to other products. Dirty or oily is a defect that often occurs in the Yamaha Emblem assy manufacturing process, because it can affect product quality not according to the standards set by the company. The customer of Emblem assy product is PT Yamaha Indonesia.

PT. Preshion Engineering *Plastec* Surabaya often faces several challenges, such as activities that do not provide added value and bottlenecks on the production line. These challenges can reduce productivity in the manufacturing industry. So there is a need for more effective and comprehensive repair handlers to suppress product defects and improve production quality.

According to Kholil et.al's research, based on the results of integrating Lean six sigma with DMAIC tools, it can be known the types of waste that occur in the Tablet Coating A production line, namely defects, over production and inventory [8]. Based on the results of fishbone diagrams analysis, the first cause of waste is a cracking tablet defect caused by a machine or station setting error by the operator.

According to Saryanto et.al, this research Sigma succeeded in improving service quality in the Automotive service industry in the after sales (express maintenance) subdivision. Characterized by a decrease in service lead time in one service cycle and an increase in Express Maintenance process capabilities [9].

Based on the background above, this study uses *Lean Six Sigma* to optimize the production process. In addition, the purpose of this research is to reduce *waste* on the production line with Yamaha Emblem assy products at PT. Preshion Engineering Plastec thus, can improve production efficiency.

Lean and Six Sigma complement each other, the combination of these two methods provides a comprehensive tool for solving problems. *Lean six sigma* (LSS) is described as a methodology that focuses on waste and variable reduction using systematic DMAIC phases as a problem-solving method. Through lean, manufacturing can be achieved by using less human effort in factories, less space, less financial resources and less materials to produce the same product [10].

Lean accelerates Six Sigma by solving problems and improving processes resulting in increased revenue, reduced costs, and increased collaboration. Both methodologies should be seen as platforms to guide cultural and operational change, leading to overall organizational transformation. Using lean methods and techniques, these maps uncover obstacles blocking the continuous flow of materials, and recognize opportunities for loss reduction [11].

Six Sigma is a comprehensive approach to problem solving and process improvement through the DMAIC (Define, Measure, Analyze, Improve, Control) stage which is the heart of Six Sigma analysis that ensures the Voice of Customer that will run in the entire process so that the results expected by customers [1]. The advantages of Six Sigma are a focus on quality improvement by using defect prevention, cycle time reduction and cost reduction. Six Sigma will remove cost that do not provide any additional value to a customer. The tools in Six Sigma are almost similar to those used in other quality improvement strategies [12].

Figure 1. Six Sigma [12]

SIPOC diagram is a diagram that serves to display what production activities are in a business process along with the distribution flow until it can reach consumers. The things presented in this diagram include: Supplier, Input, Process, Output, Customer [13].

Critical to Quality (CTQ) is used to identify specific consumer needs. CTQ is a standard measurement method of products/processes that must be in accordance with customer satisfaction. The level of consumer satisfaction can be an added value to get CTQ. CTQ can be determined through research or experimentation [14].

DPMO (Defect Per Million Opportunities) is a measure of failure in Six Sigma that indicates the damage of a product in one million goods produced. While the Six Sigma level is a measure of company performance that describes the ability to reduce defective products [15].

According to Heizer and Render, Pareto Diagram (Pareto Analysis) is a method for managing errors, problems over defects to help focus attention on problem-solving efforts [16]. Fishbone Diagram according to Neyestani, fishbone diagram or cause and effect diagram that has a shape like a fish skeleton is a diagram used to identify quality problems based on their importance [17].

Failure Mode and Effect Analysis is a type of failure where it is possible to occur, both specification failures and failures that affect consumers. FMEA aims to detect errors in running processes [18].

Using FMEA can provide suggestions for improvements to the company. Technically determining the value of the seriousness of errors due to errors to processes and consumers (severity), the frequency of occurrence of errors (occurrence), and the seriousness due to errors to control devices due to Potential Cause (detection) by brainstorming. [19].

