



## Analysis Defect Products in Silencers Using the New Seven Tools Method

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### Article Info

#### Article history:

Received 27 January 2025

Received in revised form 12 March 2025

Accepted 21 March 2025

#### Keywords:

Qualities

Defect

New Seven Tools

### Abstract

Quality is important for a product so that it can have more value than other products. To maintain quality, quality assurance (quality) is required. As is the case with silencer products produced by CV. Nyoto Plastik, silencer is a product that must maintain its quality value. Therefore, many defects in silencer products must be repaired by analyzing the causes of the defects. Based on research, the average defect in this silencer product reaches 10% within one year. New Seven Tools is a method for finding out the causes of defects based on humans, methods, materials, machines or the environment by using the seven tools contained in it. Therefore, this research aims to help maintain the quality of silencers by analyzing the causes of defects and providing suggestions for improvements to minimize defects that occur using the New Seven Tools method.

## Introduction

Industry is a sector that continues to experience development. Companies need to increase the quality value of a product to be able to keep up with competition. The benchmark for a product to increase competition and product sales is the definition of quality (Wang et al., 2022; Zhao et al., 2022). Quality is the main thing that a company has so that it can compete with other competitors. To be able to improve quality, control is needed to maintain the quality of a product. Quality control is very important to maintain product value, in order to increase competition (Lestari & Purwatmini, 2021; Alzoubi et al., 2022; Mehra & Agrawal, 2003). PT. XYZ is a company that produces a product that is produced through a process injection plastic moulding. Several types of products produced by PT. XYZ includes silencers, pet helmets, trimring, grill, as well as windtube. One of the products that has the highest defect rate is silencer products. The types of defects that occur include the product not being fully charged (shortmold), decoction, silver, black spots, and excess cutting (overcut). Based on the data that has been obtained, PT. XYZ has an average defect of 10% in Januari 2024 – December 2024. The highest defects are found in overcut defects.

To be able to maintain the quality of a product, quality assurance is needed in order to improve quality and minimize defects. Defect is one of the problems that can potentially reduce product quality (Islachiyana et al., 2023; Rifaldi & Sudarwati, 2024; Erdhianto, 2021; Psarommatis et al., 2022; Powell et al., 2022). Therefore, analysis is needed to find out the cause of the defect. In this research, the method used New Seven Tools to analyze the factors that cause product defects and provide suggestions for improvements. New Seven Tools is a technical tool to assist in carrying out qualitative problems consisting of Affinity Diagram, Interrelationship Diagram, Matrix Diagram, Analysis Data Matrix, Tree Diagram, Activity

Network, and Process Decision Program Chart (Prabowo & Wijaya, 2020; Islam, 2005; Shukla et al., 2014).

Based on Arianti (2020) the definition of quality according to experts Matzler & Hinterhuber (1998) is that quality is the fulfillment or exceeding of customer expectations through the products the company provides. According to Garvin (Gasperz, 1997), there are eight quality dimensions to analyze the quality of an item, such as: performance, features, reliability, conformance, durability, service ability, aesthetics, and perceived quality (reputation) (Ramiawati, 2020; Abubakar et al., 2023; Wahyudi et al., 2022; Lone & Bhat, 2022).

Quality control is defined as a system of verifying and maintaining product quality as desired through planning, use of appropriate equipment, continuous inspection and corrective action (Parhusip, 2023). Quality control plays an important role in maintaining product quality by minimizing defective products. According to Ardhiansyah et al. (2023) quality control aims to ensure that the process is carried out in accordance with established standards, then produces products with the desired quality (Lestari & Purwatmini, 2021; Dutta et al., 2021; Alzoubi et al., 2022; Shahriar et al. 2022).

New Seven Tools is a quality control tool that originates from development *seven tools*. According to Purwanto (2017), New Seven Tools This exists due to the need for qualitative problem solving in a structured manner at the management level. The tools contained in New Seven Tools is as follows (Yusnita & Puspita, 2020).

According to Lafeniya & Suseno (2023), Affinity diagram is a tool for collecting and managing several facts, opinions and ideas in the circumstances of an incident and then grouping the information according to similarities (Prakosa et al., 2024). The causes of defects can be identified based on the type of defect and problems found in the work area. Identification of the causes of types of defects and to find out the relationship between the causes and consequences of product defects can be done using a linkage diagram (interrelationship diagram) (Putri & Bachtiar, 2024; Hossen et al., 2017).

Tree diagram used to break down a concept or activity in more detail into sub-components or lower and more detailed levels (Yusnita & Puspita, 2020). Matrix diagrams aim to show the closeness or strength of the relationship between two or more groups of information (Yusnita & Puspita, 2020). There are several steps in determining matrix data analysis, including: The initial step is to create a table of decision criteria for alternative improvements, the second step is to determine the Important Ratings for all criteria, the third stage is to determine the Final Rankings for each criterion, the fourth stage is to create a Combining Rankings table, the fifth stage is to calculate the operator's score or assessment (Pardosi & Sumiati, 2024; Zakeri et al., 2022; Wang et al., 2024).

It is a tool for new seven tools which is used to graphically plan activity schedules and control their implementation. Besides that, tools This is useful for determining the sequence of work processes in order to reduce the number of product defects (Setiawan & Nuryanto, 2023). Possibility mapping is carried out to find appropriate corrective actions to overcome existing problems. Process decision program chart (PDPC) is used in the mapping of possibilities in which there are alternatives that can be done to reduce product defects.

## Methods

The research approach selected for this study uses quantitative methods to examine defect causes in silencer products manufactured by PT. The study examines defect causes at PT. XYZ by applying New Seven Tools. The main goal focuses on determining product-defect causes while developing quality control enhancement strategies. The research project took place within the facilities of PT. The research addresses silencer production at PT. XYZ during July 2024 in its plastic injection molding division.

The research explores different aspects that affect the development of product defects. Silencer production's defect rate serves as the dependent measure while human factors together with machine conditions and material quality and production methods and environmental influences form the independent factors. Data collection involved two methods: observing the production process and interviewing production managers and workers while analyzing product defect patterns through historical data from January to December 2024.

