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Improving Stock Opname Accuracy Using Six Sigma DMAIC at PT. Citra Plastik Makmur

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Abstract. Akurasi persediaan memiliki peran penting dalam mendukung keandalan gudang, perencanaan produksi, dan pengendalian material pada perusahaan manufaktur. PT Citra Plastik Makmur mengalami ketidaksesuaian berulang antara stok fisik dan data sistem pada proses stock opname produk Cover Housing Remote Control. Penelitian ini bertujuan untuk menganalisis penyebab selisih stock opname dan memberikan usulan perbaikan menggunakan metode Six Sigma DMAIC. Penelitian ini menggunakan pendekatan kuantitatif deskriptif berdasarkan data stock opname periode Januari sampai Desember 2024. Data dianalisis melalui tahapan Define, Measure, Analyze, Improve, dan Control dengan alat bantu SIPOC, Critical to Quality, check sheet, p-control chart, diagram Pareto, DPMO, level sigma, fishbone diagram, dan analisis 5 Why's. Hasil penelitian menunjukkan total selisih sebesar 691 pcs dari total stok sistem sebanyak 35.567 pcs. Quantity Error menjadi faktor dominan dengan jumlah 387 pcs atau 56,01% dari total selisih, diikuti oleh Part Defect dan Part Terjatuh. Usulan perbaikan meliputi penguatan verifikasi data stok, peningkatan pelatihan operator, pemisahan area penyimpanan defect, peningkatan pengawasan material handling, dan standarisasi prosedur gudang untuk meningkatkan akurasi persediaan.

Keywords: Akurasi Persediaan; DMAIC; Quantity Error; Six Sigma; Stock Opname.

1. INTRODUCTION

Inventory accuracy is essential in manufacturing because production planning, material control, warehouse performance, and delivery reliability depend on reliable stock records. Inaccurate inventory data can create discrepancies between physical stock and system stock, which may disrupt material availability, increase rechecking activities, reduce warehouse efficiency, and affect production decisions. These discrepancies commonly arise from recording errors, weak verification, human error, unreported damaged goods, and inconsistent warehouse procedures (Nur Annisa et al., n.d.; Manurung et al., 2024; Purba & Manurung, 2021).

PT Citra Plastik Makmur is a plastic manufacturing company that produces injection molding components for electronic products, including Cover Housing Remote Control. This product has high material movement in the finished goods warehouse, covering receiving, storage, internal transfer, stock checking, and stock opname activities. Based on preliminary observation and company data, repeated discrepancies occurred from January to December 2024 and were classified into Quantity Error, Part Defect, and Part Dropped. Quantity Error refers to differences between physical quantity and system records, Part Defect refers to damaged products that affect stock records, and Part Dropped refers to products that fall during

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handling, storage, or transfer. Table 1 presents the stock opname discrepancy data for Cover Housing Remote Control products in 2024.

Table 1. Stock Opname Discrepancy Data of Cover Housing Remote Control in 2024.

Month	System Stock (pcs)	Quantity Error (pcs)	Part Defect (pcs)	Part Dropped (pcs)	Total Discrepancy (pcs)	Percentage (%)
January	1,142	39	12	9	60	5.25
February	2,467	27	16	12	55	2.23
March	2,418	26	8	10	44	1.82
April	1,253	38	17	11	66	5.27
May	2,789	35	12	13	60	2.15
June	3,192	29	10	10	49	1.54
July	1,364	30	12	14	56	4.11
August	3,689	25	14	12	51	1.38
September	3,630	23	11	11	45	1.24
October	4,092	33	16	8	57	1.39
November	4,790	40	22	10	72	1.50
December	4,741	42	24	10	76	1.60
Total	35,567	387	174	130	691	29.48
Average	2,963.92	32.25	14.50	10.83	57.58	2.46

Source: PT Citra Plastik Makmur Stock Opname Data, 2024.

Table Table 1 shows that the total system stock in 2024 reached 35,567 pcs, with a total discrepancy of 691 pcs. The average monthly discrepancy was 57.58 pcs or 2.46%. The highest discrepancy occurred in April at 5.27%, followed by January at 5.25% and July at 4.11%. Quantity Error was the largest category with 387 pcs, followed by Part Defect with 174 pcs and Part Dropped with 130 pcs. These results indicate that the main problem was not only related to product damage or handling loss, but also to inaccurate stock quantity recording.

Previous studies show that Six Sigma DMAIC can reduce stock opname discrepancies and improve inventory accuracy through structured problem identification, measurement, root cause analysis, and improvement planning. DMAIC has been applied to minimize differences between system records and actual warehouse stock, improve warehousing operations through SIPOC, Ishikawa diagram, root cause analysis, and 5 Why's, and identify stock discrepancy causes such as human error, manual recording, weak supervision, and inconsistent warehouse procedures (Candra & Dewantoro, 2025; Apri Setiani et al., n.d.; Manurung et al., 2024).

Although Six Sigma DMAIC has been widely used in quality control and inventory improvement, studies on stock opname accuracy in plastic manufacturing companies remain limited. Most previous studies focus on product defects, retail inventory, spare parts, or general warehouse discrepancies (Manurung et al., 2024). Few studies analyze Quantity Error, Part Defect, and Part Dropped in plastic injection molding products, even though plastic components are vulnerable to scratches, deformation, defects, and handling damage during storage and movement. Therefore, this study applies Six Sigma DMAIC to improve stock opname accuracy at PT Citra Plastik Makmur by measuring discrepancy levels, identifying dominant causes, analyzing root causes, and proposing practical control actions for Cover Housing Remote Control products.

2. THE ORETICAL REVIEW

Inventory Management and Inventory Accuracy

Inventory Inventory management ensures that materials and finished goods are available in the right quantity, time, and location to support production planning, purchasing, warehouse control, and delivery activities. When inventory records do not match physical stock, companies may face production delays, repeated checking, inaccurate material planning, and higher operational costs. Therefore, inventory accuracy becomes an important indicator of warehouse performance and supply chain reliability (Caballero-Morales & Bonilla-Enriquez, 2022;Nur Annisa et al., 2021).