The PDCA method is an improvement activity that is carried out repeatedly to find the root of the real problem. From this PDCA method, the solution to a problem can be addressed correctly. If the improvement of the work process is due to efforts to cut the factors that cause the weakening of process performance, then what must be done is to control the critical variables of the work process using a control diagram. [20].

Methods

The method section contains a description of the research flow that has been carried out by the author. In the background stage, explain the reasons for taking the research topic to be discussed. Another explanation of the importance of this research is carried out, the object of research, the method to be used. Then identify and formulate the problem in the research so that the objectives of this research can be achieved.

ISSN : 2085 – 1669
e-ISSN : 2460 – 0288

The problem that will be discussed is that Lean six sigma can help companies to get an optimal production process by identifying waste or waste in a production process and eliminating it. Determination of research objectives is a form of answer to the problems that have been identified in the problem formulation. Literature study, can compare the theory with the actual conditions found in the company or organization.

Furthermore, the data collection stage is carried out in order to find out the problems that must be solved. Data Processing Stage Based on the results of observations, interviews with production managers and questionnaire distribution at PT Preshion Engineering Plastec using *Lean six sigma* using historical company data:

Define: Identify processes by using SIPOC. Measure: Calculates DPMO value and Calculates Sigma level value. Analyze: Analyze with Pareto and fishbone diagrams. Improve: with FMEA. Control with PDCA. The Conclusion and Suggestion stage is the stage of taking the results of the research that has been done, and providing input for future research.

Results and Discussion

Define

At this stage, brainstorming with related parties is carried out to identify problems and types of defective products with the aim of reducing defects and waste in emblem assy products. The first step in improving the quality of this product is to know the identification of SIPOC (Supplier-Input-Process-Output-Customer), then CTQ. The stages are as follows:
Supplier: PT. Indochimial Citra Kimia.
become a supplier of PT. Preshion Engineering Plastec Surabaya as a supplier of the main raw material, namely plastic pellets.
Input: Plastic Pellets
In making Emblem assy products the raw material or input used is plastic pellets.
Process:
The processes involved in making Emblem assy products are as follows: Raw material preparation and weighing process. Mixing process, Injection Molding process, Spray and screen printing process, Conveyor drying process, Assembly process, Quality Control process, Packing process.
Output: Emblem Assy
For the output produced by PT Preshion Engineering Plastec Surabaya, it is an Emblem assy product.
Customer: PT. Yamaha Indonesia
Product Emblem assy by PT. Preshion Engineering Platec Surabaya based on requests from consumers, one of which is from PT. Yamaha Indonesia, which means that it will be distributed to bookers according to the schedule and targets that have been set

The following is an analysis of *waste* that occurs in the production process of Yamaha emblem assy
Over production: is waste that occurs if the product results of the production process exceed customer demand, because this will cause additional costs to inventory. In the production process of Yamaha emblem assy at PT. Preshion Engineering Plastec Surabaya does not occur waste over production, because the target of PT. YAMAHA for one round of production produces 1.5 kg emblem assy.
Waiting: is waste that occurs if the next process waits for the previous process or delays. In the production process of Yamaha emblem assy at PT. Preshion Engineering Plastec Surabaya was delayed because it had to wait for 3480 seconds or 58 minutes or almost 1 hour to run the next process.
Transportation: is *waste* that occurs in the production process of Yamaha emblem assy at PT. Preshion Engineering Plastec Surabaya if the transfer between processes takes too long. In addition, there is no *waste* transportation, because the location of the work station is good.
Over processing: is waste that occurs if the operator performs unnecessary activities in the process and does not add value. In the Yamaha emblem assy production process at PT Preshion Engineering Plastec Surabaya, there is waste over processing, the flow of the production process is still not organized. So that it causes operators to carry out unnecessary activities.
Inventory: is waste in the storage of raw materials and finished materials. In the Yamaha emblem assy production process at PT Preshion Engineering Plastec Surabaya,

there is waste inventory because it has implemented FIFO (First in - First out) so that goods that have been in the warehouse for a long time are removed first to be sold to customers.