Through the New Seven Tools method the research team conducted defect cause analysis while suggesting structured solutions for improvement. The initial step employed the Affinity Diagram which sorted defect causes into five categories including human elements and machine factors and material characteristics and method practices together with environmental elements. The refined classification system enabled the detection of particular error origins that included improper parameter settings along with contaminated raw materials and overheating machines as well as insufficient temperature inspections and environmental noise exposure. The Interrelationship Diagram acted as a second tool which illustrated how different factors affected one another for better comprehension of their interlocking nature. The Tree Diagram analyzed major issues by dividing them into smaller sub-components which generated appropriate corrective measures for each segment.

Improving action prioritization involved using the Matrix Diagram for visualizing defect factors and proposed solutions relationships. The analysis resulted in understanding which defect reduction methods would deliver the most substantial outcomes. Professional assessments enabled the Matrix Data Analysis process to rank improvement criteria effectively which validated that employee training improvement together with machine maintenance and raw material inspection controls would produce the best corrective action results. The Activity Network Diagram was built to properly organize the recommended improvements so they could be implemented smoothly. The Process Decision Program Chart (PDPC) was employed to analyze the feasibility aspects of proposed solutions by identifying both risks and possible alternative corrective steps.

Expert assessments and production history support the data validity and reliability through data cross-referencing. The ranking of improvement priorities underwent statistical verification through analytical procedures. The researcher maintained both business data confidentiality and needed authorization for every step of research plus ethical standards during the process.

## Results and Discussion

Data collection was carried out from January 2024 to December 2024. The number of silencer production from January 2024 to December 2024 is shown in the following table:

Table 1. Silencer Production Data

Month	Production Amount	Lots of defects	Defect Type					Presentation
			Shortmold	Decoction	Black Spots	Overcut	Silver	
January	43445	4495	1398	1116	117	1844	20	10%
February	58679	6009	2375	1347	104	2133	50	10%
March	23944	2732	874	775	20	1053	10	11%
April	36430	3442	835	1139	20	1428	20	9%
May	28559	2865	852	220	150	1563	80	10.0%
June	46430	4642	1606	847	250	1839	100	10%
July	53865	4755	1728	829	30	2163	5	9%
August	53055	5746	1884	1162	50	2630	20	10%
September	32690	2870	922	732	43	1153	20	9%

October	31780	3387	852	1046	66	1381	42	10%
November	45890	4571	1478	1292	16	1774	11	9%
December	37830	3614	1142	870	40	1535	27	9%

Based on this table, it can be seen that silencer products have a defect percentage of 10%. For this reason, it is necessary to analyze the causes of defects using the New Seven Tools method below:

