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Improvement Of Material Quality In The Warehouse Using The Failure Mode And Effect Analysis (FMEA) And 5W+1H Methods At PT XYZ

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Abstract

PT. XYZ is a manufacturing company specializing in the production of disc brakes and mufflers. This study identifies issues within the management of the M2FW Raw Material warehouse at PT. XYZ, stemming from the suboptimal implementation of the First-In, First-Out (FIFO) system. The failure to maintain an effective FIFO system has led to several serious problems, including material damage due to corrosion, discrepancies between recorded data and actual physical stock, and poor warehouse maintenance regarding cleanliness and organization. These findings underscore the urgent need for systemic and procedural improvements to ensure operational efficiency and prevent further losses.This research utilizes a quantitative descriptive approach using the Failure Mode and Effect Analysis (FMEA) method to evaluate failure risks, alongside a 5W+1H analysis to identify root causes. Data collection results during the research indicate the presence of 465 pieces of Not Good (NG) products (0.17% of total stock) with total losses reaching IDR 8,688,270.97, as well as a physical stock discrepancy of 302 pieces. Based on the FMEA analysis, work methods that deviate from standard operating procedures were identified as the most critical failure factor, yielding the highest Risk Priority Number (RPN) of 270. Applying a Kaizen approach, the proposed improvements include: standardizing methods through daily checksheets for 5S and FIFO control; implementing a structured warehouse area monitoring schedule; and categorizing supplier delivery schedules based on part size (small, medium, large) to streamline the storage process. The implementation of these steps is expected to minimize financial losses, improve stock data accuracy, and ensure operational fluidity in accordance with Standard Operating Procedures (SOP).

Keywords: Warehouse, 5W+1H, FMEA, FIFO, NG Material, Kaizen.

INTRODUCTION

For a company, improving productivity is crucial to the success of business processes, as it enables the company’s profits to reach an optimal level. One example of productivity improvement is evaluating the performance of a company’s operational systems. FIFO, or *First In, First Out*, is one of the inventory management systems used to regulate the flow of goods and information across various fields, including accounting, logistics, and information systems. The basic concept of FIFO is that items that enter the system first are the first to be issued. This method is particularly important to ensure that products especially those with limited shelf lives are processed and utilized efficiently, thereby reducing the risk of losses due to corrosion or discrepancies between physical parts and recorded data.

PT XYZ operates in the manufacturing industry, producing disc plates and mufflers for both two-wheeled and four-wheeled vehicles. In carrying out its operations, particularly in the warehouse section where the supply to production must be performed at a relatively fast pace, an accurate and safe work process is essential. The warehouse employs a total of 11 workers on the morning shift and 7 workers on the second shift, with an additional 2 workers on each shift serving as leader and checker. Due to the relatively small number of workers compared to the number of production lines supplied, warehouse personnel must rotate responsibilities in managing the activities of the Raw Material Muffler 2 Wheels (MF2W) warehouse, an area dedicated to storing parts for two-wheeled muffler production. However, in practice, warehouse operations continue to experience constraints, as the FIFO system has not been implemented optimally. As a result, several serious issues have emerged, disrupting the smooth operation of production and overall operations.

One of the main problems arising from the ineffective implementation of FIFO is material corrosion. Materials that should have been used promptly become classified as *Not Good* (NG) because they are not supplied according to their order of arrival, ultimately resulting in financial losses for the company. Although some materials can occasionally be reworked, the repair process requires additional time and costs, which in turn delays warehouse activities and disrupts overall production flow. Furthermore, the failure to implement FIFO effectively has led to discrepancies between administrative records and physical stock levels. These discrepancies complicate stock-taking processes and have the potential to cause more serious recording issues. Such problems are exacerbated by the lack of regular supervision and evaluation. Without periodic inspections, issues related to cleanliness, damage, and improper arrangement are allowed to persist. Investigations into the causes of NG products and data discrepancies, conducted with the assistance of warehouse staff, revealed that some parts had been stored in the warehouse for extended periods despite being regularly used in production. Other contributing factors included items not being placed on their designated racks, making them difficult to locate during inventory counting or shipment preparation. Errors during data input or receipt of goods from suppliers, as well as insufficient accuracy among employees when counting quantities, were also identified as contributing factors.