Inventory accuracy refers to the conformity between physical stock and system records. High accuracy indicates that warehouse transactions, material movements, storage, and stock recording are well controlled. Low accuracy shows process variation, such as input errors, unrecorded movements, damaged items, incorrect product locations, or weak verification. In this study, inventory accuracy is measured through the discrepancy between system stock and physical stock in the stock opname process of Cover Housing Remote Control products (Persediaan et al., 2021).

Stock Opname and Inventory Discrepancy

Stock opname is a physical counting activity used to compare actual warehouse stock with inventory system records. It helps companies identify stock differences, evaluate warehouse discipline, detect material recording errors, and assess whether the inventory system is reliable for production and operational decisions. When differences between physical stock and system stock occur repeatedly, companies need to identify root causes and improve related warehouse procedures (Rizaldy et al., 2025); (Kurnia et al., 2022).

Inventory discrepancies may result from human error, inaccurate input, manual recording, unrecorded incoming or outgoing goods, weak stock verification, unseparated damaged goods, and material handling problems. Previous studies show that recording discipline and warehouse procedure consistency strongly affect inventory accuracy. Stock differences in spare part inventory were influenced by inaccurate records, mismatch between system data and actual stock, and difficulties in item tracing, while other discrepancies came from unrecorded outgoing goods, unrecorded returned goods, incorrect input, and different part numbers (Junianto et al., 2021; Irfan et al., 2025).

In plastic manufacturing, inventory discrepancies become more complex because finished goods may be scratched, cracked, deformed, dropped, or mixed with normal stock when defect control is weak. Therefore, stock opname is not only a counting activity, but also a control activity that checks quantity, product condition, and handling safety. This study classifies discrepancies into three categories: Quantity Error, Part Defect, and Part Dropped.

Six Sigma DMAIC

Six Sigma is a data-driven process improvement method used to reduce variation, minimize defects, and improve process capability. In warehouse and inventory management, this method helps companies evaluate inventory errors, identify dominant discrepancy factors, and design improvement actions based on measurable evidence (Rizaldy et al., 2025).

The main framework in Six Sigma is DMAIC, which consists of Define, Measure, Analyze, Improve, and Control. The Define phase identifies the problem, process scope, and Critical to Quality. The Measure phase evaluates current performance using data collection and statistical measurement. The Analyze phase identifies root causes using tools such as Pareto diagram, Fishbone diagram, and 5 Why's. The Improve phase develops corrective actions, while the Control phase maintains improvements through standard procedures, monitoring, audits, and documentation (Ramadhani & Ifalda, 2025).

In this study, Six Sigma DMAIC is used to analyze stock opname accuracy through check sheet, discrepancy proportion, p-control chart, DPO, DPMO, yield, and sigma level. DPMO measures defects per one million opportunities, while sigma level shows process capability in reducing defects. These measurements indicate whether the stock control process is stable and capable of supporting accurate inventory records.

Previous Studies and Research Gap

Several previous studies have applied DMAIC and Six Sigma to inventory discrepancy and warehouse improvement problems. These studies show that DMAIC can be used to identify dominant causes, measure process performance, and design improvement actions for stock accuracy. To clarify the position of this research, several relevant studies are summarized in Table 2.

Table 2. Summary of Previous Studies Related to Stock Opname and Six Sigma DMAIC.

Author(s)	Research Focus	Method	Main Finding	Relevance to This Study
Annisa 2021 (Nur Annisa et al., 2021)	Discrepancy between inventory system and actual stock in finished goods warehouse	DMAIC	DMAIC helped identify dominant factors causing *stock opname* mismatch	Supports the use of DMAIC for *stock opname* discrepancy
(Caballero-Morales & Bonilla-Enriquez, 2022)	Inventory and warehousing improvement in a bottling company	Six Sigma DMAIC	DMAIC improved inventory-related warehouse operations using SIPOC, Ishikawa diagram, root cause analysis, and 5 Why's	Supports DMAIC tools for inventory and warehouse improvement
Manurung et 2024(Manurung et al., 2024a)	Stock opname discrepancy in spare part inventory	Six Sigma and Kaizen	Discrepancy was caused by inaccurate records, mismatch between system and physical stock, and poor item tracking	Supports analysis of stock discrepancy and recording accuracy
(Stevani Agatha Yudiantoro & Mega Cattleya PA Islami, 2024a)	Causes of stock opname discrepancy in consumable goods	DMAIC	Main causes included unrecorded outgoing goods, unrecorded returns, incorrect input, and part number mismatch	Supports root cause analysis of inventory data mismatch
Candra and Dewantoro 2025 **(Candra & Dewantoro, 2025)**	Stock opname control and inventory record accuracy	DMAIC	DMAIC improved stock opname control and reduced mismatch between system and actual stock	Supports DMAIC as a structured inventory accuracy improvement method
Irfan et al. 2025 (Irfan et al., 2025)	Stock discrepancy in warehouse inventory	DMAIC	Stock mismatch was caused by goods issued without system records, goods received without records, and counting errors	Supports the relationship between warehouse discipline and inventory accuracy

Table 2 shows that previous studies confirm the relevance of DMAIC for improving inventory accuracy and reducing stock opname discrepancies. Most studies found that stock mismatches were caused by human error, weak recording discipline, unrecorded item movement, poor warehouse procedures, and lack of verification. These findings support the use of DMAIC in this study because it can identify dominant discrepancy factors and formulate data-based improvements.

However, previous studies mostly focused on general warehouse inventory, spare parts, retail goods, consumable items, or finished goods in non-plastic industries. Limited studies specifically examine stock opname accuracy in plastic injection molding companies by classifying discrepancy causes into Quantity Error, Part Defect, and Part Dropped. This classification is important because plastic components are vulnerable to physical damage, handling mistakes, and unreported defects during storage and movement. Therefore, this study fills the research gap by applying Six Sigma DMAIC to analyze stock opname discrepancies in a plastic manufacturing company and propose improvements based on the dominant discrepancy factors.