### Affinity Diagram

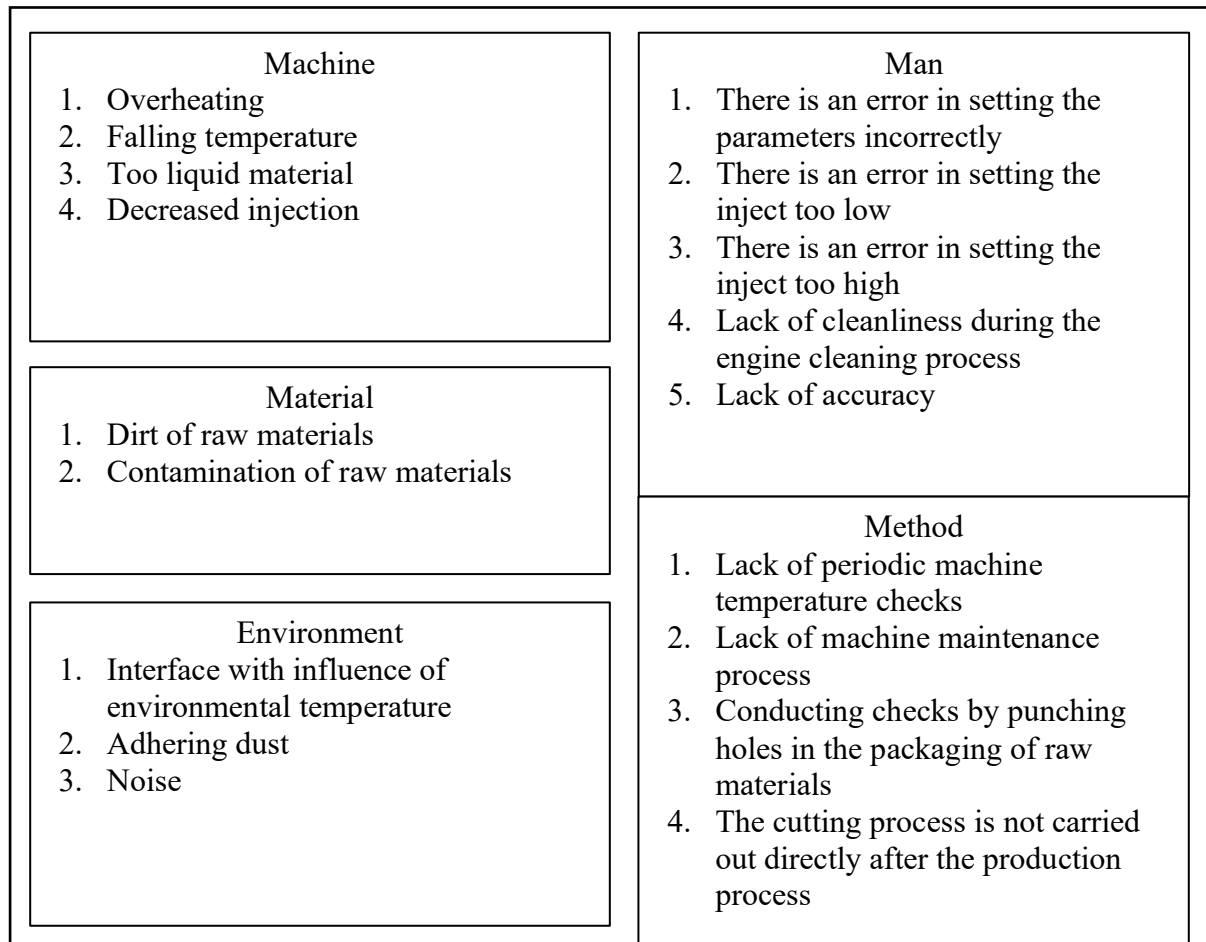


Figure 1. Affinity Diagram

Affinity Diagram useful for identifying and grouping the causes of defects based on the causal factors. The following is a picture of the grouping of causes of product defects during the production process, resulting in defects in silencer products. This grouping will later be used to make it easier to provide recommendations for improvement so that it can help minimize defects that occur. Based on affinity diagram, it can be seen that the causes of defects in silencer products consist of human, machine, material, method and environmental causes. Machine errors such as overheating, falling temperature, too liquid material, and decreased injection. Material errors such as dirt and contamination of raw materials. Errors based on the environment such as temperature, adhering dust, and noise. Errors based on methods are lack of inspection, lack of maintenance, incorrect checks, and buildup during cutting. Human errors such as parameter and injection setting errors, lack of cleanliness, and lack of accuracy.

### Interrelationship Diagram

Interrelationship Diagram is a diagram used to analyze cause and effect relationships to find out the causes of a problem. This diagram is used to determine the correlation of relationships that cause defects in silencer products.

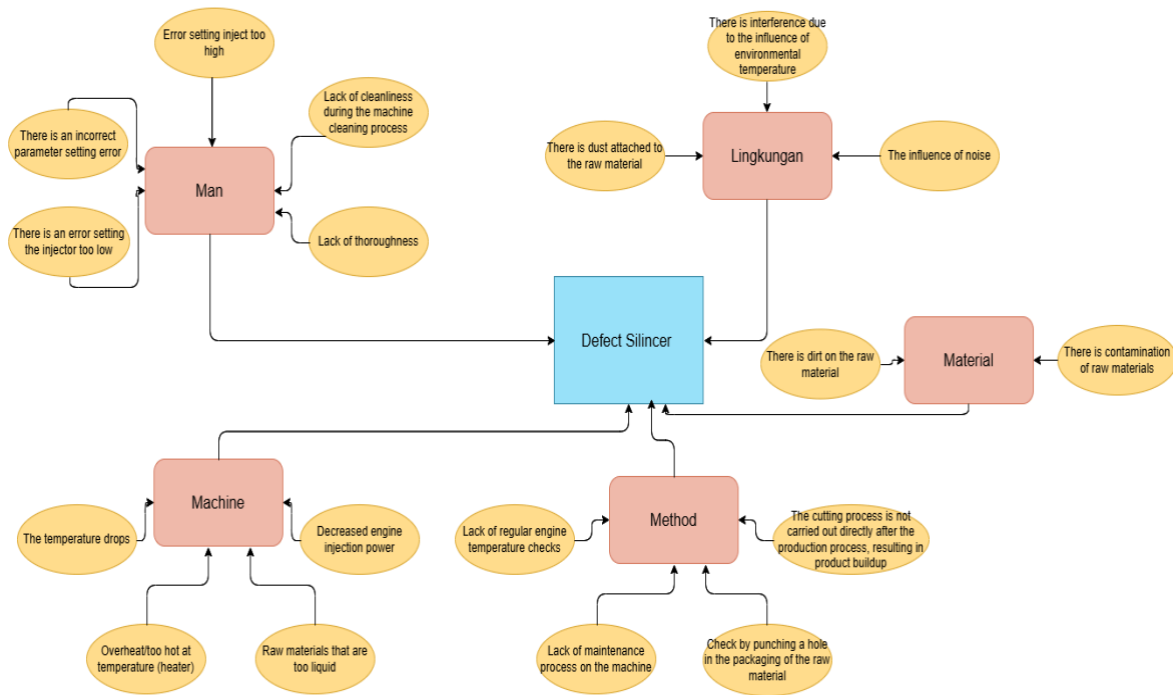


Figure 2. Interrelationship Diagram

Based on Figure 2, it can be seen that these interconnected relationships can have an influence on each other. So, this diagram is used to determine the correlation between cause and effect.

### Tree Diagram

Tree Diagram is a tool used to classify in detail a problem based on the solution required. Tree diagram is a useful tool for mapping the causes of defects based on factors as well as suggestions for improvements that can be applied to the company.

The Figure 3 Tree Diagram serves as an implementation method in this analysis to analyze product faults by creating detailed actionable improvements for addressing their root causes. This research examines silencer production defects at PT. The Tree Diagram provides visual understanding of defect cause hierarchy by displaying human (man), machine and material categories together with their each sub-cause as environment and method and human (man) and machine at top levels.

The diagram shows human factors include wrong parameter adjustments and imprecise injections with unclean machine sanitation along with insufficient precision. The diagram establishes data links to operational improvements which include the implementation of supervision and the delivery of technician training and the use of cleanliness checklists. The diagram points to performing thermocontrol checks and conducting maintenance tasks and installing heat protection devices when dealing with temperature issues and weak injection strength along with unstable temperature conditions in machines.

Raw material contamination and dirt are evaluated through the Tree Diagram. The proposed solutions connect to problems because they focus on better relationships between raw material suppliers while using stricter inspection methods. The absence of periodic temperature monitoring and cutting process delays can be attributed to defined maintenance protocols and workflow adjustments. The redesign of facility layout along with better storage conditions results from environmental factors such as noise and dust.