Moving: is a waste that occurs in the production process if the operator performs unnecessary and unergonomic movements. In the process of working on the Yamaha emblem assy production process at PT Preshion Engineering Plastec Surabaya, there is no waste.

Defect: is a waste that occurs if there is a defect in the product. In the Yamaha emblem assy production process at PT Preshion Engineering Plastec Surabaya, defects often occur due to operator negligence.

Next identify with CTQ. CTQ is a characteristic that is considered important because it is directly related to customer expectations and desires. Based on observations and interviews with the head of production, researchers found 4 CTQs in the production of Emblem assy.

Shink Mark: Emblem assy *surface* scratched.
Short mold: Unfinished product, a condition where the product is not 100% fully formed.
Dirty: There is dirt on the surface of the product and the edges of the product
Outgoing Rays : The light on the product penetrates, so the product is not completely covered.

Measure

Next, the measurement stage with the level of Defect Per Million Opportunities (DPMO) and the achievement of the sigma level. By displaying historical data of defective product emblem assy at PT. Preshion Engineering Plastec Surabaya, from January to March 2023, conducted interviews with production managers and operators on duty during production to find out real information on defective emblem assy products

Table 1. Production Data for January to March 2024

Week	Production
1	1,880,675
2	2,198,111
3	1,569,231
4	1,744,552
5	2,429,094
6	1,897,314
7	1,773,859
8	998.25
9	2,414,525
10	2,986,229
11	2,759,424
12	2,879,181

Table 2. Defective product history data January to March 2024

Shink Mark	Outgoing Rays	Dirty	Short mold	Number of Defects
1,512	1,576	601	1,006	4,694
1,399	3,153	395	848	5,795
1,313	1,823	2,054	80	5,269
894	3,913	2,983	1,705	9,495
486	2,724	422	168	3,800
991	2,693	734	1,466	5,884
787	1,734	3,877	1,972	8,371
288	2,405	3,806	575	7,074
979	2,203	2,452	1,073	6,707
810	2,063	2,359	1,154	6,387
1,776	2,780	2,593	1,109	8,258
959	2,299	693	750	4701

DPMO calculation and sigma conversion

The results of the DPU, DPO, and DPMO values can all be seen in the following table is the calculation of DPMO in the first week of January 2023.

Defect Per Unit (DPU)
(The Number of Defects)/(Number of Units) = 4694/1,880,675 =0.00249

Defect Per Opportunity (DPO)
(The Number of Defects)/(Number of Units x ctq) =4694/(1,880,675 x 4) = 0.009984486

Defect Permillion Opportunity (DPMO)
DPO × 1,000,000 = 9984.48617

ISSN : 2085 – 1669
e-ISSN : 2460 – 0288

Table 3. Emblem Assy DPMO calculation

Week	Defect	DPU	DPO	DPMO
1	4694	0.00249	0.00998	9984.486
2	5795	0.00263	0.01054	10545.632
3	5269	0.00335	0.01343	13431.808
4	9495	0.00544	0.02177	21770.047
5	3800	0.00156	0.00625	6256.772
6	5884	0.00310	0.01240	12404.427
7	8371	0.00471	0.01887	18875.976
8	7074	0.00708	0.02834	28346.900
9	6707	0.00277	0.01111	11111.659
10	6387	0.00213	0.00855	8555.567
11	8258	0.00299	0.011970	11970.089
12	4701	0.00163	0.00653	6531.343

After knowing the DPMO (Defect per Million Opportunity) value, the next step is to calculate *the sigma* value. The calculation of the sigma value is as follows:

The results of the *sigma* value can be seen in **Table 4.** below is the calculation of the sigma value in the first week of January 2023

