Quality Improvement and Waste Minimization in The Production Process of 450 MM Jacking Pipe Using the Lean Six Sigma Method

Azalia Zhafira
Department of Industrial Engineering,
University Trisakti
Jakarta, Indonesia
azhaliazhavira7@gmail.com

Rina Fitriana*
Department of Industrial Engineering,
University Trisakti
Jakarta, Indonesia
rinaf@trisakti.ac.id*

Idriwal Mayusda
Department of Industrial Engineering,
University Trisakti
Jakarta, Indonesia
idriwal.mayusda@trisakti.ac.id

Abstract

PT LCI produces two types of precast: centrifugal concrete and non-centrifugal concrete. The company's main problem is a defective product in December 2021 with a defect percentage of 4.12%. In addition to defective products, in the production process of Jacking Pipe 450 mm, there is waste, namely activities that do not add value to the product, reducing product activity. This study aims to reduce waste and improve quality by applying Lean Six Sigma can be used with the Define, Measure, Analyze, Improve, and Control stages. Define stage in the form of diagrams Supplier-Input-Process-Output-Customer and Critical to Quality product. The Measure stage calculates Defects per Million Opportunities (DPMO), sigma level, Process Cycle Efficiency, and Value Stream Mapping. The Measure results are calculated (DPMO) of 19867.54 units with a sigma level of 3.55 sigma, Process Cycle Efficiency (PCE) of 51.46%, Manufacturing Lead Time of 12.978 Hours, Exit Rate of 11.64 Units/Hour, and Process Velocity of 2.31 Activities/Hour. The waste is found in the form of defective products and waiting time. The tools used in the Analyze stage are Ishikawa diagrams and FMEA. This is used as the basis for proposed improvements at the improvement stage. The Control phase is the implementation of the proposed improvement activities in the form of cleaning the mold using mold oil, adding mold inspection activities with checklist tools, making machine work instructions and daily check sheet overhead cranes, and minimizing setup time. After the implementation, the DPMO value is 16666.67 units, equivalent to 3.62 sigma level, PCE value is 58.08%, Manufacturing Lead Time is 11.499 hours, Exit Rate is 3.48 Units/hour, and Process Velocity is 2.61 Activities/Hour.

Keywords
Lean Six Sigma, Kualitas, DMAIC (*Define*, *Measure*, *Analyse*, *Improve*, dan *Control)*, FMEA*(Failure Mode and Effect Analysis)*, Value Stream Mapping

1. Introduction

PT LCI produces two types of precast, namely centrifugal concrete and non-centrifugal concrete. Centrifugal concrete is concrete produced by spinning (spinning), while non-centrifugal concrete is produced by molding on demand. The product produced by PT LCI is a product type with a Make to Order system. From one of the mainstay products of PT LCI, namely Pipe Jacking 450 mm. Pipe Jacking products include RCP (Reinforced Concrete Pipe) concrete pipes. Pipe Jacking is a channel with a round cross-section that functions as rainwater drainage or transportation of raw water and clean water and wastewater. Historical data for January - December 2021 shows an average Based on the limit of 4.21%. The most significant 450 mm Pipe Jacking product in December 2021 with a total production of 129 pcs and has a total of 10 Pcs with the type of defect, namely porous operates 5 Pcs, Impenetrable crack opens 3 Pcs, and Sergei opens 2 Pcs. The method used to fix quality problems on 450 mm Pipe Jacking products is Lean Six Sigma. The Lean method can find out the causes of waste in the production process, while the six-sigma method is a reduction in 450 mm Jacking pipe products. Lean Six Sigma can be used with DMAIC stages (Define, Measure, Analyze, Improve, and Control).

Research conducted at PT LCI aims as follows:
1. Identify the types of defects that arise and the causal factors in the Jacking Pipe 450 mm production process.
2. Identify the waste that occurs and analyze the causes.
3. Determine DPMO, Sigma Level, PCE, Exit Rate, and Process Velocity of Jacking Pipe production 450 mm.
4. Provide suggestions for improvement by applying the Lean Six Sigma approach to efforts to reduce waste.
5. Comparing the results obtained before and after implementation.

Quality has become one of the most critical consumer decision factors in selecting competitive products and services. According to Gaspersz, Lean is a continuous effort (Continuous Efforts) to eliminate waste (waste) and increase the added value (Value Added) of products (goods or services) to provide value to customers (Customer Value) (W. O. Widyarto, et.al.2019). According to the APICS Dictionary, referred to by Gaspersz, Lean is a business philosophy that focuses on the identification and elimination of non-value-added activities in the design, production, or operation of supply chain systems that are directly related to customers.

Lean Manufacturing requires an overall technical understanding of the manufacturing system and the relationships between Manufacturing and other areas within the company itself, such as supply chain management, consumer demand, perception, distribution, and logistics. Six Sigma (6σ) is a continuous effort (continuous improvement) to reduce the variation of the process to increase the capability of the process in producing products that are free from defects (zero defects) to provide value to customers (customer value).