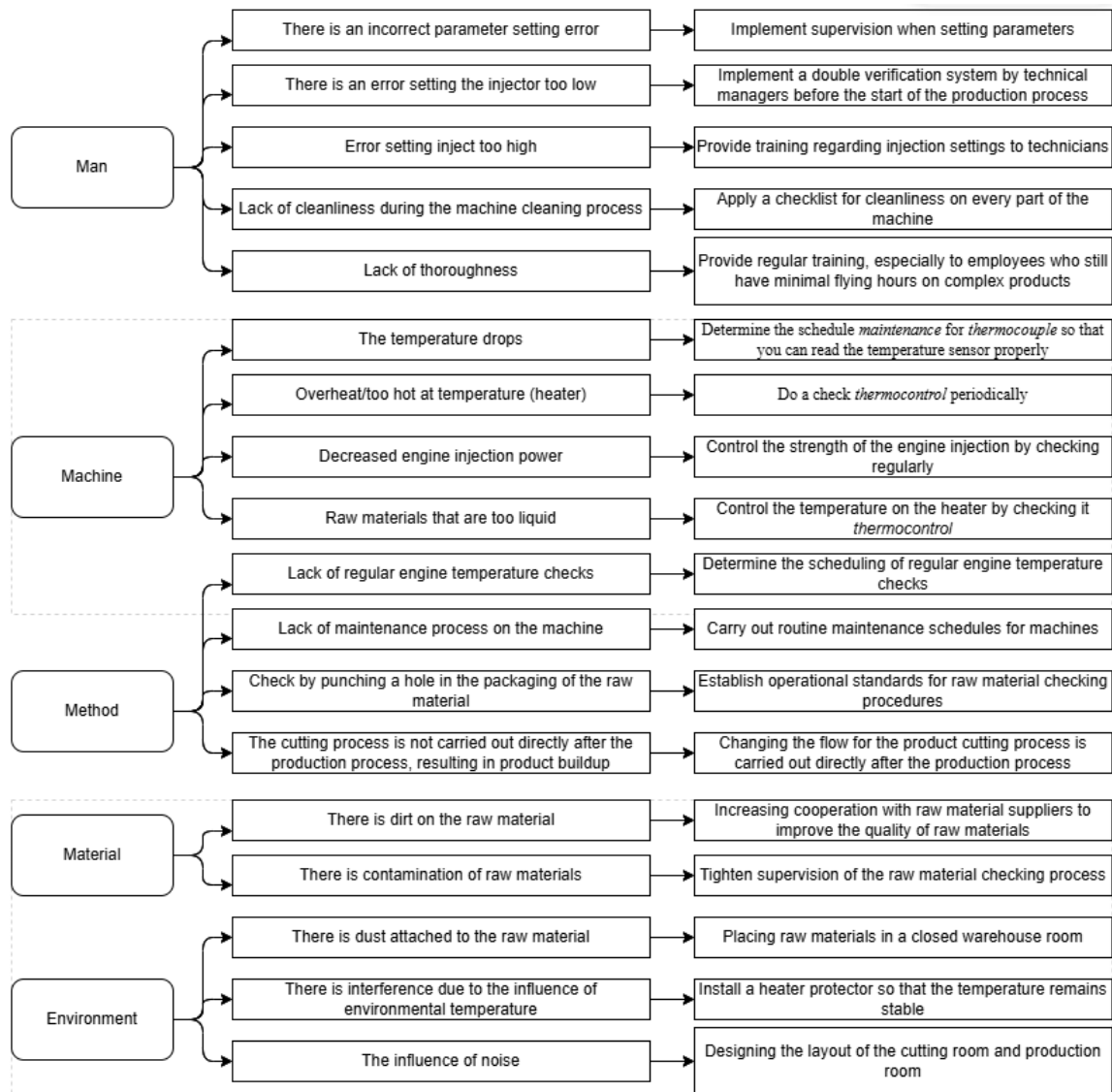


Figure 3. Tree Diagram

### Matrix Diagram

Matrix Diagram is a tool for identifying and visualizing the relationship between items in two or more different factor groups. The goal is to be able to communicate relationships through symbols that are easy to understand.

Table 2. Matrix Diagram Defect Cause Symbol With Defect Factor

Improvement Suggestions	Symbols of the relationships between disability factor and improvement activities					
	Man	Material	Machine	Method	Environment	Assessment Score
Implement supervision when setting parameters	●	○	○	▲	○	15
Implement a double verification system by technical managers before the start of the production process	●	○	○	▲	○	17
Provide training regarding injection settings to technicians	●	○	○	▲	○	17

Apply a checklist for cleanliness on every part of the machine	●	○	▲	○	○	15
Provide regular training, especially to employees who still have minimal flying hours on complex products	●	▲	▲	▲	▲	<b>19</b>
Increasing cooperation with raw material suppliers to improve the quality of raw materials	○	●	○	▲	○	15
Tighten supervision of the raw material checking process	▲	▲	▲	○	▲	<b>19</b>
Determine the schedule maintenance for <i>thermocouple</i> so that you can read the temperature sensor properly	●	○	▲	○	○	15
Do a check <i>thermocontrol</i> periodically	●	○	▲	○	○	17
Carry out regular machine maintenance by paying attention to the heater protective components	●	○	●	○	○	<b>19</b>
Control the temperature on the heater by checking <i>thermocontrol</i>	▲	○	●	○	○	15
Determine the scheduling of regular engine temperature checks	▲	○	●	○	○	<b>19</b>
Carry out routine maintenance schedules for machines	●	○	▲	○	○	17
Establish operational standards for raw material checking procedures	▲	▲	▲	○	○	17
Changing the flow for the product cutting process is carried out directly after the production process	▲	○	○	▲	○	13
Placing raw materials in a closed warehouse room	○	●	○	○	○	17
Install a heater protector so that the temperature remains stable	▲	○	○	○	○	17
Designing the layout of the cutting room and production room	▲	○	○	○	○	<b>19</b>

A relationship between proposed improvement actions shows their association with Man (human error) and Material and Machine defects and also Method and Environment. Table 2 provides this illustration. The designed table visualizes which proposed improvements serve to resolve particular defect origins. A strong relationship appears as a solid circle whereas a weak one shows up as an empty circle yet moderate relationships have triangle symbols. Through this representation of symbols people can efficiently determine which proposed improvements contain the most comprehensive solutions for diverse defect causes. The assessment reaches 19 points due to how employee training provides regular instruction to complex product handlers leading to strong relationships with every defect category. The raw

material checking process supervision receives a high assessment score since it addresses numerous quality factors. Experts use their professional evaluation methods to determine ranking scores for each suggestion that shows effectiveness against defects.