=normsinv((1.000.000-DPMO)/1.000.000) + 1.5

=normsinv((1.000.000+9984.48617)/1.000.000) + 1.5= 3.82693

Table 4. Sigma emblem assy conversion DPMO calculation of emblem Assy

Week	DPMO	SIGMA
1	9984,486	3.826
2	10545,632	3.806
3	13431,808	3.713
4	21770,047	3.518
5	6256,772	3.997
6	12404,427	3.744
7	18875,976	3.577
8	28346,900	3.405
9	11111,659	3.786
10	8555,567	3.884
11	11970,089	3.758
12	6531,343	3.982
Total	159784,715	45,0011
Mean	13315,39	3,75

From **Table 4** it can be seen that the assy emblem production process produces a DPMO of 159784,715 with an average of 13315,39 and produces a sigma value of 45,0011 with an average of 3.75.

P Control Map Calculation

This tool is used to find out data that exceeds the upper control limit and lower control limit. The results of the calculation of the overall CL, UCL, and LCL values can be seen in Table 5. The following is the calculation of the P control map for the first week of January 2023:

Calculate the average of uncertainties (according to equation 2.4)
P = Di/ni = 4.964/1.880.675 = 0.00249

Calculating the Control Limit value (CL)
CL = P (∑*Defect*) / (∑Production Quantity)= 76436/25.530.441=0.00299

Calculating the Up Contol Limit value(UCL)
UCL = P + 3√((p(1-p))/n)
= 0,00299 + 3 √((0,00299(1-0,00299))/1.880.675)=0.00311

Calculating the Low Control Limit value (LCL)
LCL = P - 3√((p(1-p))/n)
= 0,00229 – 3 √((0,00229(1-0,00229))/1.880.675)
= 0.002874381

Table 5. Calculation of P control map of emblem assy production

Week	Defective porportion	CL	UCL	LCL
1.	0,00250	0,00299	0,00311	0,00287
2.	0,00264	0,00299	0,00310	0,00288
3.	0,00336	0,00299	0,00312	0,00286
4.	0,00544	0,00299	0,00312	0,00287
5.	0,00156	0,00299	0,00310	0,00289
6.	0,00310	0,00299	0,00311	0,00287
7.	1.773.859	0,00299	0,00312	0,00287
8.	998.246	0,00299	0,00316	0,00283
9.	2.414.525	0,00299	0,00310	0,00289
10	2.986.229	0,00299	0,00309	0,00290
11.	2.759.424	0,00299	0,00309	0,00290
12.	2.879.181	0,00299	0,00309	0,00290

The following is an identification of waste from the *lean six sigma waste questionnaire* that has been filled out by the head of production, production supervisor, and *quality* as well as production operators

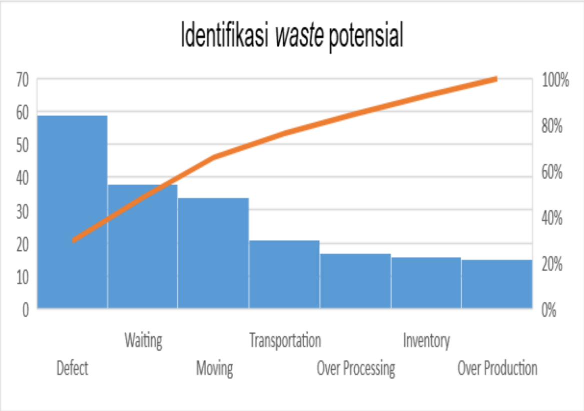

Figure 2. Pareto diagram of potential waste

Based on the results of the questionnaire distributed, then a pareto diagram was made showing that all types of waste reached more than 20% but the management wanted 1 cause of waste that must be repaired, namely defects.