The application of Lean Six Sigma using the DMAIC method (Define, Measure, Analyze, Improve, Control) is the methodology used because the company has produced certain products but cannot meet customer demand specifications (R. Andiwibowo, et.al., 2021). The Define stage determines the Lean Six Sigma quality improvement activity, the first operational step in improving quality. At the Define stage, it will be carried out using the production process by identifying SIPOC diagrams (Supplier, Input, Process, Output, and Customer), determining CTQ (Critical to Quality), and identifying waste that occurs in the production process. Critical to Quality is an element of a product, process, or practice that directly impacts customer satisfaction.

SIPOC diagram (Supplier, Input, Process, Output, and Customer) is a diagram that describes the flow of the production process. The SIPOC diagram must go through five stages: entry, installation, design, obtaining materials, production, and delivery to customers (I. Rinjani, et.al., 2019).

The Measure stage is the second stage in measuring and evaluating the process performance that has been identified. The Measure stage is the stage of assessing the measurement system and interpreting the precast company's performance capabilities (output) (S. Lestari and M. H. Junaidy, 2017). Involves collecting data on measures of quality, cost, and time. Data processing uses control chart data to determine whether the information being studied is within the control limits or not.

The Analyze stage is the third stage in the analyze step, which aims to analyze and determine the causes of the problems. Tools used for this stage are fishbone diagrams, Pareto diagrams, and FMEA (Failure Mode Effect Analysis).

Improve stage is the fourth stage, namely improvement; after the cause of the quality problem is identified, it is necessary to determine an action plan to improve product quality (A. Faturochman, et.al., 2020). This stage is carried out to provide suggestions for improvements after knowing the existing root cause. At this stage, did namely providing suggestions for improvements based on critical causative factors that can be seen from the highest RPN value in the FMEA table and providing a Quality improvement strategy design that can be applied by the company in the future (K. Muhammad, et.al., 2020).

The Control stage is the last stage which is the final operational stage in improving the Quality of six Sigma on Jacking Pipe products 450 mm. This stage aims to maintain quality control and maintain the characteristics of the products that have been repaired so that there are no mistakes from before. This Control stage determines the ability to control variables and implements a process control system for variables that affect the characteristics of Critical to Quality (CTQ) (R. Fitriana and N. Anisa, 2019). This stage will document and disseminate the quality improvement results and practice the proposed revisions in the improvement stage (W. O. Widyarto, et.al., 2019).

Control at this stage focuses on the product to keep the improvements ongoing and ensure that the key variables are within the region. (Table 1)

Table 1. Previous Research

No	TOPICS	WRITER'
1	Lean Six Sigma Approach in Waste Improvement and Reduction to Increase Productivity in Tubing Pipe Production at PT. J	A.N. Zaman et.al,2021
2	Lean Six-Sigma Application to Reduce Waste in Cement Packaging	R.D. Astuti and Lathifurahman,2020
3	Application of Six Sigma Method in Product Quality Analysis (Case Study of Steel-Reinforced Concrete Production Company)	A. Faturochman, et.al.,2020
4	Plywood Product Quality Control Using Six Sigma and Kaizen Methods and Statistical Quality Control As An Effort To Reduce Defective Products	R. Andiwibowo, et.al.,2018
5	Improved Quality Control Through Lean Six Sigma Method	P. A. Wicaksono, et.al.,2017
6	Analysis of Quality Control of Defective Products on Type X Lenses Using Lean Six Sigma with the DMAIC Concept	I. Rinjani, et.al.,2021
7	Quality Control of Compound At-807 Products in Plant Mixing Center Using Six Sigma Method	S. Lestari and M. H. Junaidy,2020
8	Proposed Implementation of Lean Six Sigma to Improve the Quality of Cement Products	T. Alawiyah, et.al.,2021
9	Implementation Of the Lean Six Sigma Method as An Effort To Minimize Product Defects Of 240 Ml Mineral Water Cup Packaging (Case Study Of Drinking Water Company	A. F. Sanny, et.al.,2015
10	Product Quality Improvement and Waste Minimization Using a Six Sigma Approach in Animal Feed Companies	K. Muhammad, et.al.,2020
11	Design of Bolt and Screw Product Quality Improvement Using Six Sigma Method and Data Mining at PT. A	R. Fitriana and N. Anisa,2019
12	Analysis of Bottled Water Quality Control Using the Six Sigma Method	W. O. Widyarto, et.al.,2019

2. Methods

The lean six sigma approach methodology consists of the Define, Measure, Analyze, Improve, Control stages.

a. The defined stage is the first stage in improving quality with the six-sigma method. At this stage, the tools used are SIPOC diagrams (supplier, input, process, output, and customer) and Critical to Quality (CTQ).
b. The Measure stage uses measurements, namely uniformity and data adequacy tests, Adjustment factors, Allowance Calculations, Normal time calculations, Standard time calculations, and identifying processes using a p control chart that will determine whether the product is within the control limits or outside the control limits., then calculate the DPMO value, sigma level, Pareto chart, and Value Stream Mapping (VSM).
c. Analyze stage is the third stage in the lean six sigma method. At this stage, the causes of quality problems are identified. This stage uses a fishbone diagram (fishbone diagram) and FMEA (Failure Mode Effect Analysis).

d. Improve stage is the fourth stage in the lean six sigma method. This stage is the stage of improvement carried out after analyzing the causes of the problems. At this stage, a proposed revision that is very close to the problem is drawn to solve the problem of the causes of waste with the most significant value in the analysis stage.
e. The control stage is the last in the lean six sigma method. This stage aims to control quality control that has been corrected so that there are no previous mistakes.