3. RESEARCH METHODOLOGY

Research Design

This study used a descriptive quantitative approach to analyze stock opname accuracy at PT Citra Plastik Makmur. The descriptive approach explained the actual condition of inventory discrepancies based on company data, while the quantitative approach measured discrepancy levels using system stock, total discrepancy, discrepancy percentage, DPO, DPMO, yield, and sigma level.

The study applied the Six Sigma DMAIC framework, consisting of Define, Measure, Analyze, Improve, and Control, because the research focused on data-based process improvement. DMAIC helps define the problem, measure current performance, analyze root causes, formulate improvement actions, and design control mechanisms to prevent repeated discrepancies. In warehouse and inventory cases, DMAIC supports structured analysis of recording errors, physical stock differences, handling problems, and process variation.

This study did not use respondents as population and sample because the unit of analysis was company inventory data. The data covered all monthly stock opname records for Cover Housing Remote Control products from January to December 2024, so the research used total observation data for one full year rather than sample-based data.

Research Object and Location

The research was conducted in the finished goods warehouse of PT Citra Plastik Makmur. The object of this study was the Cover Housing Remote Control product, a plastic component produced through the injection molding process. This product was selected because it has a high frequency of warehouse movement, including receiving from production, storage, internal transfer, product issuing, and periodic stock opname.

The study focused on discrepancies between physical stock and system stock in the stock opname process. Based on company data, the discrepancies were classified into three categories: Quantity Error, Part Defect, and Part Dropped. Quantity Error refers to the mismatch between physical quantity and system quantity. Part Defect refers to damaged products that do not meet quality standards, while Part Dropped refers to products that fall during handling, storage, or material transfer. These categories became the basis for measuring inventory accuracy and identifying root causes through the DMAIC analysis.

Data Collection

The data used in this study consisted of primary and secondary data. Primary data were obtained through direct observation, interviews, and documentation. Observation was conducted to identify warehouse conditions, product movement flow, physical counting activities, stock recording, and potential causes of stock opname discrepancies. Interviews were conducted with warehouse operators, inventory staff, and warehouse administration staff to obtain information about stock recording, material handling, defect reporting, and verification procedures.

Secondary data were obtained from company documents related to inventory control, including monthly stock opname reports, system stock data, discrepancy records, defect data, material movement records, and warehouse operational documents. The main data covered January to December 2024 and included system stock, Quantity Error, Part Defect, Part Dropped, total discrepancy, and discrepancy percentage. These data were used for statistical measurement, process capability analysis, and root cause analysis in the DMAIC framework.

The research procedure was arranged from initial observation to conclusion. The flowchart shows the sequence of problem identification, data collection, DMAIC analysis, improvement planning, and conclusion. The research flowchart is presented in Figure 1.

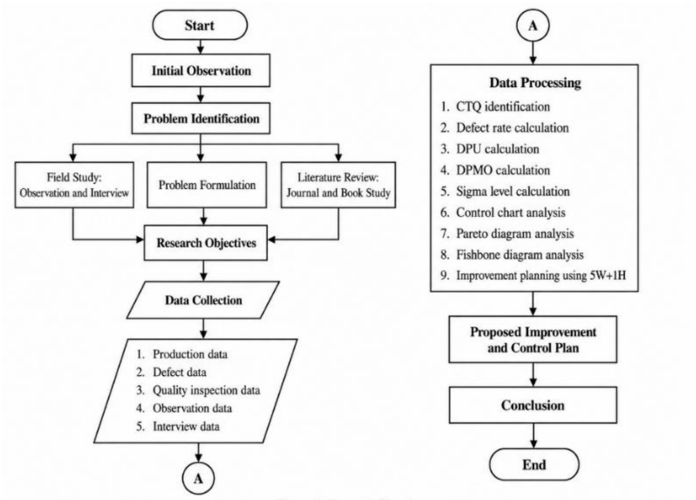

Figure 1. Research Flowchart.
Source: Processed by the author, 2024.

Figure 1 shows that the research began with initial observation in the finished goods warehouse of PT Citra Plastik Makmur. The observation was followed by problem identification, field study, literature review, problem formulation, and research objective formulation. After the objectives were determined, the research continued to data collection and data processing. The collected data were then analyzed using Six Sigma DMAIC, starting from CTQ identification, discrepancy calculation, control chart analysis, Pareto analysis, Fishbone diagram analysis, and improvement planning. The final stages consisted of proposed improvement, control planning, conclusion, and suggestions.

Data Analysis Method

Data analysis was conducted using the Six Sigma DMAIC method. Each DMAIC stage had a specific function and used different analysis tools. The Define stage identified the process scope and determined the Critical to Quality. The Measure stage measured the current performance of the *stock opname* process. The Analyze stage identified the dominant discrepancy factor and root causes. The Improve stage developed improvement actions based on the identified causes. The Control stage prepared mechanisms to maintain the improvement and prevent repeated stock discrepancies.

To make the analysis process clearer, the DMAIC stages, analysis tools, objectives, and outputs used in this study are presented in Table 3.

Table 3. DMAIC Analysis Stages.

DMAIC Stage	Analysis Tool	Objective	Output
Define	SIPOC and Critical to Quality	To define the process flow, problem scope, and key quality characteristics in the *stock opname* process	SIPOC diagram and CTQ classification
Measure	Check sheet, discrepancy proportion, p-control chart, DPO, DPMO, yield, and sigma level	To measure the current performance and stability of the inventory control process	Discrepancy proportion, control limit, DPMO, yield, and sigma level
Analyze	Pareto diagram, Fishbone diagram, and 5 Why's	To identify the dominant discrepancy factor and root causes	Dominant cause and root cause analysis
Improve	Improvement proposal based on root causes	To formulate practical improvement actions for each discrepancy factor	Proposed improvements for Quantity Error, Part Defect, and Part Dropped
Control	SOP standardization, monitoring, inventory audit, and documentation	To maintain process consistency and prevent repeated stock discrepancies	Control plan for inventory accuracy improvement

Source: Processed by the author, 2024.