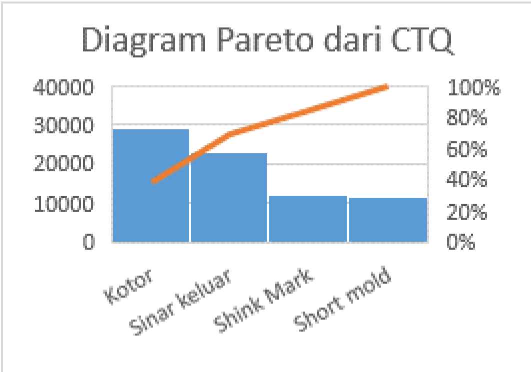

Figure 3. Pareto diagram from CTQ

The CTQ shows that there are 4 defects that occur, namely dirty, ray out, shin mark, and short mold. These 4 defects are the criteria in determining defects. It can be seen that dirty with a value of 12196 is the most cause. The second is outgoing ray with a value of 29366, the third is shin mark with a value of 22970, and the last is short mold with a value of 11,905.

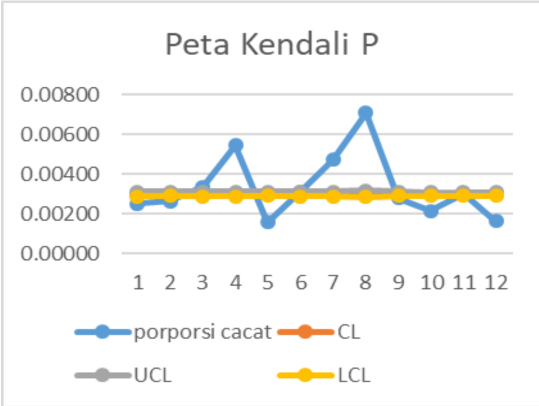

Figure 4. P Control Map

From **Figure 4**, it can be seen that the data obtained is cumulative and there are 6 weeks of data that exceed the limit. There are 4 data that exceed the upper limit, namely in week 3, week 4, week 7, week 8. Then there are 4 weeks that exceed the lower limit, namely week 5, week 9, week 10, week 13. From the data above, it can be known that the 6th data, and the 2nd is the largest that crosses the control limit.

Analyze

At the analyze stage, the brainstorming method is carried out with related parties, namely production and engineering to find out the root cause of the problem of defective products and other waste that causes the production output of the assy emblem to decrease, then a discussion is held to find the root of the problem described by fishbone. Fishbone is used to find the root cause of the problem of the occurrence of emblem assy defective products and down time which causes the production target not to be achieved. From several root problems that arise, the dominant causal factor is then determined and then the solution is sought.

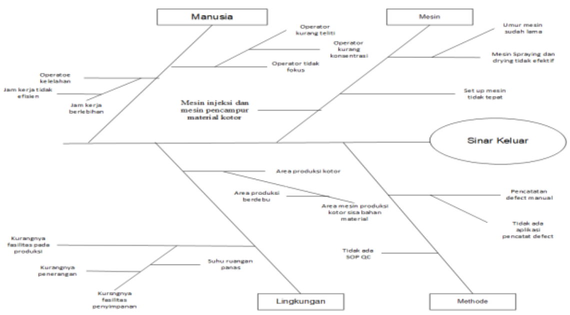

Figure 5. Fishbone Diagram

ISSN : 2085 – 1669
e-ISSN : 2460 – 0288

Improve

At this stage, improvements are made to solve the problems that occur as a solution to reduce product defects. In the next stage, we will improve with FME in order to get the best proposal to be used as an implementation of future improvements in the emblem assy manufacturing process.