3. Results and Discussion

A. Define Stage

The SIPOC diagram is a diagram that describes the Supplier, Input, Process, Output, and Customer involved in the production of Jacking Pipe. The function of this diagram is to show in detail the production process of making Jacking Pipe shown in Fig. Critical to Quality (CTQ) is one of the key quality characteristics of the resulting product. There are 3 types of defects in Jacking Pipe products, namely porous defects, impenetrable cracks, and segregation defects. Porous defects are defects in the concrete cavity caused by uneven mortar caused by residual concrete adhering to the mold, impermeable crack defects are defects caused by hot temperatures or an unstable temperature change, and segregation defects are defects that are where there is a tendency to separate the aggregate particles in the concrete mixture.

B. Measure Stage

The Measure stage in Lean Six Sigma is to calculate the calculation, divided into two parts, namely lean and six sigma. The lean analysis begins by calculating the standard time taken from the observation time by calculating the normality of the data, the data uniformity test, the data adequacy test, and adjusting and calculating the data allowance. Furthermore, the standard time that has been obtained in the observations is then made Value Stream Mapping (VSM) by calculating the manufacturing lead time, PCE, and finally determining the Value-Added Time and Non-Value-Added Time.

1. Normality Test

At the normality test stage, it is used to determine whether the data is normally distributed or not. This stage is carried out before testing the uniformity and adequacy of the data.

2. Uniformity Test

At the uniformity stage, this is done to see if the cycle time data taken at
Observations are already within the upper control limit and lower control limit. The data uniformity test uses a confidence level of 95% and an accuracy level of 5%. What took stages of testing the data 20 times where subgroup five and each subset consists of 4 standard time data.

3. Data Sufficiency Test

The data adequacy test phase aims to determine the number of observations before calculating the standard time (WB). At this stage, the hypothesis is that the value of N' is smaller than N's, where the value of N is the amount of data and N' is greater than the data taken is not enough.

4. Normal Time Calculation

The standard time calculation is calculated based on the adjustment value that occurs in the work element. Analyses using the Westinghouse method. This method considers four factors: skills, effort, working conditions, and constancy.

5. Calculation of Standard Time

Calculation of standard time is calculated based on the value of the allowance that occurs when the work element occurs.

6. Identify Value Added and Non-Value Added

The production process of Jacking Pipe products consists of 30 work elements, which start from the initial administrative stage to product storage in the finished goods warehouse. The results obtained in the Standard Time of 30 work elements are 778.69 Minutes, Value Added of 181.98 Minutes, and Non-Value Added of 596.71 Minutes.

7. Calculation of Process Cycle Efficiency (PCE)

The process cycle efficiency (PCE) calculation phase relates to the total value-added time compared to the manufacturing lead time.

8. Exit Rate Calculation

Exit Rate calculation is the number of units that one can process in a team. The calculation of process velocity calculates the number of activities carried out in hours.

9. Mapping Value Stream Mapping

Value Stream Mapping is a diagram that describes the overall activity in the production process. Value Stream Mapping (VSM) aims to consider the product flow from the beginning of production to the end and identify any waste during the production process. (Figure 1)

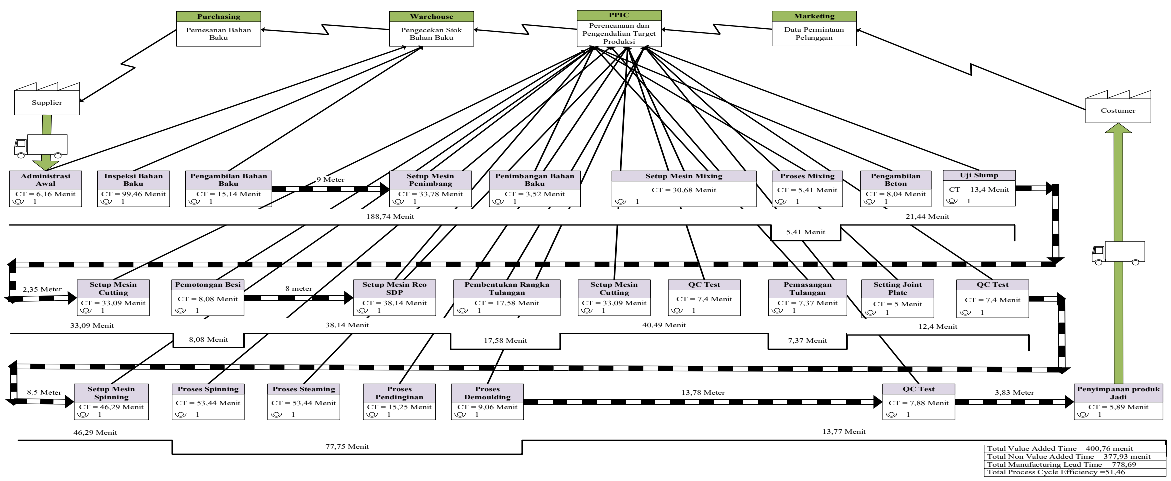

Figure.1 Current *Value Stream Mapping*

10. P Control Map

P Control Map is based on the total proportion of defective products from the inspection data. Before making the control chart, P. At the stage of calculating the control, chart P calculates the value of the proportion of defects, UCL, CL, and LCL. The following is the calculation of the values for observation one as follows:

