
Design Implementation and Evaluation of Warehouse SOP of PT XYZ in Batam with DMAIC Approach

Ilmi Ardi¹, Eddo Nanda Oktarici^{1*}

¹Batam State Polytechnic, Indonesia

*Email corresponding author: eddonanda@polibatam.ac.id

Received 00/00/0000 Revised 00/00/0000 Published 00/00/0000

Abstract

PT XYZ, a CCTV distributor in Batam, faced significant operational challenges post-business reconstruction due to the absence of Standard Operating Procedure (SOP), causing inefficiency, inconsistency, and stock management issues in the warehouse. This study aims to design, implement, and evaluate warehouse operational SOPs using the Six Sigma DMAIC method to improve efficiency and accuracy. Through a qualitative approach with DMAIC (Define, Measure, Analyze, Improve) stages, problem identification, process mapping, root cause analysis (Fishbone Diagram), and solution development in the form of detailed SOPs (for inbound, storing, stock-taking, outbound), layout rearrangement, and a new stock-taking format were conducted. The results of the implementation trial show that the SOPs can be implemented consistently and provide significant performance improvements, as evidenced by a 63% decrease in stock-taking duration and a 24% increase in accuracy. The application of DMAIC has proven effective in producing SOPs that can improve the efficiency and accuracy of PT XYZ's warehouse operations.

Keywords: Standard Operating Procedure (SOP), Warehouse Management, DMAIC, Operational Efficiency

INTRODUCTION

In an increasingly competitive business environment, PT XYZ, a CCTV distributor in the city of Batam, is facing significant challenges after reconstructing its previous business that focused on selling computer and electronic accessories. This phenomenon reflects the company's adaptation to changing market needs and technology, but also creates operational problems that need to be addressed immediately.

Currently, PT XYZ does not have standardized work instructions for repetitive operational activities, making it difficult for the company owner to specifically manage the business process. In addition, some of the main problems that hinder operational efficiency and customer service include ineffective stock management, difficulty in finding goods.

The main problems faced by the company can be broken down into 3 (three) main things, the first is the absence of standard guidelines in operations causing uncertainty, inconsistency in the implementation of tasks, and lack of discipline at work. This is reinforced through the results of an interview with the Operations Manager, that he argues "This SOP is also intended to discipline all friends" this is emphasized by the statement "in the absence of SOPs, there is no one to control who takes goods, especially on the shelves, it is less tracked, so far people take first then report not report first then take." Secondly, ineffective stock management results in poorly organized storage, often making it difficult to find items, especially small accessories. Thirdly, the time-consuming search for items that relies on employees' memories of the last storage location adds to the complexity of the operational process. In the second and third points, this is based on the results of observations and interviews as evidenced by the case of searching for a CCTV machine that has been stored from the last 3-6 months, when it was about to be issued for installation it turned out that the item was not in the storage area, so it had to mobilise all available employees for 3 (three) days (on 14 October 2024, 16 October and 19 October 2024) to search which in the end turned out to have been taken by the company branch but not documented.

Several previous studies have examined the importance of Standard Operating Procedure (SOP) and inventory management systems in improving company performance. Studies conducted by (Sari et al., 2023). show that business process improvements documented into SOPs aim to improve service performance and ensure operations run consistently, effectively, and efficiently. Furthermore, research conducted by

(Rahmaningtias & Hati, 2020). resulted in the design of SOPs that aim to facilitate employees in managing stock items in the warehouse and increase employee work effectiveness. These findings indicate that the implementation of efficient SOPs is a crucial factor in improving company performance.

In accordance with the background of the need for SOPs at PT XYZ, the author formulates this research problem for how the implementation conditions in handling goods, both incoming goods, outgoing goods, storage of goods, and warehouse stock-taking that have been carried out by PT XYZ. How to design an appropriate SOP using the DMAIC method based on an evaluation of current conditions. How to implement the SOP that has been designed in the warehouse operations of PT XYZ and how to evaluate the effectiveness of the SOP that has been implemented in improving the efficiency and accuracy of warehouse management.

The purpose of this research is to evaluate and improve operations at PT XYZ by evaluating the current operational conditions thoroughly on the process of handling goods, including the flow of incoming goods, storage to outgoing goods, stock-taking. Furthermore, designing a structured Standard Operating Procedure (SOP) using the Six Sigma (DMAIC) method based on the results of the evaluation of current conditions. Implement the SOP that has been designed in PT XYZ's warehouse operations during the trial period. Finally, evaluate the effectiveness of the SOP that has been implemented to improve the efficiency and accuracy of warehouse operations.