FMEA (Failure Mode Effect Analysis) as a recommendation for improvement

a. In potential causes operator fatigue has S=4, O=4, D=5 so RPN=80, so the proposed improvement provides additional rest
b. In potential causes of inefficient working hours has S=3, O=2, D=3 so RPN=18, so the proposed improvement is to provide additional breaks and reduce working hours.
c. The potential cause of overwork hours has S = 3, O = 2, D = 2 so that the RPN = 12, so the proposed improvement is coaching for operators
d. In the potential cause the operator is not focused, has S = 4, O = 3, D = 4 so that the RPN = 48, so the proposed improvement is to make a supervision SOP
e. In the potential cause, the operator's lack of concentration has S = 2, O = 3, D = 3 so that the RPN = 18, so the proposal is to make a supervision SOP.
f. In the potential cause the operator is less careful, has S = 6, O = 5, D = 6 so that the RPN = 180, so the proposed improvement is brefing at the beginning of work.
g. In the potential cause of dirty injection machines and material mixing machines, it has S = 5, O = 5, D = 6 so that the RPN = 150, so the proposed improvement is to clean the machine every shift change.
h. In the potential cause the age of the machine is old, has S = 3, O = 5, D = 6 so that the RPN = 90, so the proposed improvement is to replace the machine.
i. In the potential cause of ineffective spraying and drying machines, it has S = 3, O = 6, D = 6 so that the RPN = 108, so the proposed improvement is to provide maintenance once a week.
j. The potential cause of improper machine set up has S = 2, O = 2, D = 2 so that the RPN = 8, so the proposed improvement is the standardization of the system.
k. In the potential cause of the dirty production area, it has S = 6, O = 5, D = 6 so that the RPN = 120, so the proposed improvement is to check or maintain the machines used in the production process.
l. In the potential cause of the dusty production area, it has S = 6, O = 5, D = 6 so that the RPN = 18, so the proposed improvement is to provide additional breaks and reduce working hours.
m. In the potential cause of dirty production machine areas due to leftover materials, it has S = 6, O = 5, D = 6 so that the RPN = 18, so the proposed improvement is to check or maintain the machines used in the production process.
n. In the potential cause of lack of facilities in production, has S = 6, O = 4, D = 5 so that the RPN = 120, so add the facilities needed to support good quality.
o. In the potential cause of lack of lighting, it has S = 5, O = 5, D = 6 so that the RPN = 150, so the proposed improvement is to add lighting facilities.
p. In the potential cause of lack of storage facilities, it has S = 6, O = 7, D = 5 so that the RPN = 210, so the proposed improvement is to replace storage that still uses cardboard boxes with storage boxes.
q. In the potential cause of hot room temperature, it has S = 7, O = 5, D = 5 so that the RPN = 175, so the proposed improvement is to add fan facilities.
r. In the potential cause of manual defect recording, it has S = 7, O = 4, D = 4 so that the RPN = 112, so the proposed improvement is to create a defect recording application, so that defect calculations are easier.
s. In the potential cause there is no defect recording application, has S = 6, O = 6, D = 5 so that the RPN = 180, so the proposed improvement is to create a

defect recording application, so that defect calculations are easier.

t. In the potential cause there is no QC SOP, it has S = 7, O = 6, D = 8 so that the RPN = 336, so the proposed improvement is to make an SOP to minimize defects.

Control

At this stage, standardization of activities is carried out to control quality based on proposals made at the improve stage. It is hoped that this control can solve the problems that occur and eliminate defects that occur so that they do not recur.

Monitoring waste with PDCA through SOPs.

PDCA

Plan: Improve operator skills

- Procurement of storage equipment
- Supervision of machines and operators
- Purchase raw materials that meet specifications
- Create SOPs

Do: Provide training to improve operators' abilities and skills.

- Purchase some storage equipment
- Checking machines regularly and giving warnings to negligent operators and building good coordination
- Purchase raw materials from several alternative suppliers
- Creating SOP in product QC

Check: It has been done but not maximized due to time and cost constraints

- Purchase the required quantity
- Already done
- Already done
- Done and ongoing according to field conditions

Action: Reschedule and budget for training

- Plan immediate purchases on a regular basis with capital considerations
- Conduct regular preventive maintenance and stricter operator supervision
- Always control the ups and downs of the quality of newly arrived raw materials
- Maintaining to be better at producing products

Conclusions

This section contains conclusions from the research results. Starting from the define stage using SIPOC. In the SIPOC identification, the supplier of PT Preshion Engineering Plastec is PT Indochimial Citra Kimia. Furthermore, the input or raw material used is plastic pellets. The process or stages of manufacture carried out are the mixing process, injection molding process, spray and screen-printing process, conveyor drying process, assembly process, quality control process, packing process. The output produced is the emblem assy product. The customer of this product is PT Yamaha Indonesia.