- $p = \frac{Jumlah\ unit\ cacat}{Ukuran\ subgrup}$

$$p = \frac{2}{7} = 0{,}285714286$$

- $CL = \bar{p} = \frac{Total\ Cacat}{Total\ Inspeksi}$

$$CL = \bar{p} = \frac{10}{151}$$
$$CL = \bar{p} = 0{,}0662252$$

- $UCL = \bar{p} + 3\sqrt{\frac{\bar{p}(1-\bar{p})}{n}}$

$$UCL = 0{,}285714286 + 3\sqrt{\frac{0{,}285714286(1-0{,}285714286)}{7}}$$
$$UCL = 0{,}348196$$

- $LCL = \bar{p} - 3\sqrt{\frac{\bar{p}(1-\bar{p})}{n}}$

$$LCL = 0{,}285714286 - 3\sqrt{\frac{0{,}285714286(1-0{,}285714286)}{7}}$$
$$LCL = -0{,}21575$$

The following is Figure 2 of the P control chart. Based on the P control chart made, it can be concluded that there is no data within the lower control limit or out of control; it can be said that the data is within the control limit.

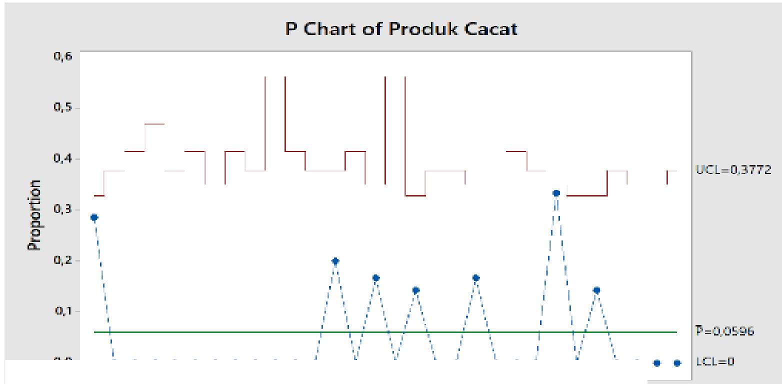

Figure 2. Control Chart P

11. Determination of DPMO and Sigma Level

At this stage, the DPMO (Defect per Million) value is calculated on the attribute data. DPMO calculation is carried out to determine the sigma level of Jacking Pipe products 450 mm. There are 151 units inspected; there are three types of defects.

- **Defect per Opportunities**

$$DPO = \frac{Defect}{TOP}$$

$$DPO = \frac{10}{1510} = 0{,}006225$$

- **Defect per Million Opportunities (DPMO)**

$$DPMO = DPO \; x \; 1000000$$

$$DPMO = 0{,}006225 \; x \; 1000000 = 6622{,}5165$$

- **Sigma Level**

$$\sigma = Normsinv \left(1 - \frac{DPMO}{1000000}\right)$$

$$\sigma = Normsinv \; (1 -) = \; 3{,}97 \; sigma$$

12. Identification of Dominant Disability

Dominant defects in observations were identified using the Pareto diagram using the 80:20 rule. The total number of defects in Jacking Pipe products from December 2021 – to January 2022 is ten units and has three defects: porous, impermeable cracks, and regression. The following is an overview of the dominant defects in Jacking Pipe products 450 mm. Based on the results obtained from the Pareto diagram through the MINITAB software in Figure 4.27, there are two. predominant types of defects, namely Porosity and Impenetrable Cracks, with percentages of 50% and 30%, respectively. Thus, based on the results of this data, it can be concluded that these two types of disability will be a priority for further analysis related to the factors that cause disability. (Figure 3)

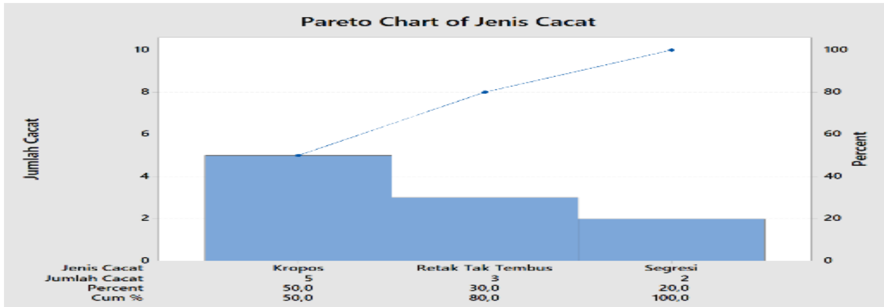

Figure 3. Pareto Chart

C. Analyze Stage

1. Analysis of the Causes of Waste

In the production process of Jacking Pipe 450 mm and the occurrence of waste in the production of Jacking Pipe 450 mm, who can identify namely defective products, several litters. Waste that occurs in Jacking Pipe 450 mm production process is waiting time.