Table 3 shows that the data analysis followed all DMAIC stages. The Define stage focused on mapping the *stock opname* process and identifying CTQ. The Measure stage calculated the current level of discrepancy and process capability. The Analyze stage determined the most dominant cause of discrepancy and traced its root causes. The Improve stage generated practical improvement actions for warehouse operations. The Control stage ensured that the improvement actions could be maintained through standard procedures, monitoring, audit, and documentation.

The measurement stage used several formulas to evaluate the performance of the *stock opname* process. The discrepancy proportion was used to measure the ratio between stock discrepancy and system stock. DPO was used to measure defects per opportunity. DPMO was used to standardize the defect rate into one million opportunities. Yield was used to show the percentage of successful process output without discrepancy. Sigma level was used to measure the capability of the inventory control process. The formulas used in this study are presented as follows.

$$P = \frac{d}{n} \tag{1}$$

$$\mathrm{DPO} = \frac{D}{U \times O} \tag{2}$$

$$\mathrm{DPMO} = \mathrm{DPO} \times 1{,}000{,}000 \quad (3)$$

$$\mathrm{Yield} = 1 - \mathrm{DPO} \quad (4)$$

$$\mathrm{Sigma\ Level} = \mathrm{NORMSINV}(\mathrm{Yield}) + 1.5 \quad (5)$$

In these formulas, P refers to the discrepancy proportion, d refers to the number of discrepancies in each observation period, and n refers to the total system stock. D refers to the total defects or discrepancies, U refers to the total units observed, and O refers to the number of defect opportunities. DPMO refers to defects per million opportunities. Yield refers to the proportion of successful outputs without discrepancy. The sigma level refers to the capability level of the *stock opname* process after converting yield into the standard normal distribution and adding the 1.5 sigma shift commonly used in Six Sigma analysis.

The opportunity used in this study consisted of three discrepancy categories: Quantity Error, Part Defect, and Part Dropped. Quantity Error represents mismatch in stock quantity. Part Defect represents damaged products that affect inventory records. Part Dropped represents products damaged or lost due to handling activities. These three categories were used because they appeared consistently in the company's *stock opname* data and directly affected inventory accuracy.

Through this method, the study can measure the actual condition of the *stock opname* process, identify the dominant discrepancy category, analyze the root causes, and propose improvement actions that fit the operational condition of PT Citra Plastik Makmur. The method also supports the control stage, which is important to ensure that the proposed improvements can be applied consistently in warehouse operations.

4. RESULTS AND DISCUSSION

Stock Opname Discrepancy Data

Before applying the Six Sigma DMAIC method, the stock opname discrepancy data were collected to describe the actual condition of inventory accuracy at PT Citra Plastik Makmur. The data were obtained from the finished goods warehouse for Cover Housing Remote Control products during January to December 2024. The discrepancy was classified into three categories, namely Quantity Error, Part Defect, and Part Dropped. Quantity Error refers to the mismatch between physical stock and system stock. Part Defect refers to damaged products that do not meet quality standards. Part Dropped refers to products that fall or are damaged during handling, storage, or material transfer activities.

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The stock opname discrepancy data are presented in Table 4. The table shows the monthly system stock, the number of discrepancies in each category, the total discrepancy, and the discrepancy percentage. This data becomes the baseline for identifying the current inventory accuracy problem before further analysis is conducted using the DMAIC framework.

Table 4. Stock Opname Discrepancy Data of Cover Housing Remote Control in 2024.

Month	System Stock (pcs)	Quantity Error (pcs)	Part Defect (pcs)	Part Dropped (pcs)	Total Discrepancy (pcs)	Percentage (%)
January	1,142	39	12	9	60	5.25
February	2,467	27	16	12	55	2.23
March	2,418	26	8	10	44	1.82
April	1,253	38	17	11	66	5.27
May	2,789	35	12	13	60	2.15
June	3,192	29	10	10	49	1.54
July	1,364	30	12	14	56	4.11
August	3,689	25	14	12	51	1.38
September	3,630	23	11	11	45	1.24
October	4,092	33	16	8	57	1.39
November	4,790	40	22	10	72	1.50
December	4,741	42	24	10	76	1.60
Total	35,567	387	174	130	691	29.48
Average	2,963.92	32.25	14.50	10.83	57.58	2.46

Source: PT Citra Plastik Makmur Stock Opname Data, 2024.

Table 4 shows that the total system stock during 2024 was 35,567 pcs, while the total stock opname discrepancy reached 691 pcs. The average monthly discrepancy was 57.58 pcs, with an average discrepancy percentage of 2.46%. The highest discrepancy percentage occurred in April at 5.27%, followed by January at 5.25% and July at 4.11%. These months indicate that the stock opname process still experienced high variation and required further investigation.

The data also show that Quantity Error was the largest discrepancy category with 387 pcs. Part Defect contributed 174 pcs, while Part Dropped contributed 130 pcs. This condition indicates that the main problem was not only caused by damaged or dropped products, but also by inaccurate stock quantity records. Therefore, Quantity Error needs to be analyzed further as the dominant factor affecting stock opname accuracy.

Based on these findings, the stock opname process at PT Citra Plastik Makmur still requires improvement because the discrepancy occurred repeatedly throughout the year. The repeated mismatch between physical stock and system stock can reduce inventory record reliability and affect warehouse control. For this reason, the next analysis is conducted using the Six Sigma DMAIC stages to define the problem, measure process performance, analyze root causes, propose improvements, and design control actions.

Define Phase

The Define phase is the first stage in the Six Sigma DMAIC framework. This phase aims to clarify the main problem, determine the process scope, and identify quality characteristics that directly affect stock opname accuracy. In inventory improvement projects, a clear problem definition is important because stock discrepancies may come from several process points, including receiving, storage, recording, material transfer, counting, and verification activities (Zulkhulaifah & Apriliani, 2024; Maryana et al., 2024).