Table 3. Matrix Diagram Improvement Proposal Symbol With Defect Factor

Improvement Suggestions	Symbols of the relationships between disability factor and improvement activities					
	Man	Material	Machine	Method	Environment	Assessment Score
Implement supervision when setting parameters	●	○	○	▲	▲	15
Implement a double verification system by technical managers before the start of the production process	●	▲	○	▲	▲	17
Provide training regarding injection settings to technicians	●	○	○	▲	▲	17
Apply a checklist for cleanliness on every part of the machine	●	○	▲	▲	○	15
Provide regular training, especially to employees who still have minimal flying hours on complex products	●	▲	▲	▲	▲	19
Increasing cooperation with raw material suppliers to improve the quality of raw materials	○	●	○	▲	○	15
Tighten supervision of the raw material checking process	▲	▲	▲	○	▲	19
Determine the schedule maintenance for <i>thermocouple</i> so that you can read the temperature sensor properly	●	○	▲	○	○	15
Do a check <i>thermocontrol</i> periodically	●	○	▲	○	○	17
Carry out regular machine maintenance by paying attention to the heater protective components	○	○	●	○	●	19
Control the temperature on the heater by checking <i>thermocontrol</i>	▲	○	●	○	○	15
Determine the scheduling of regular engine temperature checks	▲	○	●	○	○	19
Carry out routine maintenance schedules for machines	●	○	▲	○	○	17
Establish operational standards for raw material checking procedures	▲	▲	▲	○	○	17
Changing the flow for the product cutting process is carried out directly after the production process	▲	○	○	▲	○	13

Placing raw materials in a closed warehouse room	○	●	○	○	○	17
Install a heater protector so that the temperature remains stable	▲	○	○	○	○	17
Designing the layout of the cutting room and production room	▲	○	○	○	○	<b>19</b>

Table 3 boosts the analysis introduced in Table 2 with added detail. The framework adopts a similar structural framework along with its symbol system to validate proposed corrective measures against identified defect origins. The assessment scores measure the anticipated effects of each suggestion according to expert opinions. The assessment scores indicate high potential for impact through proposals like “carry out regular machine maintenance” alongside “design the layout of the cutting room and production room” which achieve identical scores of 19. These solutions address machine-related and environmental problems because these factors produced major defects in products. Table 3 functions as a vital step for confirming that proposed solutions match the actual root causes of defects thus both recommendations and strategies become focused and strategic.

### Matrix Data Analysis

*Matrix Data Analysis* is a tool used to resolve the factors causing a problem by looking for suggestions for improvement and improvement criteria obtained based on interview data. Matrix data analysis consists of several stages, namely:

***The initial stage is to create a table of decision criteria for proposed improvements***

Table 4. Decision Criteria

Proposed Code	Proposed Improvements	Code Criteria	Decision Criteria
1	Provide regular training, especially to employees who still have minimal flying hours on complex products	A	Increase performance focus by conducting evaluations and providing training to employees
2	Control engine injection strength by checking regularly	B	Carry out routine inspections after the production process is carried out to determine the strength of the injection
3	Determine the scheduling of regular engine temperature checks	C	Check engine temperature by controlling the temperature on <i>thermocontrol</i> periodically to maintain the stability of the heater temperature
4	Establish operational standards for raw material checking procedures	D	Determine operational standards for checking raw materials and provide sanctions for those who commit violations.
5	Designing the layout of the cutting room and production room	E	Improves focusing by changing the layout of the cutting room to the separate production room

***The second stage is determining ranking (Important Ratings) for each criterion***

Table 5. Important Ratings

<b>Code Ratings</b>	<b>Resp 1</b>	<b>Resp 2</b>	<b>Resp 3</b>	<b>Resp 4</b>	<b>Resp 5</b>	<b>Sum Of Score</b>	<b>Final Criteria Rankings</b>
A	5	4	4	5	5	23	4
B	5	5	5	5	5	25	5
C	4	5	4	4	4	21	3
D	4	4	5	3	3	19	2
E	5	3	3	4	3	18	1

Information :

- A : Increasing performance focus by conducting evaluations and providing training to employees
- B : Carry out routine inspections after the production process is carried out to determine the strength of the injection
- C : Checking engine temperature by controlling the temperature on *thermocontrol* periodically to maintain the stability of the heater temperature
- D : Determine operational standards for checking raw materials and provide sanctions for those who commit violations
- E : Improve focusing by changing the layout of the cutting room and the production room separately

**The third stage is determining the final ranking for each criterion based on proposed improvements**

Table 6. Final ranking

<b>Proposed Improvement Code</b>	<b>Resp 1</b>	<b>Resp 2</b>	<b>Resp 3</b>	<b>Resp 4</b>	<b>Resp 5</b>	<b>Sum Of Score</b>	<b>Final Criteria Rankings</b>
1	5	5	5	4	5	24	5
2	4	4	5	4	5	22	4
3	4	5	4	4	4	21	3
4	4	4	3	3	4	18	1
5	5	4	3	3	4	19	2
<b>Proposed Improvement Code</b>	<b>Resp 1</b>	<b>Resp 2</b>	<b>Resp 3</b>	<b>Resp 4</b>	<b>Resp 5</b>	<b>Sum Of Score</b>	<b>Final Criteria Rankings</b>
1	4	5	5	4	4	22	4
2	5	5	5	5	5	25	5
3	4	5	3	4	4	20	3
4	3	4	3	3	3	16	1
5	4	4	3	3	3	17	2
<b>Proposed Improvement Code</b>	<b>Resp 1</b>	<b>Resp 2</b>	<b>Resp 3</b>	<b>Resp 4</b>	<b>Resp 5</b>	<b>Sum Of Score</b>	<b>Final Criteria Rankings</b>
1	4	5	4	4	4	21	4
2	4	4	3	4	3	18	3
3	5	4	4	5	5	23	5
4	4	3	4	3	3	17	2
5	4	3	3	3	3	16	1
<b>Proposed Improvement Code</b>	<b>Resp 1</b>	<b>Resp 2</b>	<b>Resp 3</b>	<b>Resp 4</b>	<b>Resp 5</b>	<b>Sum Of Score</b>	<b>Final Criteria Rankings</b>
1	4	4	4	3	4	19	3
2	3	3	3	4	3	16	1
3	4	5	5	4	4	22	4
4	5	4	5	5	5	24	5
5	4	3	3	4	3	17	2