The urgency of this study lies in the company's pressing need to improve its internal processes in order to compete effectively in the market. The main argument of this study is that the design and implementation of SOPs using the Six Sigma method can help the company overcome the various problems that have been identified, thereby improving customer satisfaction and the overall performance of the company. The basic assumption of this study is that the design and implementation of SOPs using the Six Sigma method has an impact on the performance of a more structured company, so that the company will be able to optimize its operations and achieve business goals more effectively.

The expected benefits of this study are to help PT XYZ optimize operational activities that have been running from direct direction to having standard guidelines in carrying out its business operations. Assisting PT XYZ in managing the stock of goods in the warehouse from the stage of receiving goods to stock-taking. The hope is that PT XYZ can maximize company operations to be more effective, especially in the management of goods. As for the author, it is hoped that the results of this study can add insight and implement the knowledge that has been learned while studying at the Batam State Polytechnic.

This research is limited to the evaluation of PT XYZ's warehouse operations which include the cycle of receiving, storing, picking, recording and issuing. The main focus is to understand the effective application of the DMAIC method in the preparation of the SOP, with this research itself limited to the Improve stage. The implementation of the Control stage was left to the company managers. This decision was based on two main considerations: firstly, the time constraints of the research did not allow for long-term monitoring of performance, which is the essence of the control stage. Second, the scope of the researcher's authority as an external party who did not have the authority to institutionalize policies, impose sanctions, or make structural adjustments on an ongoing basis within the company. The responsibility for sustaining performance improvement, monitoring compliance, and managing long-term change lies within the realm of operational management. Therefore, the implementation of the control phase is left to company managers who have full authority and responsibility for daily operations. The implementation of the SOP was conducted in the form of a limited trial over a one-month period to validate the feasibility of the designed procedures. Evaluation of the effectiveness of the SOP was limited to measuring the improvement of time efficiency and accuracy in the warehouse operational process during the implementation period.

LITERATURE REVIEW

Standard Operation Procedure (SOP)

SOPs are detailed step-by-step instructions that guide personnel in performing tasks uniformly, thereby minimizing variation and ensuring compliance with the quality management system (Beyene et al., 2022). Effective SOPs cover various aspects, including institutional, business, and financial management as demonstrated by Sarinah Cooperative, which utilizes SOPs to maintain transparency and accountability (Wuryani & Harti, 2020). In addition, the audit process of SOPs in an integrated management system is essential

to improve efficiency and address challenges related to resource allocation and organizational culture (Khairunnisa et al., 2020).

Operations Management

Operations management is an important discipline that focuses on efficient and effective processes in organizations, aiming to optimize resources and improve productivity. Effective operations management is essential for long-term strategic planning, enabling companies to gain competitive advantage through improved efficiency and resource utilization (Schmuck, 2022). The evolution of operations management research, as seen in the journal *Operations Management Research*, emphasizes the importance of themes such as supply chain performance and the implications of the fourth industrial revolution (Dhiaf et al., 2021). Thus, operations management remains a dynamic field that adapts to market demands and technological advancements.

Warehouse Management

Warehouse management involves controlling and optimizing warehouse operations to ensure that goods are received, stored and distributed effectively and efficiently. It covers a wide range of activities including inventory control, order fulfilment, and maintenance of warehouse facilities. Warehouse management is the process of monitoring and improving the efficiency of warehouse operations, ensuring that goods are received, stored, and distributed in a way that maximizes effectiveness. It encompasses a wide range of activities, including inventory level control, order filling, and maintaining storage facilities in optimal condition. (Rathee & Rani, 2024).

Six Sigma

Six Sigma is a comprehensive and data-driven quality improvement methodology, focused on minimizing variability and defects in business processes (Antony et al., 2016). This methodology aims to understand and evaluate the root causes of problems. DMAIC is an interactive process that provides structure and guidance to improve processes in various fields (Antony et al., 2016). Its five phases are easy to understand and logical, making it possible to define problems, measure performance, analyze root causes, test improvement recommendations, and implement changes for long-term sustainability.