To address these complex and interrelated problems, this study adopts a systematic improvement approach by integrating two well-established quality analysis methodologies: Failure Mode and Effect Analysis (FMEA) and the What, Why, When, Who, Where, and How (5W+1H) method.

This research integrates FMEA and 5W+1H as a framework for problem analysis and solution design. FMEA is employed to process data by analyzing the relationship between potential failure modes and the resulting defect effects. The primary focus of FMEA is to determine severity levels and safety risks in order to systematically identify the root causes of problems. Subsequently, priority levels are established by calculating the Risk Priority Number (RPN), which is obtained by multiplying the parameters of severity, occurrence, and detection. Problems with the highest RPN scores are designated as top priorities requiring immediate corrective action.

To further deepen the analysis, the 5W+1H method is applied in two stages: first, to explore the root causes of problems in greater detail (problem analysis), and second, as a tool for formulating targeted improvement proposals. Through the 5W+1H approach, each priority issue identified by FMEA is translated into a comprehensive action plan that encompasses technical aspects, responsible parties, and implementation mechanisms, with the ultimate goal of eliminating NG products in the Raw Material MF2W warehouse of PT XYZ.

RESEARCH METHODS

This study employed a quantitative descriptive approach using a case study method, focusing on the MF2W Raw Material warehouse at PT XYZ to identify the causes of the suboptimal implementation of the FIFO system, which resulted in the occurrence of *Not Good* (NG) materials, stock data discrepancies, and inadequate warehouse conditions. Data were collected during the period of 15 November–15 December 2025 through direct observation and interviews with warehouse operators, team leaders, and section heads, and were supported by secondary data obtained from relevant literature and company archives. Data processing was carried out by integrating the 5W+1H method to identify root causes in depth and the Failure Mode and Effect Analysis (FMEA) method to assess risk levels by determining Severity, Occurrence, and Detection scores, resulting in the calculation of the Risk Priority Number (RPN). Issues with the highest RPN values were then prioritized for improvement using a Kaizen approach. The research stages included observation, literature review, data collection and processing, analysis and discussion of findings, and the formulation of conclusions and improvement recommendations aimed at reducing NG material levels and enhancing the performance of the FIFO system in the warehouse.

RESULTS AND DISCUSSION

Analysis and Discussion

5W+1H Analysis

The 5W+1H method was used to analyze the causes of problems occurring in the MF2W warehouse during the period of 15 November–15 December 2025. The following sections describe the identified causes based on environmental, human, and material factors.

Table 1. 5W+1H Analysis of Environmental Factors

Factor	5W+1H	Type	Description
Environment	What	What is happening in the warehouse area?	Limited warehouse space; several materials are not placed on storage racks.
	Why	Why does this occur?	Some racks do not have name tags, resulting in them being left empty or filled with inappropriate parts.
	Where	Where does this occur?	MF2W Warehouse
	When	When does this occur?	During storage and retrieval of parts in the warehouse.
	Who	Who is involved?	All warehouse employees.
	How	How does the problem occur?	Due to full racks and unlabelled racks, suppliers place materials on the floor or on unlabelled racks to expedite unloading.

Source: Author's Research Results, 2026

The current condition of the MF2W warehouse area is disorganized due to limited rack capacity and the absence of rack identification labels (name tags), which forces suppliers to place materials on the floor or on unlabelled racks to accelerate loading and unloading activities. This situation is exacerbated by low employee awareness in taking corrective actions toward these abnormal conditions, particularly during storage and retrieval processes.

Table 2. 5W+1H Analysis of Human Factors

Factor	5W+1H	Type	Description
Human	What	What is happening in the warehouse area?	Employee workload increases because suppliers do not comply with warehouse storage SOPs.
	Why	Why does this occur?	Lack of supervision in the warehouse area.
	Where	Where does this occur?	MF2W Warehouse
	When	When does this occur?	During storage and retrieval of parts in the warehouse.
	Who	Who is involved?	Employees and suppliers.
	How	How does the problem occur?	Insufficient supervision allows suppliers to ignore storage SOPs, resulting in additional workload for employees to reorganize the disordered area.