In this study, the main problem was the discrepancy between physical stock and system stock in the Cover Housing Remote Control product at PT Citra Plastik Makmur. The discrepancy was classified into three categories, namely Quantity Error, Part Defect, and Part Dropped. Similar problems have also appeared in previous stock opname studies, where inventory mismatch was related to inaccurate recording, weak transaction control, unrecorded material movement, and limited verification during physical counting activities (Maryana et al., 2024; Yanti et al., 2023)

The Define phase used two main tools, namely SIPOC and Critical to Quality. SIPOC was used to map the stock opname process from supplier to customer, while Critical to Quality was used to identify the key characteristics that must be controlled to reduce stock discrepancies. In Six Sigma projects, SIPOC helps define process boundaries and clarify the relationship between process inputs, activities, outputs, and customers. CTQ helps convert operational problems into measurable quality characteristics (Stevani Agatha Yudiantoro & Mega Cattleya PA Islami, 2024).

Before determining the Critical to Quality, the stock opname process was mapped using SIPOC. This mapping was needed to identify the internal parties involved, the inputs used, the activities performed, the outputs produced, and the customers who use the stock opname results. The SIPOC diagram of the stock opname process is presented in Table 5.

Table 5. SIPOC Diagram of Stock Opname Process.

Supplier	Input	Process	Output	Customer
Production Department	Cover Housing Remote Control products	Receiving finished goods from production	Stock opname data	Warehouse Department
Warehouse Operator	Inventory system data	Storing products in the finished goods warehouse	Stock discrepancy report	Inventory Control
Inventory Staff	Stock opname form	Retrieving inventory data from the system	Quantity Error data	PPIC
Warehouse Admin	Barcode and product label	Counting physical stock	Part Defect data	Quality Control
Material Handling Team	Material movement records	Matching physical stock with system stock	Part Dropped data	Company Management
		Identifying discrepancy categories	Improvement proposal	
		Analyzing discrepancy using Six Sigma DMAIC	Inventory control recommendation	

Source: Processed by the author based on PT Citra Plastik Makmur stock opname process, 2024.

Table 5 shows that the stock opname process involves several internal parties, including the production department, warehouse operator, inventory staff, warehouse admin, and material handling team. The inputs used in this process include finished goods, inventory system data, stock opname forms, barcode labels, and material movement records. The process starts from receiving finished goods from production and continues to storage, data retrieval, physical counting, stock matching, discrepancy identification, and DMAIC analysis. The outputs include stock opname data, discrepancy reports, Quantity Error data, Part Defect data, Part Dropped data, and improvement recommendations.

The SIPOC mapping indicates that stock discrepancy can occur at several process points. Errors may appear during receiving, storage, data retrieval, physical counting, data matching, or material movement. This condition shows that stock opname accuracy depends not only on the final counting activity, but also on recording discipline, handling control, defect separation, and verification procedures. Structured stock opname practices supported by clear procedures and verification mechanisms can improve inventory accuracy and reduce repeated discrepancies (Wafa et al., 2025)

Critical to Quality represents the key characteristics that must be controlled to achieve accurate stock opname results. In this study, CTQ was determined based on the three main discrepancy categories found in the company data, namely Quantity Error, Part Defect, and Part Dropped. The CTQ classification is presented in Table 6.

Table 6. Critical to Quality of Stock Opname Process

No.	Critical to Quality	Quality Characteristic	Discrepancy Category	Operational Definition
1	Inventory quantity accuracy	Conformity between physical stock and system stock	Quantity Error	A mismatch between the number of Cover Housing Remote Control products physically available in the warehouse and the number recorded in the inventory system. This error may occur due to counting mistakes, input errors, unreadable barcode labels, delayed updates, or unrecorded material movement.
2	Product physical quality	Product condition meets company quality standards	Part Defect	A condition where the product is physically damaged or does not meet quality standards, such as cracks, scratches, deformation, short molding, excessive flash, or color changes. Defective products can create stock mismatch if they are not separated and reported properly.
3	Handling safety	Product remains safe during storage and material movement	Part Dropped	A condition where the product falls during handling, storage, or internal transfer activities. Dropped products can cause physical damage, loss, or mismatch between physical stock and system records.

Source: Processed by the author based on PT Citra Plastik Makmur stock opname data, 2024.

Table 6 shows that the stock opname process has three main CTQ elements. The first CTQ is inventory quantity accuracy, which is related to Quantity Error. This CTQ becomes the most critical because it directly reflects the conformity between physical stock and system stock. If quantity accuracy is not controlled, inventory records cannot support reliable warehouse control and production planning. Studies on stock opname discrepancies show that quantity mismatch often appears when item movement, transaction updates, and physical verification are not controlled consistently (Maryana et al., 2024).

The second CTQ is product physical quality, which is related to Part Defect. Defective products must be identified, separated, and reported properly because they can create a difference between available stock and usable stock. If damaged products remain mixed with normal products, the system may still record them as usable inventory even though they do not meet quality standards. This condition can reduce the reliability of stock records and complicate warehouse decision-making.

The third CTQ is handling safety, which is related to Part Dropped. This CTQ is important because product damage or loss may occur during storage and material transfer. Poor handling control can increase the risk of dropped parts and reduce inventory accuracy. Warehouse improvement studies using Six Sigma emphasize that inventory accuracy requires control over material movement, storage discipline, barcode or system updates, and audit mechanisms (Nur Annisa et al., 2021).

Based on the Define phase, the focus of this study is to improve stock opname accuracy by controlling Quantity Error, Part Defect, and Part Dropped. SIPOC mapping shows the process scope, and the parties involved, while CTQ classification shows the key quality characteristics that must be measured and improved. The results of this phase become the basis for the Measure phase, where the current performance of the stock opname process is calculated using discrepancy proportion, p-control chart, DPO, DPMO, yield, and sigma level.