RESEARCH METHOD

Method

Qualitative method was chosen because this research aims to analyze the design and evaluation of Standard Operational Procedure (SOP) in PT XYZ in depth. This method allows a comprehensive understanding of business processes, identification of weaknesses in the design and evaluation of SOPs, and analysis of the root causes of problems using the DMAIC (Define, Measure, Analyze, Improve, Control) Six Sigma approach. Qualitative data, collected through field observations, interviews, and related literature studies, will be interpreted to produce descriptive and analytical improvement recommendations.

Design Research

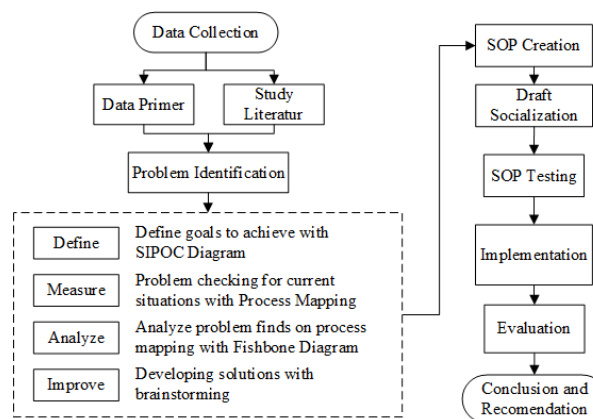


Figure 1. Research Flow

In accordance with Figure 1, this research begins with identifying problems through literature studies and primary data collection at PT XYZ. Next, the Six Sigma (DMAIC) method was applied to analyse the existing process and design an improvement solution. The Define, Measure, Analyze, and Improve stages were followed systematically to develop a Standard Operating Procedure (SOP). The designed solution was then trialed to validate and evaluate its effectiveness, the results of which showed that the procedure was effective. The final stage of the research was to conduct a thorough evaluation of the impact of the implementation and draw conclusions based on the findings.

Sampling Method

Non-random sampling was used to this data collection process. The informants of this research are individuals at PT XYZ who are directly involved in the operational activities of goods in the warehouse and meet the criteria. First, occupying key positions such as Operations Manager and Admin. Second, have at least 2 (two) years of experience in the position or have worked at PT XYZ for at least 2 (two) years, given the reconstruction of the business model in 2022. Third, responsible for providing work direction in accordance with applicable business processes. These criteria are expected to increase the validity and reliability of research data.

Data Collection Techniques

Participant observation was conducted directly at the PT XYZ warehouse from 21 August 2024 to 23 April 2025 to observe the operational process of goods, record workflows, and identify potential problems for SOP design and evaluation. Furthermore, semi-structured interviews were conducted with the Operations Manager and Operations Admin as well as marketing staff to explore in-depth information about perceptions, experiences, and constraints related to the absence of SOPs. Interview guidelines were developed based on previous guidelines (Anietie et al., 2024; Pereira et al., 2021) with exploratory flexibility. Qualitative data analysis from observations and interviews focused on three main stages according to Sugiyono, (2018): data reduction, data presentation, and conclusion drawing, which were then systematically integrated within the Six Sigma DMAIC framework.

Data Analysis Techniques

Qualitative data analysis from observations and interviews focused on three main stages according to Sugiyono, (2018): data reduction, data presentation, and conclusion drawing, which were then systematically integrated within the Six Sigma DMAIC framework. Data Reduction: The process of filtering and summarizing data from interview transcripts (key quotes) and observations (field notes, photos, representative videos) to make it more focused. Data Presentation: Reduced data is presented systematically using diagrams (including fishbone for root cause analysis), informative narratives, and visualizations such as new process flowcharts for brainstormed improvement recommendations.

Six Sigma DMAIC Stages: Define: Identify and define specific problems in goods handling, understand the context, stakeholders, and improvement objectives, with the help of SIPOC diagrams. Measure: Conduct process mapping to understand the flow, identify bottlenecks, and find opportunities to improve efficiency. Analyze: Analyze data to identify root causes of problems using fishbone diagrams and narrative analysis of qualitative data. Improve: Formulate and implement improvement recommendations (such as procedure changes) based on the analysis results, through a brainstorming process. Draw Conclusions: Performed after analysis and implementation of recommendations, conclusions are drawn based on holistic interpretation of data and evaluation of the impact of improvements, to answer the formulation of problems and research objectives related to improving the operational efficiency of goods in the warehouse of PT XYZ.

RESULT AND DISCUSSION

Problem Identification

The work carried out by employees of PT XYZ is only based on non-standard work processes, starting from direct instructions from the Operations Manager to form work processes based on experiences and cases that occurred in the past. Therefore, the author took the initiative to collect instructions that have been carried out

to become more standardized and well-documented by designing a Standard Operating Procedure (SOP) as a routine work guide, especially in the process of inbound goods, storage, stock-taking, and outbound goods.