2. Analysis of the Causes of Defects

After identifying the dominant defects on the Pareto diagram, who made an Ishikawa diagram on porous defects and impermeable cracks to analyze different causes and effects. Ishikawa diagram of the causes of porous defects can be seen in Fig 4.

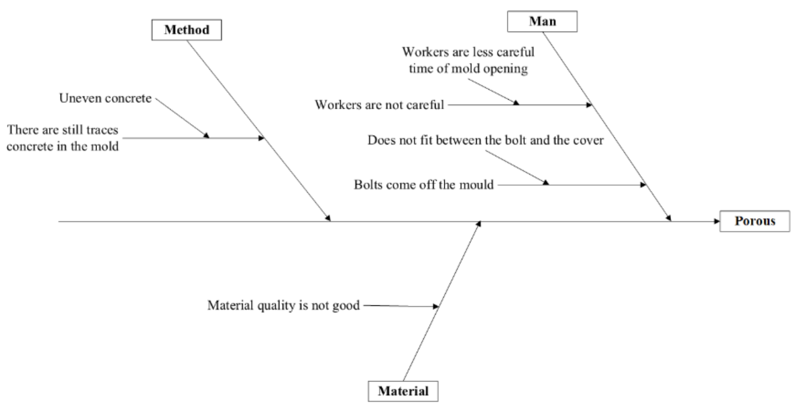

Figure 4. Ishikawa Diagram of Proud

In Figure 4, porous defects are influenced by three factors, namely Man, Material, and Method, as follows:

1) Man

The human factor that causes the type of porosity in Jacking Pipe products 450 mm is when the workers lack accuracy when opening the mold. This accuracy can be due to workers being negligent or lack of communication/cooperation between other workers and other errors that cause porous products, namely being affected by bolts that must be tightened every time before the mold opening process.

2) Material

The material factor is the quality of the material that is not good. The declining quality of raw materials can cause poor material quality.

3) Method

The method factor that causes the type of porous defect of the Jacking Pipe product 450 mm is shaken during the transfer process using an overhead crane because the load on this product is so heavy that the Jacking Pipe 450 mm crashes when you want to put it in the following process, and the presence of concrete will affect it. The next concrete to be cast. When the mold is opened, the freshly cast concrete will find a space, causing defects.

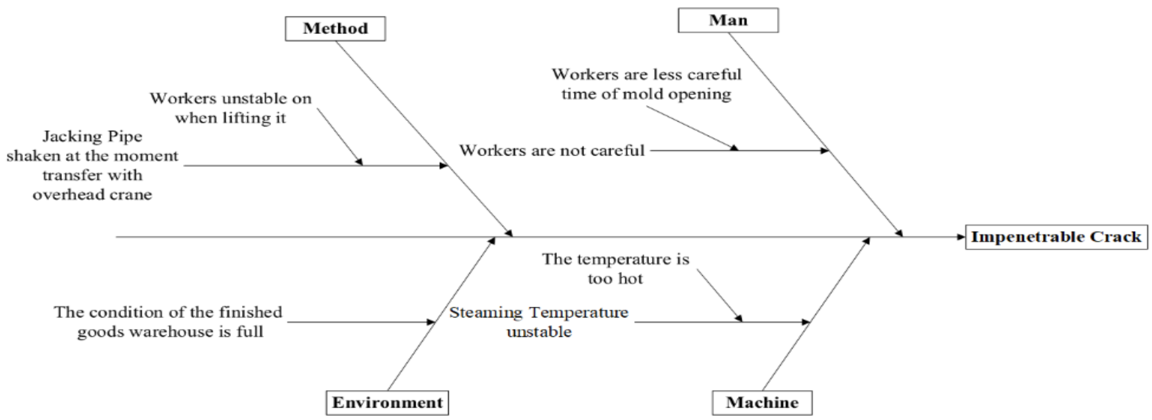

Figure 5. Ishikawa Diagram of Impenetrable Cracks

In Figure 5, crack defects are influenced by four factors, namely Man, Environment, Machine, and Method, which are as follows:

1) Man

The human factor that causes the impenetrable crack in Jacking Pipe products 450 mm is the worker's lack of accuracy when opening the mold. This accuracy could be due to the worker being negligent or the lack of communication/cooperation between other workers.

2) Environment

The environmental factor is an environment with a complete stockyard condition, so the movement of finished goods products will be limited. The placement of finished goods products will be tighter so that Jacking Pipe products 450 mm experience cracks.

3) Machine

The machine factor causes the type of crack defects in Jacking Pipe products 450 mm when steaming, which has an unstable temperature which should be 70◦C steaming temperature.

4) Method

The method factor that causes the type of porous defect of the Jacking Pipe 450 mm product during the transfer process using an overhead crane is that the load on this product is hefty, so the Jacking Pipe 450 mm crashes when it crashes you want to put it in the following process. When the mold is opened, the new concrete will find cracks inside and outside the Jacking Pipe 450 mm product.