Measure Phase

The Measure phase was conducted to evaluate the current performance of the stock opname process at PT Citra Plastik Makmur. This stage measured the discrepancy proportion, process stability, DPO, DPMO, yield, and sigma level. The measurement was based on stock opname data from January to December 2024. In Six Sigma analysis, the Measure phase is important because it provides numerical evidence of the current process condition before root cause analysis and improvement planning are conducted (Priyanti, 2025; Dwiyanti, 2025).

The first measurement was conducted by calculating the monthly discrepancy proportion. The discrepancy proportion shows the ratio between total stock discrepancy and total system stock in each month. This calculation was needed to understand how large the stock opname discrepancy was compared with the inventory quantity recorded in the system.

The formula for discrepancy proportion is as follows. Manual calculation example for January:

$$P = \frac{60}{1{,}142}$$

$$P = 0.0525 \qquad\qquad P = 5.25\%$$

The calculation shows that the discrepancy proportion in January was 0.0525 or 5.25%. This means that 5.25% of the system stock in January experienced discrepancy during the stock opname process. The same calculation was applied to all months from January to December 2024.

After calculating the monthly discrepancy proportion, the process stability was analyzed using a p-control chart. A p-control chart is suitable for monitoring the proportion of nonconforming units across different observation periods. This method helps identify whether the process variation still occurs within statistical control limits or whether special-cause variation exists in certain periods(Junianto et al., 2021).

The formulas for the p-control chart are as follows. Manual calculation for the Central Line:

$$\mathrm{CL} = \frac{691}{35{,}567}$$

$$\mathrm{CL} = 0.0194 \qquad\qquad \mathrm{CL} = 1.94\%$$

Manual calculation of UCL for January:

$$\mathrm{UCL} = 0.0194 + 3\sqrt{\frac{0.0194 \times (1 - 0.0194)}{1{,}142}}$$

$$\mathrm{UCL} = 0.0194 + 3\sqrt{0.00001667}$$

$$\mathrm{UCL} = 0.0194 + 0.0123$$

$$\mathrm{UCL} = 0.0317$$

Manual calculation of LCL for January:

$$\mathrm{LCL} = 0.0194 - 3\sqrt{\frac{0.0194 \times (1 - 0.0194)}{1{,}142}}$$

$$\mathrm{LCL} = 0.0194 - 0.0123$$

$$\mathrm{LCL} = 0.0072$$

Based on these formulas, the discrepancy proportion, CL, UCL, and LCL were calculated for each month. The results are presented in Table 6.

Table 7. P-Control Chart Calculation of Stock Opname Discrepancy.

Month	System Stock (pcs)	Total Discrepancy (pcs)	P	CL	UCL	LCL	Status
January	1,142	60	0.0525	0.0194	0.0317	0.0072	Above UCL
February	2,467	55	0.0223	0.0194	0.0278	0.0111	In control
March	2,418	44	0.0182	0.0194	0.0278	0.0110	In control
April	1,253	66	0.0527	0.0194	0.0311	0.0077	Above UCL
May	2,789	60	0.0215	0.0194	0.0273	0.0116	In control
June	3,192	49	0.0154	0.0194	0.0268	0.0121	In control
July	1,364	56	0.0411	0.0194	0.0306	0.0082	Above UCL
August	3,689	51	0.0138	0.0194	0.0262	0.0126	In control
September	3,630	45	0.0124	0.0194	0.0263	0.0126	Below LCL
October	4,092	57	0.0139	0.0194	0.0259	0.0130	In control
November	4,790	72	0.0150	0.0194	0.0254	0.0134	In control
December	4,741	76	0.0160	0.0194	0.0254	0.0134	In control

Source: Processed by the author based on PT Citra Plastik Makmur stock opname data, 2024.

Table 7 shows that the average discrepancy proportion or CL was 0.0194. This means that the stock opname process had an average discrepancy rate of 1.94% during 2024. The results also show that January, April, and July were above the upper control limit. These months indicate special-cause variation because the discrepancy proportion exceeded the maximum statistical control limit. September was slightly below the lower control limit. Although this condition shows a lower discrepancy rate, it still indicates special-cause variation that should be reviewed to understand what process condition made the discrepancy lower than usual.(Edenniera Zefanya Christyani & Ari Susanti, 2025)

The p-control chart result indicates that the stock opname process was not fully stable. Several months were still outside the control limits, especially January, April, and July. This condition shows that the inventory control process still contained abnormal variation. In practical warehouse operations, this variation may be related to inconsistent counting accuracy, transaction updates, material handling discipline, or stock verification practices. Previous Six

Sigma studies also explain that control charts help identify unstable process conditions before deeper root cause analysis is carried out (Junianto et al., 2021).

After the control chart analysis, the process capability was measured using DPO, DPMO, yield, and sigma level. These indicators were used to determine how capable the stock opname process was in producing accurate inventory records. In this study, the opportunity was defined as one stock accuracy opportunity per unit because each unit was assessed based on whether it experienced discrepancy or not. The three discrepancy categories, namely Quantity Error, Part Defect, and Part Dropped, were used as classification types, not as separate opportunity counts. The formula for DPO is as follows. Manual calculation:

$$\text{DPO} = \frac{691}{35{,}567 \times 1}$$

$$\text{DPO} = \frac{691}{35{,}567} \qquad \text{DPO} = 0.019428$$

The formula for DPMO is as follows.

$$DPMO = DPO \times 1{,}000{,}000$$

Manual calculation:

$$DPMO = 0.019428 \times 1{,}000{,}000$$

$$DPMO = 19{,}428.12$$

The formula for yield is as follows.

$$Yield = 1 - DPO$$

Manual calculation:.

$$Yield = 1 - 0.019428$$

$$Yield = 0.980572$$

$$Yield = 98.06\%$$

The formula for sigma level is as follows.

$$SigmaLevel = NORMSINV(Yield) + 1.5$$

Manual calculation:

$$SigmaLevel = NORMSINV(0.980572) + 1.5$$

$$Sigma\ Level = 2.0657 + 1.5$$

$$Sigma\ Level = 3.57\ sigma$$

Based on the manual calculations, the stock opname process had a DPO of 0.019428, DPMO of 19,428.12, yield of 98.06%, and sigma level of 3.57. The summary of Six Sigma measurement results is presented in Table 8.