Six Sigma (DMAIC)

1. Define

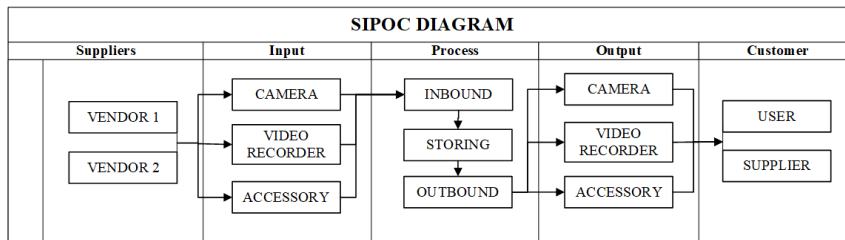


Figure 2. SIPOC Diagram of activities taking place at PT. XYZ

Warehouse operations are the daily activities that take place in the warehouse related to controlling various activities including controlling inventory levels, filling orders, and maintaining storage facilities in optimal conditions. (Rathee & Rani, 2024).

This SIPOC diagram in Figure 2 illustrates the flow of business processes from the supplier to the customer perspective, focusing on the procurement and distribution of electronic products. Two different suppliers (Vendor 1 and Vendor 2) provide three types of inputs: cameras, video recorders, and accessories. These inputs then go through three main process stages: receiving (inbound), storing (storing), and shipping (outbound), which results in the output of the same product as the input. As for the customer, there is a duality of roles, where in addition to the end user (user), the supplier also acts as a customer and this is also the main target in sales at PT XYZ to create sustainable cooperation.

2. Measurement

a) Inbound Goods

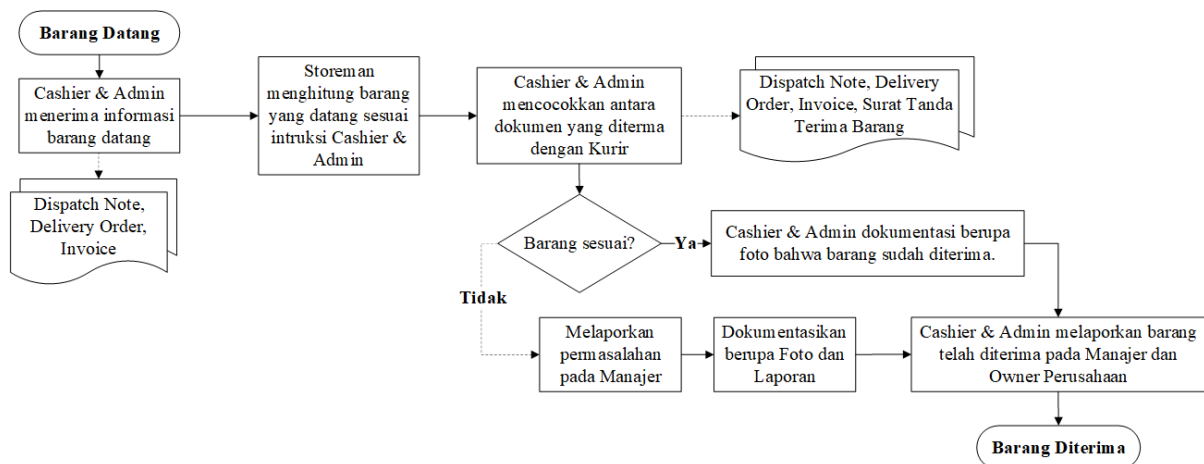


Figure 3. Inbound Flow

Process mapping on the flow of receiving goods describes a comprehensive process of receiving goods according to Figure 3, starting from the notification of the arrival of goods delivered directly from the vendor to the admin, when the goods have arrived, the storeman for counting and verification when the unloading process takes place. The cashier and admin then match the shipping documents which generally consist of a Goods Receipt Letter from the expedition, a dispatch note from the vendor, and a packing list with the courier, when the documents are in accordance and the storeman also says the goods that have been unloaded are in accordance in quantity, then the admin will sign the goods receipt document, then will document the goods that have been received. This process branches out based on the conformity of the goods: if conforming, the goods are accepted and reported to the manager and owner of the company; otherwise, handling differs depending on the type

of non-conformity. Delivery errors or shortages are handled by filing a complaint with the expedition/courier, while product or packaging damage requires further documentation and reporting to the relevant parties.