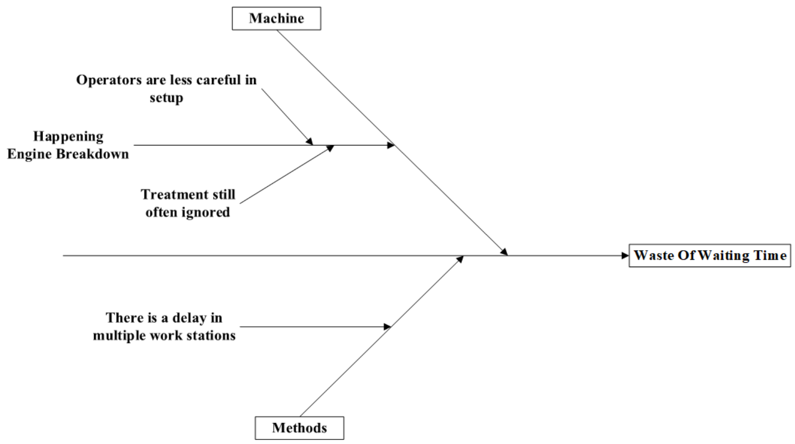

Figure 1. Ishikawa Diagram of Waiting Time

In Figure 6, the causes of waste waiting time are influenced by 1 factor, namely machines, as follows:

1. Machine
Machine factor is one of the causes of the breakdown of waiting time in the following process. Machine breakdowns can occur due to machine maintenance that is often ignored by the operator and the absence of data collection on the machine, and because the operator does not understand the actual operation of the machine.
2. Methods
The Methods factor is one of the wastes that occur due to delays at several workstations. Delay activity consists of a machine setup that takes a long time. The production process is hampered and takes a long time because of the delay.
3. Failure Mode and Effect Analysis (FMEA)
Failure Mode and Effect Analysis (FMEA) are tools used to design improvement proposals where the research results are due to waste. FMEA has Sevetery, Occurrence, and Detection ratings to determine the Risk Priority Number (RPN) value. The highest RPN value will be repaired. From the results of the Critical to Quality (CTQ) and Pareto diagrams, the highest product defects are porous defects and impenetrable cracks. The RPN numbers are sorted from the largest to the smallest for the causes that occur. The most significant RPN value is that there are still traces of molded concrete of 252. The second highest RPN is that workers are less careful when opening the mold by 125, and the last Jacking Pipe is shaken when moving with an overhead crane with an RPN value of 120. Further suggestions for improvement are needed on the highest issues.

D. Improve stage

The improvement stage is the stage of quality improvement by making improvement plans that will be carried out to overcome problems that occur in the company. In the improvement stage, suggestions for improvements will be made to problems that have the highest RPN value at the FMEA stage. The purpose of providing improvement proposals is to minimize failures that occur and product defects. The following table of proposed improvements is shown in Table 2.

Table 2. Improvement Proposal *Jacking Pipe* Ø 450 mm

Failure Type	Problem	Improvement Proposal	Implementation	Description
Porous	There are still traces of concrete in the mold.	Proposed cleaning of the mold using mold oil and a scraper.	No	Limited space far from the city.
Cracked	Workers are not careful to check the mold before opening the mold.	The proposal is to add mold inspection activities with a unique Checklist tool for opening molds.	Yes	Make a checklist for special inspection activities of mold opening.
	Jacking Pipe is shaken during overhead crane transport.	Making Work Instructions and daily check sheets for overhead crane machines.	Yes	Make work instructions and daily check sheets on overhead crane machines.

Failure Type	Problem	Improvement Proposal	Implementation	Description
Waiting Time	Operators are less careful and do not understand the use of machines,	Conducting Operator training	No	Research time is limited and requires experts for training.
	Machine setup is not too important in the setup of the raw material weighing machine, Cutting Bar Machine, and Reo SDP Machine.	Minimize Machine setup time	Yes	Minimize machine setup time in the setup of raw material weighing machines, mixing machines, bar cutting machines, SDP Reo machines, and spinning machines.

E. Stage Control

The Control phase is used to analyze the data after the proposed improvement has been implemented and to monitor the implementation so that it runs effectively. The control stage will recalculate the DPMO value, sigma level, and Process Cycle Efficiency (PCE) to find out whether the improvements that have been made have had an impact or not. The implementation of improvement proposals is carried out on the proposals given in the previous stage, namely the improvement stage. In the proposed improvement, several proposals can be applied and cannot be implemented due to certain limited conditions on the part of the company.

1. Implementation of Adding Inspection Activities with the Help of Checklists Before Demolding
Implementation of making inspection activities with the help of a checklist sheet at the time of opening the mold. The operator's error is being less careful when opening the mold with the checklist sheet, the operator being more careful when opening the mold. The results of the implementation of the checklist sheet have differences from before implementation because the implementation is carried out for six working days.

2. Implementation of Standardized Work Instructions and Daily Check Sheet
Implementation of making work instructions and daily check sheets on overhead crane machines tells operators to pay more attention to appropriate work standards and not ignore the standards that have been made. Operator error when lifting the Jacking Pipe, which makes the product shake, there are work instructions, and the daily check sheet operator can follow all the steps by the work instructions that have been made. One operator fills in the daily check sheet. The new implementation is carried out for six working days.