Table 8. Six Sigma Measurement Summary.

Measurement Indicator	Value
Total System Stock	35,567 pcs
Total Discrepancy	691 pcs
Opportunity per Unit	1
DPO	0.019428
DPMO	19,428.12
Yield	98.06%
Sigma Level	3.57 sigma

Source: Processed by the author based on PT Citra Plastik Makmur stock opname data, 2024

Table 8 shows that the stock opname process reached a sigma level of 3.57. This value indicates that the process was still at a moderate capability level. The yield of 98.06% shows that most inventory records were accurate, but the remaining discrepancy still had a significant operational impact because the mismatch occurred repeatedly every month. The DPMO value of 19,428.12 also shows that the process still had many opportunities for improvement. In Six Sigma analysis, a lower DPMO and a higher sigma level indicate better process capability. Therefore, the current performance shows that PT Citra Plastik Makmur still needs improvement actions to reduce stock opname discrepancies and increase inventory accuracy.

The Measure phase confirms that the stock opname discrepancy problem was measurable and recurring. The p-control chart showed unstable variation in several months, while the sigma level showed that the process had not reached a high capability level. These findings provide the basis for the Analyze phase. The next phase identifies the dominant discrepancy category and root causes using Pareto diagram, Fishbone diagram, and 5 Why's analysis (Hakim Hidajat & Momon Subagyo, 2022).

Analyze Phase

The Analyze phase was conducted to identify the dominant discrepancy factor and determine the root causes of stock opname inaccuracy. This phase used Pareto analysis, Fishbone diagram, and 5 Why's analysis. Pareto analysis was used to determine the priority factor that contributed the most to total discrepancy. Fishbone diagram and 5 Why's analysis was then used to trace the operational causes behind each discrepancy category. These tools are commonly used in DMAIC studies because they help identify dominant problems and direct improvement actions to the most critical causes (Setiani et al., 2024; Sholikin et al., 2025).

The percentage of each discrepancy category was calculated using the following formula.

$$\text{Percentage} = \left(\frac{\text{Discrepancy Category}}{\text{Total Discrepancy}}\right) \times 100\%$$

Where:

Discrepancy Category = number of discrepancies in each category

Total Discrepancy = total stock opname discrepancy during the observation period

Manual calculation example for Quantity Error:

$$\text{Percentage} = \left(\frac{387}{691}\right) \times 100\%$$

$$\text{Percentage} = 56.01\%$$

This calculation shows that Quantity Error contributed 56.01% of the total stock opname discrepancy. The same calculation was applied to Part Defect and Part Dropped. The Pareto analysis result is presented in Table 9.

Table 9. Pareto Analysis of Stock Opname Discrepancy.

No.	**Discrepancy Factor**	**Total (pcs)**	**Discrepancy**	**Percentage (%)**	**Cumulative Percentage (%)**
1	Quantity Error		387	56.01	56.01
2	Part Defect		174	25.18	81.19
3	Part Dropped		130	18.81	100.00
Total			691	100.00	

Source: Processed by the author based on PT Citra Plastik Makmur stock opname data, 2024

Table 9 shows that Quantity Error was the dominant factor causing stock opname discrepancy, with 387 pcs or 56.01% of the total discrepancy. Part Defect contributed 174 pcs or 25.18%, while Part Dropped contributed 130 pcs or 18.81%. The cumulative percentage shows that Quantity Error and Part Defect contributed 81.19% of the total discrepancy. This result indicates that improvement actions should prioritize quantity recording accuracy and defect control because both factors produced the largest effect on inventory accuracy.

After the dominant factors were identified, root cause analysis was conducted using Fishbone diagram and 5 Why's analysis. The analysis focused on three main discrepancy categories: Quantity Error, Part Defect, and Part Dropped. The causes were grouped based on human, method, material, system, and handling factors. The root cause analysis is summarized in Table 10.

Table 10. Root Cause Analysis of Stock Opname Discrepancy.

Discrepancy Factor	**Main Finding**	**Root Cause**	**Impact on Stock Opname Accuracy**
Quantity Error	Physical stock did not match system stock	Manual input, counting mistakes, delayed updates, and weak data verification	System records became inaccurate and required repeated checking
Part Defect	Damaged products were still recorded as normal stock	Defect parts were not separated, identified, and reported consistently	Usable stock and actual stock became different

Part Dropped	Products were damaged or lost during handling	Lack of handling discipline, limited supervision, and unclear handling procedures	Physical stock decreased but system stock was not updated properly

Source: Processed by the author based on observation, interview, and stock opname data, 2024.

Table 10 shows that each discrepancy category had different root causes. Quantity Error was mainly caused by weak recording and verification practices. The stock recording process still depended on manual input, while double-checking was not performed consistently. As a result, errors in quantity data could remain undetected until the stock opname process was conducted.

Part Defect occurred because damaged products were not always separated from normal stock. Some defect items were still mixed with usable stock or were not reported immediately. This condition caused the system to record products as available even though their physical condition did not meet quality standards. Part Dropped was related to material handling problems. Products could fall or become damaged during storage and movement because handling procedures and supervision were not applied consistently.

Based on the Analyze phase, the main priority for improvement is Quantity Error because it contributed the largest percentage of discrepancy. However, Part Defect and Part Dropped also need corrective actions because both factors directly affect the reliability of physical stock. Therefore, the next phase focuses on improvement actions related to stock data verification, defect area separation, operator training, handling supervision, and warehouse procedure standardization (Aviati & Muhammad, 2022).