b) Goods Storage



Figure 4. Flow of Goods Storage

Storage of goods in Figure 4 illustrates the next process after the goods are received then the cashier and admin prepare the item code for warehouse inventory. The code that is written is the type of item, the date code of the item received, and how many of these items are in one package, then proceed with writing the code on the packaging by the storeman. Then, the storeman unloads the goods, followed by scanning the product S/N barcode by the cashier and admin using a barcode scanner to update the stock on the system. After scanning, the storeman repackages the updated products. The process ends with placing and storing the goods into the warehouse on the 2nd floor of PT XYZ.

c) Outbound Goods

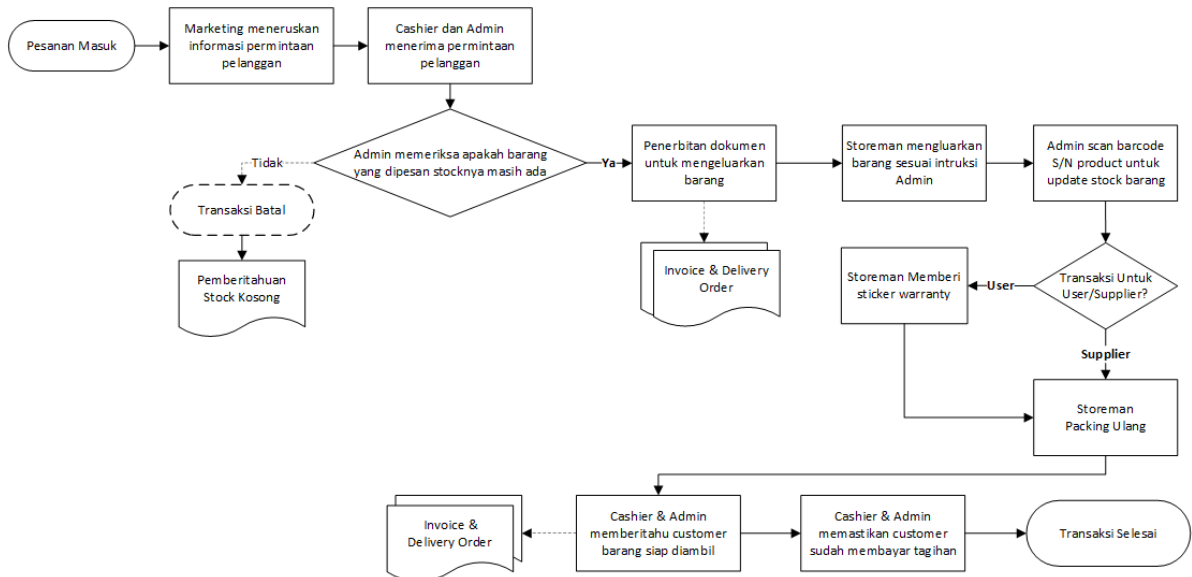


Figure 5 Flow of Outbound Goods

To process customer order fulfilment, this activity begins with marketing forwarding the request information, which is received by the cashier and admin. Admin verifies stock availability; if not available, the transaction is cancelled and the customer is notified. If stock is available, a goods release document and invoice/delivery order are issued. Storeman then removes the goods as instructed by the admin, followed by barcode scanning to update the stock. There is a branching based on the type of customer: for end users (users), storeman adds a PT XYZ warranty sticker as a marker that the item was purchased and issued by the company for handling warranty claims, then repackaging is carried out; while for reseller, after barcode scanning, repackaging is immediately carried out, and additional packaging is given to protect the product, this is done because suppliers generally order in large quantities. The cashier and admin inform the customer that the goods are ready for collection and ensure payment has been made before the transaction is declared complete.