Proposed Improvement Code	Resp 1	Resp 2	Resp 3	Resp 4	Resp 5	Sum Of Score	Final Criteria Rankings
1	4	4	3	3	4	18	2
2	4	3	3	3	3	16	1
3	4	5	4	4	5	22	4
4	4	3	4	5	4	20	3
5	5	4	5	5	4	23	5

Information :

- 1 : Provide regular training, especially to employees who still have minimal flying hours on complex products
- 2 : Control the engine injection strength by checking regularly
- 3 : Determine the scheduling of periodic engine temperature checks
- 4 : Establish operational standards for raw material checking procedures
- 5 : Designing the layout of the cutting room and production room

**The fourth stage is creating a table Combining Rankings**

Table 7. Combining Rankings

Improvement Criteria	Repair Activity Code				
	1	2	3	4	5
4	5	4	4	3	2
5	4	5	3	1	1
3	3	3	5	4	4
2	1	1	2	5	3
1	2	2	1	2	5

Information :

- 1 : Improvement activities provide regular training, especially for employees who still have minimal flying hours on complex products
- 2 : Repair activities control the engine's injection strength by carrying out routine checks
- 3 : Repair activities determine the scheduling of periodic engine temperature checks
- 4 : Repair activities establish operational standards for raw material checking procedures
- 5 : Improvement activities include designing the layout of the cutting room and production room

**The fifth stage is calculating score or operator ratings**

Table 8. x Score Proposed Improvements

Proposed Improvements	Score
Provide regular training, especially to employees who still have minimal flying hours on complex products	$= 4(5) + 5(4) + 3(4) + 2(3) + 1(2)$ $= 20 + 20 + 12 + 6 + 2$ $= 60$
Control engine injection strength by checking regularly	$= 4(4) + 5(5) + 3(3) + 2(1) + 1(1)$ $= 16 + 25 + 9 + 2 + 1$ $= 53$
Determine the scheduling of regular engine temperature checks	$= 4(3) + 5(3) + 3(5) + 2(4) + 1(4)$ $= 12 + 15 + 15 + 8 + 4$ $= 54$
<b>Proposed Improvements</b>	<b>Score</b>

Establish operational standards for raw material checking procedures	$= 4(1) + 5(1) + 3(2) + 2(5) + 1(3)$ $= 4 + 5 + 6 + 10 + 3$ $= 28$
Designing the layout of the cutting room and production room	$= 4(2) + 5(2) + 3(1) + 2(2) + 1(5)$ $= 8 + 10 + 3 + 4 + 5$ $= 30$

This table consolidates the rankings from multiple evaluators to compare the effectiveness of each proposed improvement action. Each improvement suggestion is ranked across different decision criteria, and the results are combined to identify which actions consistently receive high priority. This helps highlight the most impactful improvements based on a comprehensive evaluation.

***The sixth level is the level to determine final rankings which will be used for improvement proposals***

Table 9. x *Final Rankings* for Improvement Suggestions

No.	Proposed Improvements
1	Provide regular training, especially to employees who still have minimal flying hours on complex products
2	Determine the scheduling of regular engine temperature checks
3	Control engine injection strength by checking regularly
4	Designing the layout of the cutting room and production room
5	Establish operational standards for raw material checking procedures

Table 9 presents the calculation of weighted scores for each proposed improvement. Using the rankings from Table 8, this table multiplies each rank by its respective weight and sums the values to generate a total score. The resulting scores provide a quantitative measure of each improvement's overall importance, helping to objectively prioritize actions.

### Activity Network Diagram

*Activity Network Diagram* is a tool that can be used to plan activity schedules and the time required for an activity.

Table 10. x List of Production Process Activities and Process Duration

Activity List	Activity Code	Previous Activities	Duration
Preparation of raw materials for Silencer products	A	-	1 minute
The process of mixing colors in raw materials	B	A	1 minute
Transfer of raw materials into the machine hopper	C	B	2 minutes
The process of liquefying raw materials in machine barrels	D	C	3 minutes
Product injection process	E	D	0.5 minutes
Cooling process after injection	F	E	0.5 minutes
Product cutting process	G	F	2 minutes
Product checking process by <i>Quality Control</i>	H	G	1 minute
Packing process	I	H	1 minute
Temporary storage process in warehouse	J	I	2 minutes

This table lists the final prioritized order of all proposed improvements based on their total scores from Table 9. The highest-ranking suggestions—such as employee training and regular engine temperature checks—are identified as the most critical to implement, ensuring that resources are focused on the most effective quality-enhancing measures.