F. Evaluation

Evaluation of the results of the implementation of the proposed improvement is carried out by calculating the DPMO, sigma level, and standard time in the production process of Jacking Pipe 450mm. Calculation of DPMO and sigma level is done by taking inspection data of Jacking Pipe products 450mm back for 6 days. Then, all standard time data collection cannot be done because it cannot be implemented in 30 activities, so the lead time calculation uses the previous standard time, and several activities can be implemented according to the proposed improvements. (Table 3)

Table 3. Comparison of Lean and Six Sigma Matrix Before and After Implementation

Comparison Of Lean and Six Sigma Before and After Implementation						
	DPMO (Units)	**Sigma Level**	**Process Cycle Efficiency**	**Manufacturing Lead Time (Hours)**	**Exit Rate (Units/Hours)**	**Process Velocity (Activity/Hours)**
Before	19867,54	3,55	51,46%	12,978	11,64	2,31
After	16666,67	3,62	58,08%	11,499	3,48	2,61

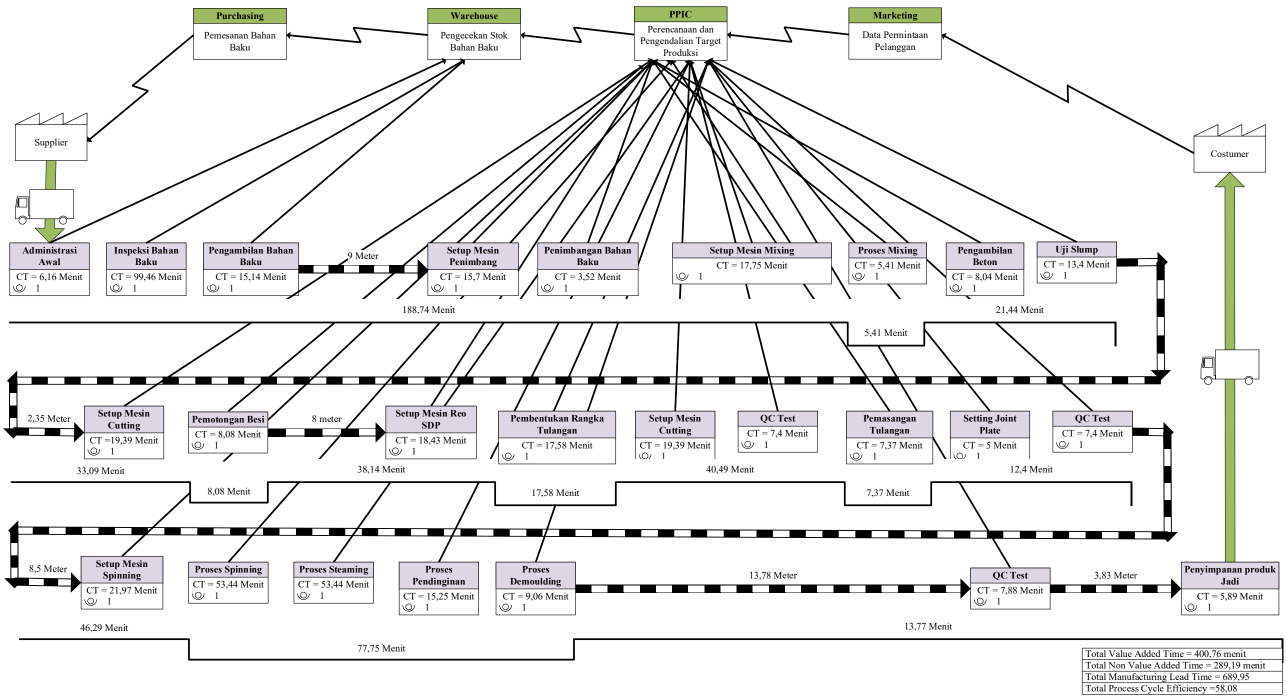

Figure 2. Future Value Stream Mapping

Conclusion

From data processing and analysis of the results that have been obtained, the conclusions obtained in this study are:

1. Types of defects that occur in the production process of Jacking Pipe 450mm are porous, impermeable cracks, and segregation. Based on Pareto, the dominant defects to be repaired are porous defects and impenetrable cracks.
2. Waste that occurs in the production process is in the form of waiting time and product defects.
3. The obtained DPMO value is 19867.54, and the sigma level is 3.55 sigma. Based on the calculation, the PCE results are 51.46%, Exit Rate is 11.64 Units/hour, and Process Velocity is 2.31 activity/hour.
4. The causes of the problems that occur are that there are still traces of concrete in the mold, the Jacking Pipe is shaken when moving with an overhead crane, and workers are not careful enough to check the mold before opening the mold. Proposed improvements to the problems that occur are using mold oil which helps clean used concrete, adding mold inspection activities with special Checklist tools for opening molds, and making work instructions and daily check sheets for overhead crane machines.