Source: Author's Research Results, 2026

The problem originates from inadequate supervision of operational activities, which is exploited by suppliers to disregard established storage standard operating procedures (SOPs). This disorder occurs during both placement and retrieval of goods, forcing warehouse employees to bear additional workload to reorganize the cluttered area.

Table 3. 5W+1H Analysis of Material Factors

Factor	5W+1H	Type	Description
Material	What	What is happening in the warehouse area?	Material racks fill up quickly.
	Why	Why does this occur?	The size of material boxes does not match rack dimensions; some boxes are not fully filled and are relatively light.
	Where	Where does this occur?	MF2W Warehouse
	When	When does this occur?	During part storage in the warehouse.
	Who	Who is involved?	All warehouse employees.
	How	How does the problem occur?	Storage becomes inefficient because some boxes are partially filled and lightweight, combined with non-standard box dimensions that do not fit rack sizes, preventing tight stacking and causing racks to reach capacity more quickly.

Source: Author's Research Results, 2026

Racks in the MF2W warehouse often reach capacity quickly due to material box dimensions that do not match rack sizes, preventing compact stacking. Additionally, many boxes are partially filled and lightweight, creating the impression that racks are already full even though the actual quantity of stored items is relatively low. This condition makes it difficult for warehouse employees to store incoming goods, ultimately leading to material accumulation in transit areas due to the lack of available rack space.

Table 4. 5W+1H Analysis of Method Factors

Faktor	5W+1H	Jenis	Keterangan
Metode	What	What is occurring in the warehouse area?	Frequent discrepancies between recorded data and physical inventory.
	Why	Why does this occur?	Inadequate implementation of standard operating procedures (SOPs) in the warehouse area.
	Where	Where does this occur?	MF2W Warehouse
	When	When does this occur?	During inventory control activities in the warehouse.
	Who	Who is involved?	All warehouse employees.
	How	How does the problem occur?	– Materials are not placed on their designated racks, causing their locations to be unknown during counting. – Errors occur during data entry for part receipt from suppliers. – Errors occur during data entry for parts issued to the production area.

Source: Author's Research Results, 2026

The recurring discrepancies between recorded data and actual inventory observed during stock opname activities in the MF2W warehouse are caused by insufficient dissemination of clear work instructions to all warehouse employees. This condition leads to inaccurate placement of materials on designated racks and data entry errors during both the receipt of components from suppliers and the recording of material issuance to the production area.

Based on the 5W+1H analysis above, the root causes for each factor were identified and are summarized in Table 5.

Table 5. Root Causes Identified through 5W+1H Analysis

Factor	Root Cause
Environment	Limited warehouse area and the absence of name tags on several racks.
Human	Suppliers' non-compliance with warehouse storage SOPs due to insufficient supervision.
Material	Material box dimensions that do not match rack sizes; some boxes are partially filled and relatively light.
Method	Inadequate implementation of SOPs in the warehouse area.
Environment	Limited warehouse area and the absence of name tags on several racks.

Source:Author's Research Results, 2026

Failure Mode and Effect Analysis (FMEA)

This study employed the Failure Mode and Effect Analysis (FMEA) method to process and analyze data by examining the relationship between potential failure modes and the resulting defect effects. The primary focus of FMEA application was to determine severity scores and safety risks, encompassing the identification of root causes and the design of appropriate corrective actions for each type of failure.

Priority levels were subsequently established by calculating the Risk Priority Number (RPN), obtained from the multiplication of severity, occurrence, and detection parameters. Failure modes with the highest RPN values were designated as top priorities requiring immediate corrective action.