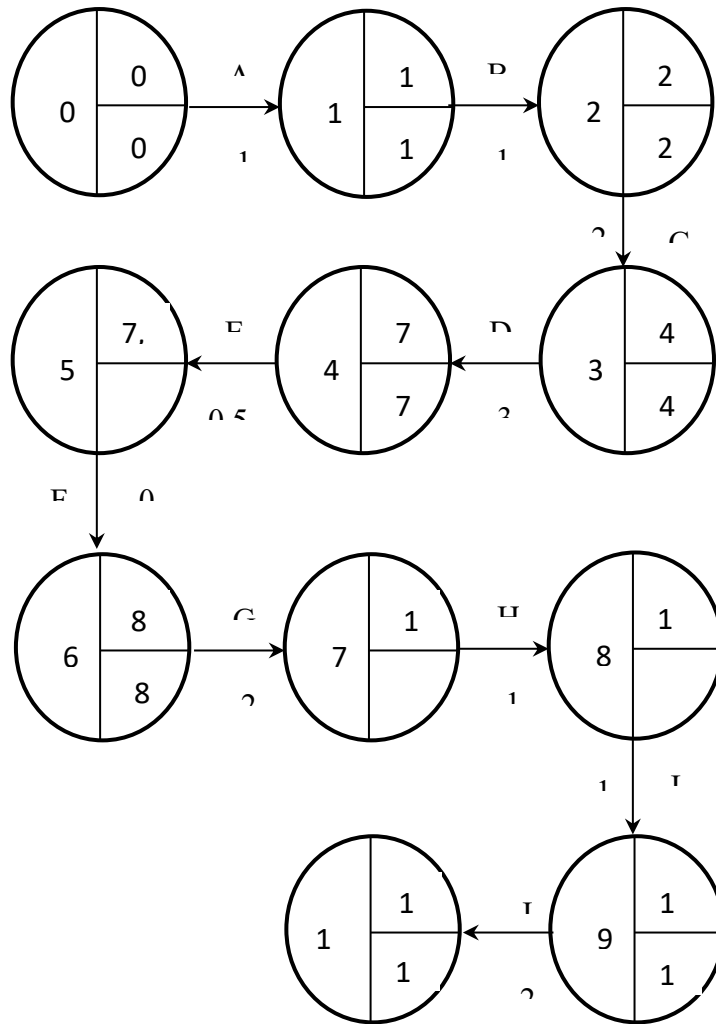


Figure 4. Flowchart for Decision Making

The diagram presents an organized sequence of operations which describe the complete silencer manufacturing process starting with material preparation through product storage. The diagram presents an ordered schedule which details all processes starting with color mixing then follows with injection molding followed by cooling then cutting and includes quality control and packing steps at the end. Through its visualization design the flowchart displays task relationships to determine points where delays and inefficient processes or defects may arise. The figure provides essential support to improve scheduling and monitoring and decision-making because it displays the entire production process thus enabling defect reduction while increasing workflow efficiency.

### Process Decision Program Chart

*Process Decision Program Chart* is a tool used to determine the feasibility of a solution to be applied to the company first, which has been formulated in *tree diagram*. The New Seven Tools analysis conducted in this study shows multiple interconnected elements that result in the continuous 10% defect rate observed in silencer production at PT. XYZ. The 10% defect rate demonstrates fundamental problems within all aspects of human resources management and machine maintenance as well as environmental control systems and operational methods and materials handling. Studies show product quality needs to be investigated in its entirety for industrial applications by handling technical elements alongside organizational along with procedural aspects.

The collected data shows that human-related errors occur frequently during operations. The production floor displays operational shortcomings indicating knowledge gaps as well as

weak operational discipline due to cases of parameter missettings and inconsistent injection practices and non-thorough cleaning procedures being observed. Mehra and Agrawal (2003) explain that human variables serve as the most unpredictable yet amendable production system components. Product complexity becomes challenging for workers because their operations lack structured training combined with a feedback learning system. The authors of Lestari and Purwatmini (2021) state that organizations primarily reach long-lasting quality improvements through consistent employee progression throughout workflow environments with high process variability.