5. The results after the implementation of several proposed improvements in the minimization of defects, the initial DPMO value was 19867.54, the sigma level was 3.55, and after the implementation, the DPMO value was 16666.66, and the sigma level was 3.62. Then the results of the implementation estimate in reducing lead time in the initial production process have a PCE of 51.46% to 58.08 %.

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Biography

Azalia Zhafira is an Fresh Graduate student of Industrial Engineering, Faculty of Industrial Technology, Trisakti University. I successfully completed my undergraduate studies in 3.8 years. I am a person who can work with a team as well as individually. I am able to work under pressure. I like exploring new things. During my studies at Trisakti, I actively participated in several organizational activities through my studies. During college, I was active in the Social Department of the Industrial Engineering Association as a Deputy Department of the social department for 1 year from August 2021 - August 2022. During my time at HMTI, especially in the social department, I learned a lot from helping the head of the department, making proposals from start to finish, organizing events, managing money for events, working with the team to make social events both large and small events, and helping and coordinating my juniors to carry out events so that the event runs well. The research is Lean Six Sigma at a concrete company, namely PT L, which is located in Karangasem, Bali. My research focuses on 450 mm diameter pipe jacking products. In this research, I analyze and identify the main factors causing defects and Eliminate production wastage in the production process, Create procedures and implementation and instructions step by step to increase DPMO by reducing defects, and Successfully identify, measure, and analyze the causes of defects in a product using Pareto Diagram with Cause and Effect Diagram. Azalia has demonstrated good time management by successfully managing various student activities.

Rina Fitriana is a Lecturer and Head of Department of Industrial Engineering Program in Universitas Trisakti. She earned Sarjana Teknik in Industrial Engineering from Universitas Trisakti, Indonesia, Masters in Management from PPM Manajemen Graduated School of Management, Indonesia and Dr in Postgraduate Program of AgroIndustrial Technology, Bogor Agricultural University, Indonesia, IPM (Intermediate Professional Engineer) was obtained from the Industrial Engineering Cooperation Agency of the Indonesian Engineers Association (BKTI PII). Asean Engineering was obtained from the AFEO Governing Board in 2018. Rina started her career as a Lecturer in the Department of Industrial Engineering, FTI Trisakti University since 2002. She has held the positions of Head of Quality Control and Head of Quality Engineering Laboratory. Rina is trusted to be the Chair of the IV Quality Management Seminar. Rina has also been trusted to be the first and second Chair of the International Seminar on Industrial Engineering and Management (ISIEM). In 2014 he was trusted to be the Secretary of the Department of Industrial Engineering and Head of the Quality Engineering Lab. Then she was trusted to be the Head of the Department of Industrial Engineering from 2017 until now. She has proud experience when successfully delivering the Industrial Engineering Department to obtain Accreditation A from BAN PT in 2018, obtaining IABEE Provisional accreditation in 2018, obtaining IABEE General Accreditation and Superior Accreditation of the National Accreditation Board for Higher Education in 2021. In 2021, the Department of Industrial Engineering received PKKM Grants (Independent Campus Competition Program) worth 2.2 billion. Since 2008 Rina has been actively organizing as an administrator at BKSTI both the Central BKSTI and the BKSTI Korwil DKI Jakarta, and since 2018 she has been actively organizing as an administrator at BKTI PII. On various occasions, Rina became a resource person at various BKSTI events. She has published journal and conference papers. Dr Rina has completed many research projects. Her research interests include quality engineering, industrial system, business intelligence, data mining. She is member of ASQ

Idriwal Mayusda is a Lecturer of Industrial Engineering Program in Universitas Trisakti. He earned Sarjana Teknik in Industrial Engineering from Universitas Gadjah Mada, Masters in Industrial Engineering from Institut Teknologi Bandung. He has published conference papers. His research interests include production system and quality engineering. During his time as a student, he was active in several student and social organizations, activities which later influenced his life plan to become an academic. While studying in Yogyakarta, Idriwal became acquainted with a social program Teaching Street Children at the Ahmad Dahlan Street Children Shelter, Yogyakarta. Through this activity he realized that education is one way to hope for a better future for the younger generation. After completing his undergraduate program, Idriwal became the Co-Founder of a scholarship program for junior and senior high school students in Yogyakarta. This scholarship is given in the form of pocket money and a coaching program to 25 junior and senior high school students in Yogyakarta. His experience of obtaining several scholarships during his studies became the reason at that time to design a scholarship program that was not only related to pocket money but also became a "hook" for other success achievements. It is hoped that the scholarship program will have a multiplier effect, through networking and mentoring programs. While completing his master's studies through the support of an LPDP scholarship, Idriwal completed a thesis entitled "Development of Industry 4.0 Readiness Models in Indonesia's Priority Industrial Sector". This research received assistance from the Ministry of Industry to initiate an evaluation of the Making Indonesia 4.0 roadmap at that time. The theme of Industry 4.0 is still the focus at this time, especially related themes related to Lean Manufacturing, Flexible Manufacturing System, Industrial Robotics, and Quality Engineering. Currently, he is the Head of the CAD Practicum at the Production Systems Laboratory, and the Head of the Experimental Design Practicum at the Quality Engineering Laboratory