Table 6. Failure Mode and Effect Analysis (FMEA)

Failure Mode	Factor	Cause of Failure	S	O	D	RPN	Rank
FIFO system not operating optimally	Environment	Limited warehouse area and absence of name tags on several racks.	5	6	2	60	4
	Human	Suppliers' non-compliance with warehouse storage SOPs due to lack of supervision.	8	7	6	336	2
	Material	Material box sizes not compatible with rack dimensions; some boxes are partially filled and lightweight.	6	7	4	168	3
	Method	Inadequate implementation of SOPs in the warehouse area.	8	9	7	504	1

Source: Processed Data, 2025

Description:
S : *Severity*
O : *Occurance*
D : *Detection*
RPN : Risk Priority Number

RPN: *Severity* (S) x *Occurrence* (O) x *Detection* (D)

Detailed Explanation of Each Score:

a. Method (Score 504):

The method factor has the highest RPN value, as it represents a systemic failure. Without strict implementation of standard operating procedures (SOPs), there are no binding operational standards governing either internal personnel or external suppliers.

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b. Human (Score 336):
   This issue ranks second in priority. Weak supervision creates opportunities for external parties (suppliers) to disregard storage standards. The impact directly affects data accuracy and the quality of material arrangement in the warehouse.
c. Material (Score 168):
   This factor has a lower RPN value because its impact primarily relates to space inefficiency. In addition, the issue is physical in nature, making it easier to detect visually by warehouse personnel during the receipt of goods.
d. Environment (Score 60):
   This issue has the lowest RPN value. Although it hinders the speed of material retrieval, the risk is the easiest to mitigate through simple corrective actions (such as labeling) and has a very high level of detectability.
   Based on Table 6, data processing has been conducted and the Risk Priority Number (RPN) values have been determined for each potential cause of failure. The FMEA results indicate that the method factor poses a higher risk of failure compared to the other factors.

Kaizen

To reduce the occurrence of non-good (NG) materials in the warehouse resulting from the suboptimal implementation of the FIFO system, the Kaizen method was applied using a 5W+1H analytical approach. This method was employed to further explore potential failure causes based on data derived from the RPN (Risk Priority Number) analysis. Through this approach, the primary causes could be identified in a more focused manner, particularly those related to the method factor.

Based on the analysis results, several solutions were formulated to address issues arising from methodological aspects that contribute to the ineffective implementation of FIFO. The detailed proposed improvements are presented in the following table.

Table 7. Proposed Improvements Based on 5W+1H Analysis

Main Causal Factor	5W+1H	Description	Action
Methods not in accordance with SOP standards	What	What is the objective of the improvement?	To reduce non-good (NG) materials and data discrepancies occurring in the warehouse area.
	Why	Why is the improvement necessary?	To standardize work processes in order to eliminate potential data input errors and to ensure that material quality is maintained in accordance with established quality standards.
	Where	Where will the improvement be implemented?	In the MF2W warehouse area of PT. XYZ.
	When	When will the improvement be implemented?	The improvement will be implemented starting January 4, 2026.
	Who	Who will carry out the improvement?	All employees in the warehouse area.
	How	How will the improvement be implemented?	– Conducting socialization regarding the correct warehouse SOP. – Establishing a control schedule for the warehouse area and developing a warehouse checksheet. – Implementing 5S activities routinely at the end of each shift. – Regulating the arrival of goods from suppliers by grouping deliveries into small parts, medium parts, and big parts.

Source: Processed Data, 2025

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The implementation of the Kaizen results using the 5W+1H method is carried out by developing a daily checksheet that must be completed by warehouse employees on a rotating basis according to the established daily control schedule, as well as by grouping the arrival of parts from suppliers. Detailed solutions are presented in the following figures and tables.

Daily Checksheet

Based on Figure 1, the daily checksheet for the MF2W warehouse area is designed as a measurable control tool covering two main aspects, namely cleanliness and layout, as well as occupational safety and health. In the cleanliness and layout section, the checksheet specifically verifies compliance with FIFO principles by ensuring that materials placed at the front or top positions are those that arrived first, and by confirming that each rack is equipped with an appropriate name tag. In addition, this document regulates daily operational standards, including floor cleanliness, waste bin emptying, and the proper placement of work equipment (such as forklifts and handlifts) within designated zones to prevent operational obstructions.