3. Analyze

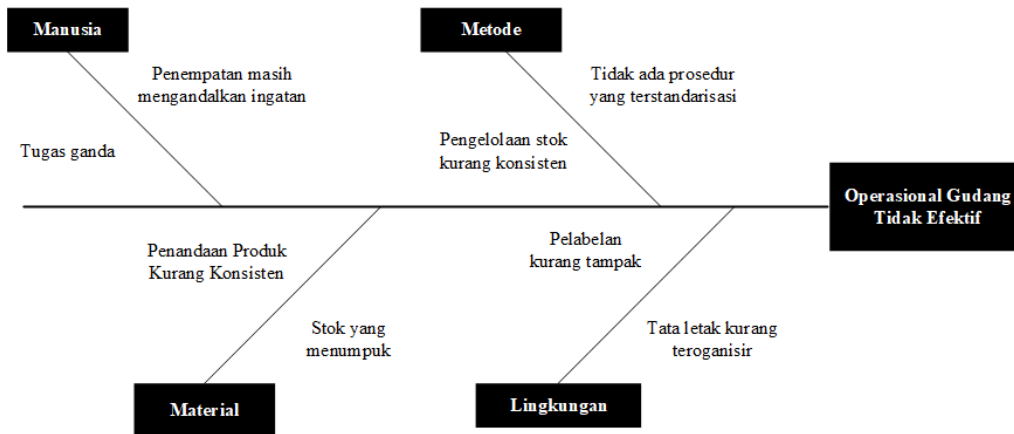


Figure 6 Fishbone Diagram

The problem lies in the responsibility of the operational admin who bears the dual task of managing, monitoring, and ensuring that the stock of goods in the company remains optimal but is still responsible for carrying out the company's administrative functions. This has an impact on the placement still relying on memory with a less organized layout which results in difficulty finding items when carrying out stock-taking. The absence of standardized procedures also complicates this problem when the admin is unable to come in, it will hamper the order picking process. Inconsistent management is characterized by not all Figure 4 Flow of Goods Storage incoming goods being given a receipt code due to the implementation of receiving goods while serving customers who want to order goods with the impact of placing goods in the warehouse not always FIFO.

4. Improvement

Based on the analysis of the root causes of warehouse operational problems identified in the fishbone diagram (Figure 6) at the Analyze stage, including multiple workloads on key personnel, reliance on memory for item location, absence of standard procedures, poorly organized physical layout, and difficulties and potential inaccuracies in the stock-taking process, the Improvement stage focuses on developing an integrated practical solution.

Two main solutions were proposed: first, a systematic rearrangement of the warehouse layout, which included logical grouping of goods and clear location labelling. This intervention directly addressed the issue of the disorganized layout and reduced the critical reliance on individual staff memory, enabling more effective delegation of storage and retrieval tasks to all staff, while supporting the implementation of consistent storage methods such as FIFO. Secondly, a new, more detailed stock-taking format was designed, with a major emphasis on the inclusion of specific physical location information for each stock item (warehouse, showroom, cupboard, basement). This structured format aimed to simplify the physical search process during inventory, standardize data collection methods, and significantly improve the accuracy of stock data as well as the time efficiency of stock-taking.

Both solutions are regulated and standardized guidelines are created to keep the implementation organized using a Standard Operational Procedure (SOP). This procedure is important to ensure that the activities that take place have a common standard that must be carried out by the staff involved in an activity. A standardized procedure is created when carrying out incoming goods according to the process mapping flow of receiving goods (Figure 3), by adding information and information needed by the staff involved in order to eliminate inconsistencies in procedures. In addition, steps are also added when receiving goods that do not match the number of orders or have damage to the packaging, this is done to reduce the risk of loss while accelerating follow-up with vendors and expeditions when these problems occur.

The implementation of this solution is carried out synergistically and then standardized into written Standard Operating Procedures (SOP) for all warehouse workflows, all of these solutions are expected to form a more structured, measurable, consistent, efficient operational system, and reduce vulnerabilities caused by human factors and work methods that have not been standardized.

Design of Standard Operational Procedure (SOP)

The design stage of the SOP document is based on the company's needs and proposals resulting from the evaluation of interviews and observations. The procedure is designed based on the process mapping that has been identified to reduce errors that occur in the current process by describing the work steps that have been carried out because the process has not had a written procedure before. The Standard Operating Procedure (SOP) design that will be used in warehouse operations includes the process of incoming goods, storage of goods, stock-taking, and outgoing goods at PT XYZ with the Cross Functional Flowchart model combined with narrative (Rahmaningtias & Hati, 2020). The following are the results of the SOP that has been designed, namely the process of incoming goods (Inbound), storage of goods, stock-taking and outgoing goods.