Improve and Control Phase

The Improve phase was conducted to formulate corrective actions based on the root causes identified in the Analyze phase. The improvement plan focused on three discrepancy factors, namely Quantity Error, Part Defect, and Part Dropped. The Control phase was then designed to ensure that the proposed improvements could be implemented consistently and prevent the recurrence of the same stock opname problems. In inventory improvement studies, structured stock opname, revised procedures, barcode support, periodic verification, and monitoring activities have been shown to improve inventory accuracy and reduce stock discrepancies (Maryana et al., 2024;Azzahra et al., 2023).

The proposed improvement and control plan was prepared based on the dominant discrepancy factors, root causes, operational needs, and warehouse control requirements. Quantity Error was prioritized because it contributed the highest discrepancy value. Part Defect and Part Dropped were also included because both factors affected the reliability of physical stock and usable inventory. The improvement and control plan are presented in Table 11.

Table 11. Improvement and Control Plan for Stock Opname Accuracy.

Discrepancy Factor	Root Cause	Proposed Improvement	Control Plan
Quantity Error	Manual input, counting mistakes, delayed updates, and weak data verification	Apply double-check before system input, validate stock data by warehouse supervisor, conduct operator training, and optimize barcode or integrated inventory system usage	Use daily stock verification checklist, supervisor approval before stock adjustment, weekly review of stock opname records, and monthly accuracy monitoring
Part Defect	Defective products are not separated, identified, and reported consistently	Provide a special area for defect products, use standardized defect report forms, improve material inspection, and label defect items clearly	Conduct routine defect inspection, separate defect stock from normal stock, review defect reports weekly, and audit defect storage area monthly
Part Dropped	Lack of handling discipline, limited supervision, and unclear handling procedures	Develop material handling SOP, train operators on safe handling, improve storage layout, and increase supervision during material transfer	Monitor handling activities, evaluate dropped part reports, check storage layout periodically, and include handling compliance in warehouse audit
Overall Stock Opname Process	Inconsistent procedure implementation and limited follow-up evaluation	Standardize stock opname SOP, define responsibilities, improve documentation, and strengthen coordination between warehouse, inventory, PPIC, and quality control	Conduct periodic inventory audit, evaluate discrepancy trends monthly, document corrective actions, and review SOP effectiveness regularly

Source: Processed by the author based on observation, interview, and DMAIC analysis, 2024.

Table 11 shows that the improvement plan was directed at the specific root causes of each discrepancy factor. For Quantity Error, the proposed improvement focuses on verification, supervisor validation, operator accuracy, and system support. This action is important because inaccurate quantity records were the largest contributor to stock opname discrepancies. A more disciplined verification process can reduce input errors and help detect stock differences earlier before they become larger discrepancies.

For Part Defect, the improvement focuses on separating damaged products from normal stock. Defective products must be identified, labeled, recorded, and stored in a specific area. This action prevents damaged products from being counted as usable inventory. It also helps the warehouse and quality control teams trace defect items more easily during stock opname. For Part Dropped, the improvement focuses on safer material handling. Clear handling procedures, operator training, storage layout improvement, and direct supervision can reduce the risk of products falling, becoming damaged, or being lost during warehouse movement.

The Control phase ensures that the proposed actions do not stop at recommendations. The company needs to implement standardized SOPs, daily or weekly verification, routine defect inspection, monthly inventory accuracy monitoring, and periodic warehouse audits. These control actions are important because inventory accuracy cannot be maintained only through one-time correction. It requires continuous discipline, documentation, and evaluation. Previous inventory improvement research also emphasizes that structured stock opname practices, revised SOPs, barcode-based support, and periodic audits can strengthen inventory control and reduce repeated stock discrepancies (Berniliyus et al., 2025; Samsudin et al., 2023).

Based on the Improve and Control phase, the main operational recommendation is to strengthen the stock verification system and standardize warehouse procedures. Quantity Error should become the first improvement priority because it contributed 56.01% of the total discrepancy. However, Part Defect and Part Dropped must also be controlled because both factors affect the accuracy of physical stock and the reliability of warehouse records. These proposed actions are expected to improve stock opname accuracy, reduce repeated discrepancies, and support more reliable inventory data for production and warehouse decision-making.

5. CONCLUSION AND SUGGESTIONS

This study analyzed the stock opname accuracy problem of Cover Housing Remote Control products at PT Citra Plastik Makmur using the Six Sigma DMAIC method. The results showed that the total stock opname discrepancy during January to December 2024 reached 691 pcs from 35,567 pcs of system stock, with an average discrepancy percentage of 2.46%. The p-control chart showed that several months were outside the control limits, especially January, April, and July. This condition indicates that the stock opname process was not fully stable and still contained special-cause variation that required improvement.

The Pareto analysis showed that Quantity Error was the dominant discrepancy factor, contributing 387 pcs or 56.01% of the total discrepancy. Part Defect contributed 174 pcs or 25.18%, while Part Dropped contributed 130 pcs or 18.81%. The Six Sigma measurement showed a DPMO value of 19,428.12, a yield of 98.06%, and a sigma level of 3.57. These results indicate that the inventory control process was at a moderate capability level and still had opportunities for improvement. The root cause analysis showed that the main problems came from manual input, counting mistakes, delayed system updates, weak data verification, inconsistent defect separation, and limited supervision during material handling.

The proposed improvements include applying double-check procedures before system input, validating stock data by warehouse supervisors, improving operator training, providing a special area for defect products, using standardized defect report forms, developing material handling SOP, improving storage layout, and increasing supervision during material transfer. To maintain these improvements, the company needs to implement SOP standardization, routine stock verification, periodic inventory audits, discrepancy trend monitoring, and proper documentation of corrective actions. These actions are expected to reduce repeated stock discrepancies and improve the reliability of inventory data for warehouse control and production planning.

This study has a limitation because the improvement actions were formulated as recommendations and were not yet tested through post-implementation measurement. Therefore, future research is suggested to evaluate the effectiveness of the proposed improvements after implementation by comparing the DPMO, yield, sigma level, and inventory accuracy before and after corrective actions. Future studies can also include digital inventory tools such as barcode integration, RFID, or warehouse management systems to strengthen real-time stock control and reduce manual recording errors.

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