The next stage is to measure the emblem assy product. The CTQ shows four defects that occur, namely outgoing rays, dirty, shin marks, and short molds. The highest defect is ray out with a value of 29,366. The second is dirty with a value of 22,970, then shin marks with a value of 12,196, and the least is short mold with a value of 11,905. In the emblem assy product, the number of DPMO (Defect Per Million Opportunies) values from January to March 2023 was 159784.715 with an average of 13315.39 and produced a sigma value of 45.0011 with an average of 3.75.

The next stage is to analyze using the fishbone diagram; in man, the operator is not focused and lacks concentration; in machine, the injection machine and material mixing machine are dirty, the age of the machine; in the environment, the production area is dirty and dusty; in the method, manual defect recording, there is no QC SOP.

The next stage is to improve using FMEA, the highest RPN value is that there is no QC SOP with an RPN value of 336, the proposed improvement is to make QC SOPs to minimize defects, the second highest RPN value is the lack of storage facilities with an RPN value of 210, the proposed improvement is that storage still uses cardboard boxes replaced with storage boxes, the third highest RPN value is that the operator is less careful with an RPN value of 180, the proposed improvement is brefing at the beginning of work.

The last stage is control, designing Standard Operating Procedures and performing rework

ISSN : 2085 – 1669
e-ISSN : 2460 – 0288

for parts that do not meet the criteria based on the non confomence standard.

Acknowledgement
The author would like thanks to Institut Teknologi Adhi Tama Surabaya.

Author Contributions
The authors' contributions to the paper are as follows: study conception, design, analysis, and interpretation of results: DF, EY; data collection: DF, EY; draft manuscript preparation: EY. All authors have reviewed the results and approved the final version of the manuscript.

Conflicts of Interest
All authors declare that they have no conflicts of interest.