1. Inbound Goods Procedure

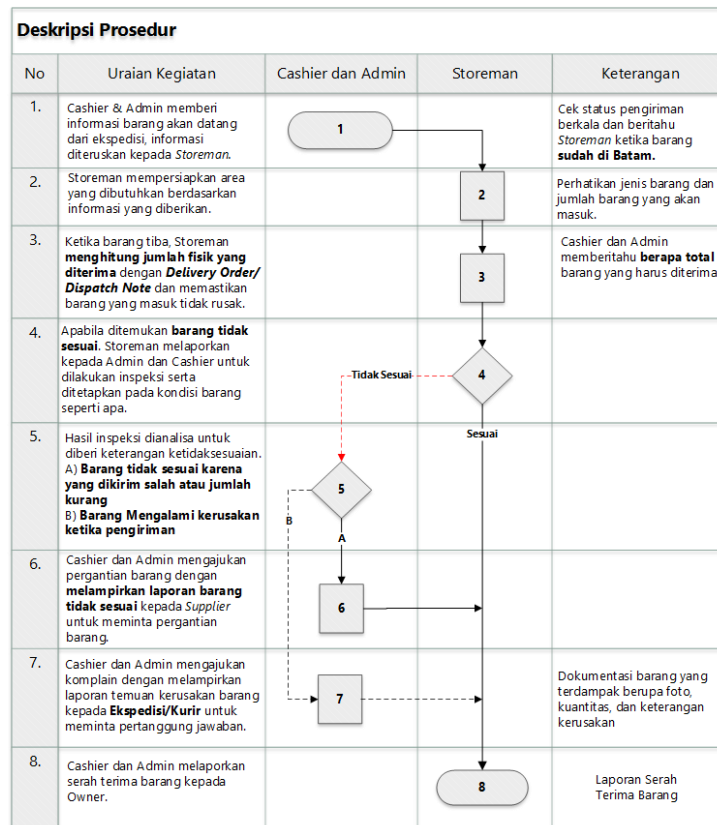


Figure 7. SOP Inbound

The description of the accompanying symbols in the Inbound SOP is as follows, terminator (Oval) signifies the starting or ending point of a process. Process (Square) signifies the activity or work steps performed. Decision (Rhombus/Diamond) signifies Figure 7 Storage SOP the point where a decision needs to be made that will determine the next flow (Yes/No).

Table 1. Details of Inbound SOP Procedures and Person in Charge

No.	Procedure Description	Person In Charge
1	Receive information on the arrival plan of goods from vendors.	Admin & Cashier
2	Forward information to Storeman for warehouse area preparation.	Admin & Cashier
3	Perform physical counting and verification of goods upon arrival.	Storeman
4	Matching shipping documents with physical goods.	Admin & Cashier
5	Analyze discrepancies (if any).	Admin and Storeman
6	Report to vendor (if wrong delivery/amount) or to expedition (if damaged).	Admin
7	Report the proper handover of goods to the company owner.	Admin & Cashier