Checksheet Harian Area Gudang MF2W																																
No.	Pengecekan	Tanggal Pengecekan																				Bulan :					Tahun :					
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
I.	Kebersihan & Tata Letak																															
1	Lantai gudang bersih dari sampah, debu																															
2	Jalur pejalan kaki (*pedestrian line*) bebas dari hambatan atau barang.																															
3	Tempat sampah dikosongkan dan berada di posisinya.																															
4	Tidak ada barang yang diletakkan langsung di atas lantai (wajib di atas palet/rak).																															
5	Pastikan ada *name tag* disetiap rak																															
6	Barang yang depan/atas adalah barang kedatangan paling awal atau sesuai prinsip *First In - First Out* (FIFO)																															
7	Semua barang berada dirak yang ditentukan																															
8	Handlift berada ditempat yang disediakan																															
9	Forklift berada ditempat yang disediakan																															
10	Tempat Alat Pelindung Diri (APD) lengkap dan terisi sesuai standar																															
II.	Keamanan dan Keselamatan Kerja																															
1	Alat Pemadam Api Ringan (APAR) dalam kondisi baik dan tidak terhalang material.																															
2	Kotak P3K lengkap dan mudah dijangkau																															
3	Lampu area gudang berfungsi semua (tidak ada yang redup atau mati)																															
4	Karyawan menggunakan Alat Pelindung Diri (APD) lengkap (sepatu *safety*, sarung tangan, *back support*)																															
5	*Lift* Barang berfungsi secara optimal																															
	PIC																															
	Leader																															

Figure 1. Daily Checksheet for the Warehouse Area

Daily Control Schedule Allocation

The number of employees in the MF2W warehouse at PT. XYZ consists of 11 workers on shift 1 and 7 workers on shift 2, with 2 individuals assigned as leaders and checkers in each shift. The results of the daily control schedule allocation for the warehouse area are presented in Table 8.

Table 8. Daily Control Schedule for MF2W Warehouse Area

Manpower	Week 1	Week 2	Week 3	Week 4
Staff 1–4	Shift 1 (A)	Shift 1 (B)	Shift 2 (C)	Shift 1 (Monthly Stock Opname)
Staff 5–9	Shift 1 (B)	Shift 2 (C)	Shift 1 (A)	Shift 1 (Monthly Stock Opname)
Staff 10–14	Shift 2 (C)	Shift 1 (A)	Shift 1 (B)	Shift 2 (5S)

Daily Control Schedule Codes:
A: Focus on 5S activities in the MF2W warehouse area
B: Conducting daily stock opname
C: Continuing daily stock opname and data recapitulation
In the fourth or final week, activities are focused on monthly stock opname for shift 1, while shift 2 is focused on implementing 5S activities in the warehouse area.

Grouping of Part Arrivals from Suppliers

To facilitate the storage process of parts in the warehouse area, a delivery schedule was established by grouping arrivals into small parts, medium parts, and big parts. The results of the part arrival schedule grouping are presented in Table 9.

Table 9. Grouping of Part Arrivals from Suppliers

Grouping of Part arrivals from suppliers	
Monday	*Big Part, Medium Part*
Tuesday	*Small Part, Medium Part*
Wednesday	*Big Part*
Thursday	*Small Part, medium Part*
Friday	*Big Part*

CONCLUSION

Based on the research findings, it can be concluded that:

1. The suboptimal implementation of the FIFO system in the Raw Material MF2W warehouse resulted in tangible losses in the form of 465 pieces of corroded *Not Good* (NG) materials (0.17% of total stock), with a total financial loss of IDR 8,688,270.97 within one month. In addition, a stock discrepancy of 302 pieces was identified between administrative records and actual inventory, with the largest loss occurring in the Joint Half A/B parts. These findings were subsequently analyzed to identify their root causes using the 5W+1H method. Through this approach, the causes of FIFO system failure in the warehouse area were identified more clearly.
2. Based on the results of the Failure Mode and Effect Analysis (FMEA), improper work methods that do not comply with standard operating procedures were identified as the most critical cause of system failure, with a Risk Priority Number (RPN) of 504 calculated based on severity, occurrence, and detection levels. This factor was therefore designated as the highest priority for corrective action.

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