References
[1] D. P. Andriyany, "Analisis Konsep Produktivitas dan Faktor-Faktor yang Mempengaruhi Produktivitas Kerja Karyawan (Studi Literatur)," STIE PGRI Dewantara Jombang, 2021.
[2] M. Sinungan, *Produktivitas: Apa dan Bagaimana*. Jakarta: Bumi Aksara, 1987.
[3] M. Y. Wibisono, "Pengaruh Keselamatan Kerja, Kesehatan Kerja dan Kesejahteraan terhadap Produktivitas Karyawan (Studi Kasus pada PT. Wahana Abadi Rayon Purbalingga)," Universitas Muhammadiyah Purwokerto, 2017.
[4] E. Sutrisno, *Manajemen Sumber Daya Manusia (Cetakan Ke-8)*. Jakarta: Kencana Prenada Media Group, 2016.
[5] S. M. Hasibuan, "Pengaruh Kepemimpinan, Lingkungan Kerja dan Motivasi Kerja terhadap Kinerja," *Maneggio J. Ilm. Magister Manaj.*, vol. 1, no. 1, hal. 71–80, 2018, doi: https://doi.org/10.30596/maneggio.v1i1.2243.
[6] G. K. Gupta, D. Agrawal, R. K. Singh, dan R. K. Arya, "Prevalence, Risk Factors and Socio Demographic Co-Relates of Adolescent Hypertension in District Ghaziabad," *Indian J. Community Heal.*, vol. 25, no. 3, hal. 293–298, 2013, [Daring]. Tersedia pada: http://www.iapsmupuk.org/journal/index.php/IJCH/article/view/331
[7] V. Gaspersz, *Manajemen Kualitas dalam Industri Jasa*. Jakarta: Gramedia Pustaka Utama, 2002.
[8] M. Kholil, J. Haekal, A. Suparno, D. Savira, dan T. Widodo, "Lean Six Sigma Integration to Reduce *Waste* in Tablet Coating Production with DMAIC and VSM Approach in Production Lines of Manufacturing Companies," *Int. J. Sci. Adv. ISSN 2708*, vol. 7972, no. 2, hal. 5, 2021, doi: https://doi.org/10.51542/ijscia.v2i5.8.
[9] S. Saryanto, H. H. Purba, dan A. Trimarjoko, "Improve Quality Remanufacturing Welding and Machining Process in Indonesia Using Six Sigma Methods," *J. Eur. Des Syst. Autom.*, vol. 53, no. 3, 2020, doi: https://doi.org/10.18280/jesa.530308.
[10] M. Alefari, K. Salonitis, dan Y. Xu, "The Role of Leadership in Implementing Lean Manufacturing," *Procedia Cirp*, vol. 63, hal. 756–761, 2017, doi: https://doi.org/10.1016/j.procir.2017.03.169.
[11] A.-A. Dadashnejad dan C. Valmohammadi, "Investigating the Effect of Value Stream Mapping on Operational Losses: A Case Study," *J. Eng. Des. Technol.*, vol. 16, no. 3, hal. 478–500, 2018, doi: https://doi.org/10.1108/JEDT-11-2017-0123.
[12] F. R. Jacobs dan R. Chase, *Operations and Supply Chain Management (4th Edition)*. New York: McGraw-Hill Education, 2016.
[13] H. Prastiyo dan F. A. Ekoanindiyo, "Pengendalian Kualitas Produk Teh Hijau Menggunakan Pendekatan Six Sigma," *Din. Tek. Ind.*, vol. 8, no. 2, 2014, [Daring]. Tersedia pada: https://www.unisbank.ac.id/ojs/index.php/ft1/article/view/3053
[14] Y. Yuliana, Y. N. Nasution, dan W. Wasono, "Penggunaan Metode Kaizen pada Tahap Improve dalam Six Sigma," *Eksponensial*, vol. 8, no. 1, hal. 81–86, 2017, [Daring]. Tersedia pada: http://jurnal.fmipa.unmul.ac.id/index.php/exponensial/article/view/80

[15] N. T. Putri, B. Hidayat, D. Fatrias, dan A. S. Indrapriyatna, "Reducing Bag *Defect*s Using Six Sigma Methodology: A Case Study in A Cement Industry," in *2018 7th International Conference on Industrial Technology and Management (ICITM)*, IEEE, 2018, hal. 11–16. doi: https://doi.org/10.1109/ICITM.2018.8333911.

[16] J. Heizer dan B. Render, *Operations Management (7th Edition)*. New Jersey: Pearson Education, 2014.

[17] B. Neyestani, "Seven Basic Tools of Quality Control: The Appropriate Quality Techniques for Solving Quality Problems in the Organizations," *Zenodo*, 2017, doi: https://doi.org/10.5281/zenodo.400832.

[18] P. Barosz, M. Dudek-Burlikowska, dan M. Roszak, "The Application of the FMEA Method in the Selected Production Process of a Company," *Prod. Eng. Arch.*, vol. 18, no. 18, hal. 35–41, 2018, doi: https://doi.org/10.30657/pea.2018.18.06.

[19] J. F. W. Peeters, R. J. I. Basten, dan T. Tinga, "Improving Failure Analysis Efficiency by Combining FTA and FMEA in a Recursive Manner," *Reliab. Eng. Syst. Saf.*, vol. 172, hal. 36–44, 2018, doi: https://doi.org/10.1016/j.ress.2017.11.024.

[20] S. Bastuti, "Analisis Kegagalan pada Seksi Marking untuk Menurunkan Klaim Internal dengan Mengaplikasikan Metode PDCA," *SINTEK J. J. Ilm. Tek. Mesin*, vol. 11, no. 2, hal. 113–122, 2017, [Daring]. Tersedia pada: https://jurnal.umj.ac.id/index.php/sintek/article/view/2103

ISSN : 2085 – 1669
e-ISSN : 2460 – 0288