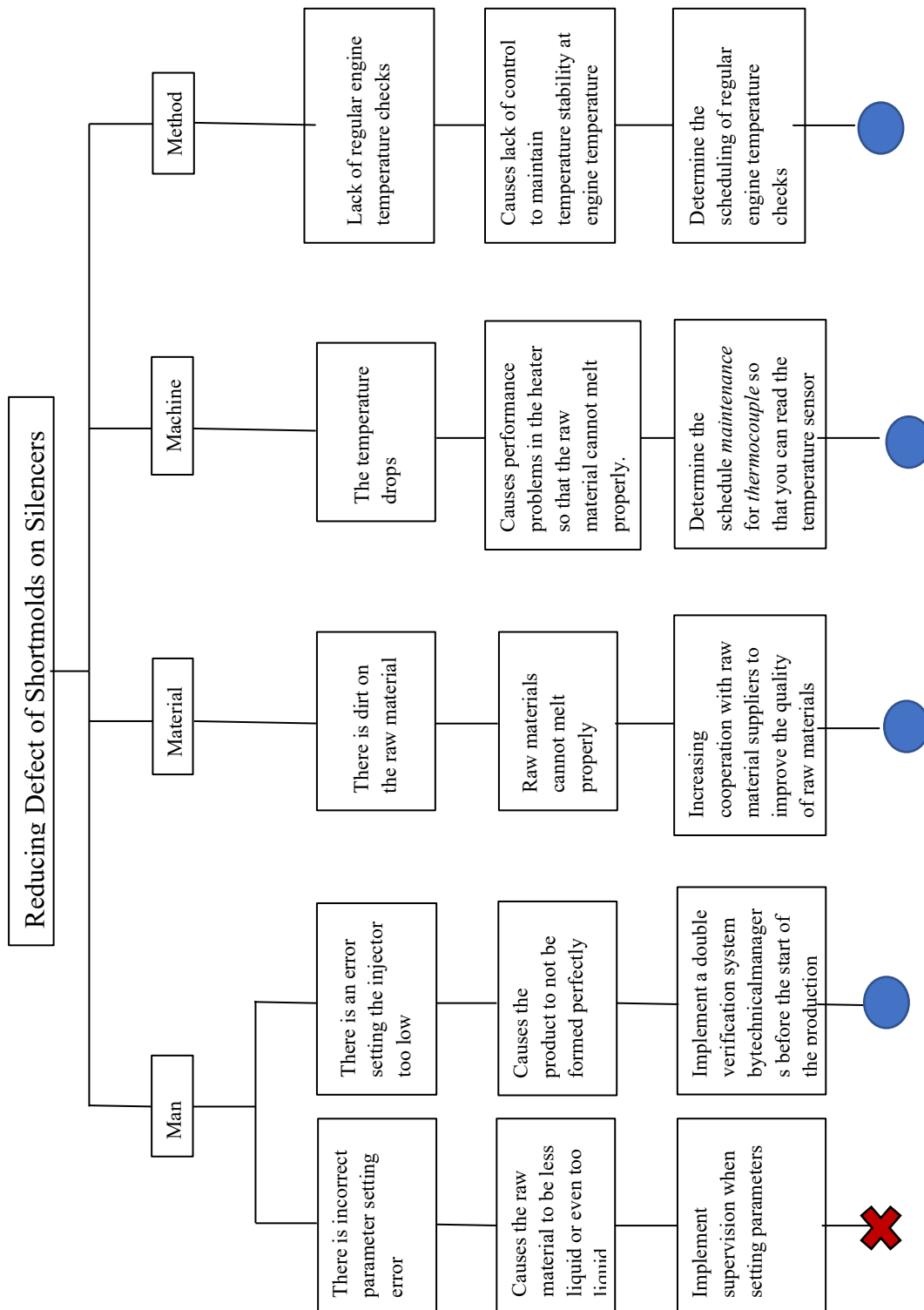


Figure 5. Hierarchical Structure in Decision Making

Product defects result significantly from mechanical equipment breakdowns. The over-temperature conditions and temperature fluctuations and inadequate thermocontrol systems diminish the performance of plastic injection machines thus negatively affecting product consistency. The results indicate that better preventive maintenance procedures should be implemented at PT. PT XYZ does not conduct their processes with adequate operational intensity. The article by Alzoubi et al. (2022) points out that equipment reliability stems from predictive diagnostic approaches which identify equipment issues before they escalate. Setiawan and Nuryanto (2023) prove structured maintenance practice together with advanced sensor controls help minimize mechanical problems by 35%. The Process Decision Program Chart identified points in the system for effective thermal inconsistency control by integrating regular monitoring and improved protective components.

Environmental variables were confirmed as crucial elements for product quality degradation although researchers usually handle them as secondary factors. The quality outcomes of products showed adverse effects from ambient temperature variations together with dust accumulation and loud noise environments. According to Islam (2005) the stability of the environment should be recognized as an essential production input. Raw materials undergo direct contamination from environmental dust which simultaneously endangers essential mechanical components in ways that reduce their operational performance. The study results demonstrate that PT. XYZ suffers from this factor. The company should reassess its actual layout arrangements combined with air filter systems to reduce possible operational risks.

The study uncovered additional proof of inadequate quality control mechanisms when it found that standard operating procedures should be established for inspecting raw materials and establishing machine settings. A production process lacking specific mandatory standards enables a free expansion of variability throughout the system (Javaid t al., 2022; Lu et al., 2016). Operational standardization serves as an essential component for reducing the direction of freedom which generate quality deviations according to Nazia and Fuad (2023). Shortmold and overcut defects seem to have been affected by unstructured inspection protocols which probably caused variations in both material integrity and injection parameters.

Matrix Data Analysis combined with the Interrelationship Diagram makes this study strong because it uses both causal complexity and implementation feasibility to establish improvement action prioritization. Employee training along with raw material inspection and thermocontrol calibration received priority status because they comprise the system's most defenseless aspects. The systematic method for corrective action matches the concepts of Total Quality Management (TQM) as described by Ramiawati (2020) because it integrates continuous feedback and employee participation while maintaining strategic process alignment. The researchers utilized the PDPC tool to identify implementation risks and resistance points prior to execution as these areas are commonly neglected in quality improvement implementations.

The study would gain additional depth if it included risk prioritization through the combination of statistical tools like the DMAIC cycle and FMEA from Six Sigma. The diagnostic attributes of the New Seven Tools receive added strength through the integration of measurement-based rigor according to Rifaldi and Sudarwati (2024). The research revealed key defect factors yet failed to establish process capability measurement standards such as Cp and Cpk because these metrics could enhance the understanding of system stability.

The wider organizational situation needs careful evaluation. Quality improvement initiatives that lack human and organizational considerations will fail to achieve their sustainable goals (Adhikari & Shrestha, 2023; Hajian & Kashani, 2021). Competitive market customer satisfaction relies on both product specifications and the consistent delivery of superior performance according to Matzler and Hinterhuber (1998). All technical solutions

implemented for quality improvement must be accompanied by culture transformation alongside changes in accountability systems and incentive frameworks. The approach holds maximum importance for PT operations. The rapid transformation of dissatisfied customers because of quality failures results in harmed reputation and poor customer satisfaction for PT. XYZ. The research contributes value to industrial quality management discussions by confirming that the systemized application of the New Seven Tools maintains their relevance. Effective implementation of chosen tools stands as the true test rather than finding the most advanced methodology. Lafeniya and Suseno (2023) demonstrate through akin examples that the worth of such tools results from their capability to simplify complex operational problems.

## Conclusion

Based on previously obtained data, the most dominant product defects are excess cutting defects (Overcut) as many as 12,502 pcs, uneven defects (Shortmold) as many as 8938, silver defects as many as 280, decock defects as many as 6603, and black spot defects as many as 749. Factors that influence product defects are factors. The human error that dominates is a lack of accuracy. The dominant material error is due to contamination of the raw material. The most dominant error based on the engine is decreased injection power. The error based on the method is the lack of periodic temperature checks. Errors based on the environment are the influence of noise. Based on Process Decision Program Chart, proposed improvements that can be implemented in the company are implementing supervision when setting parameters, implementing a double verification system, providing injection setting training, implementing checklists, providing employee training to handle complicated products, increasing cooperation with raw material suppliers, tightening supervision, determining schedules. maintenance, do a check thermocontrol, carry out machine maintenance paying attention to heater protectors, control machine injection, determine periodic checks, set operational standards, change the flow for the product cutting process, place raw materials in closed warehouses, install heater protectors, carry out layout design.

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