2. Goods Storage Procedure

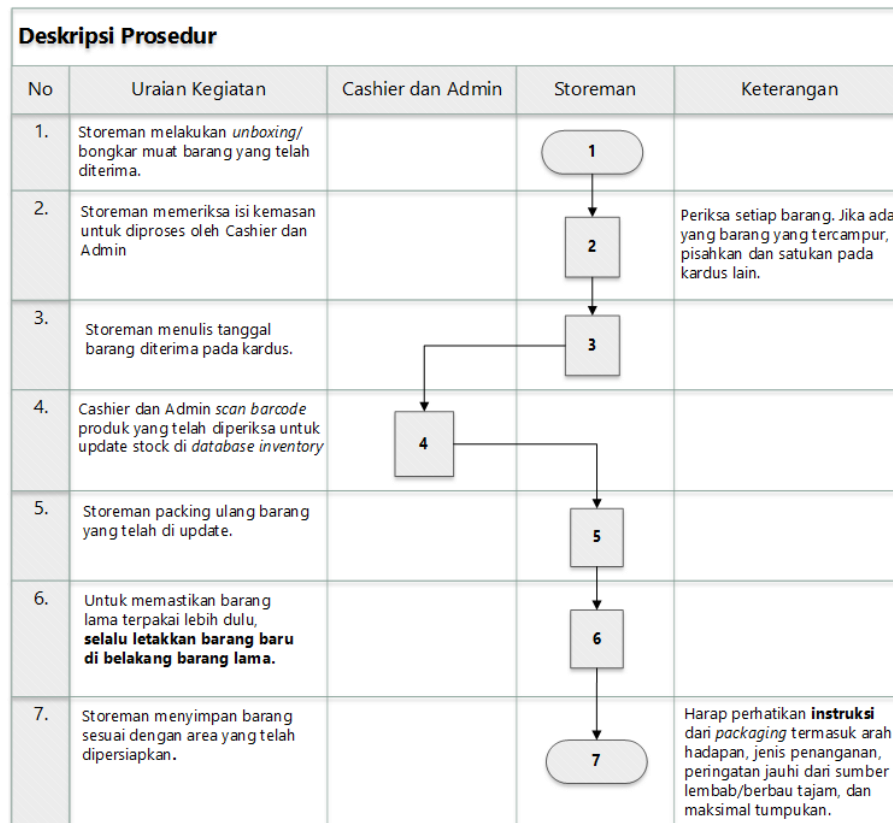


Figure 8. SOP Storing Goods

The description of the accompanying symbols in the storage SOP is as follows, the terminator (Oval) indicates the starting or ending point of a process. Process (Square) signifies the activity or work steps performed.

Table 2. Details of Procedures and Person in Charge of Storage SOP

No.	Procedure Description	Person In Charge
1	Storeman unboxing/unloading the goods that have been received	Storeman
2	Check the contents of the packaging to be processed by Cashier and Admin.	Storeman
3	Writes the date the goods were received on the cardboard box.	Storeman
4	Scans the barcode of the checked products to update the stock in the inventory database	Admin and Cashier
5	Repack the updated items.	Storeman

3. Stock-taking Procedure

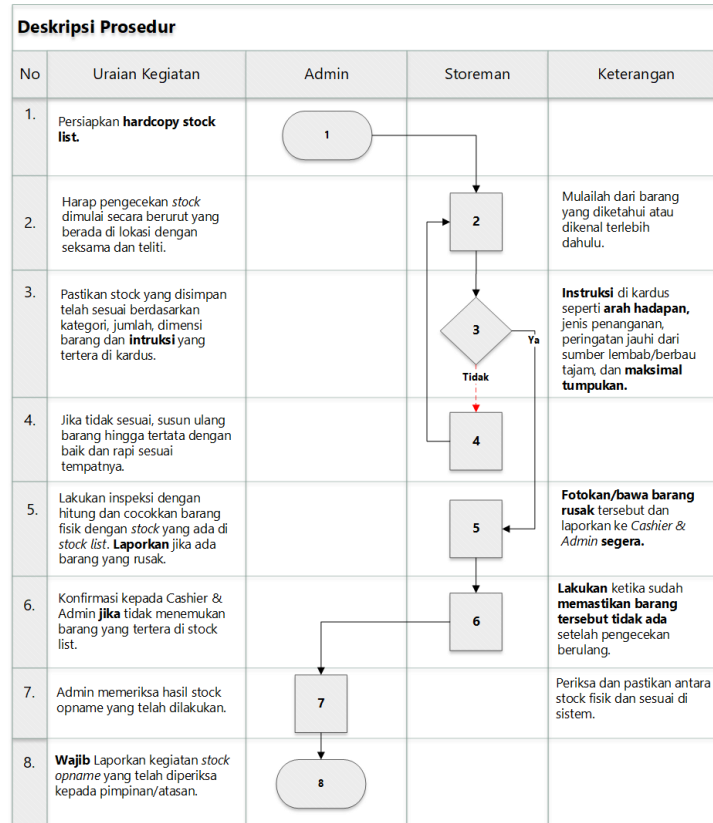


Figure 9. SOP Stock Take

The description of the accompanying symbols in the Stock Take SOP is as follows, terminator (Oval) signifies the starting or ending point of a process. Process (Square) signifies the activity or work steps performed. Decision (Rhombus/Diamond) signifies the point where a decision needs to be made that will determine the next flow (Yes/No).

Table 3 Details of Stock Take SOP Procedures and Person in Charge

No.	Procedure Description	Person In Charge
1	Prepare Hardcopy stock list	Admin
2	Please start checking the stock in order that it is in the location carefully and thoroughly	Storeman
3	Ensure that the stock stored is appropriate based on the category, quantity, dimensions of the goods and the instructions printed on the box.	Storeman
4	If not appropriate, rearrange the items until they are well organized and neatly in place.	Storeman
5	Inspect by counting and matching the physical items with the stock in the stock list. Report any damaged items.	Storeman
6	Confirm to the admin if you do not find the items listed on the stock list.	Storeman
7	Admin checks the stock-taking results that have been carried out.	Admin
8	Must report stock-taking activities that have been checked to manager.	Admin

4. Outbound Goods Procedure

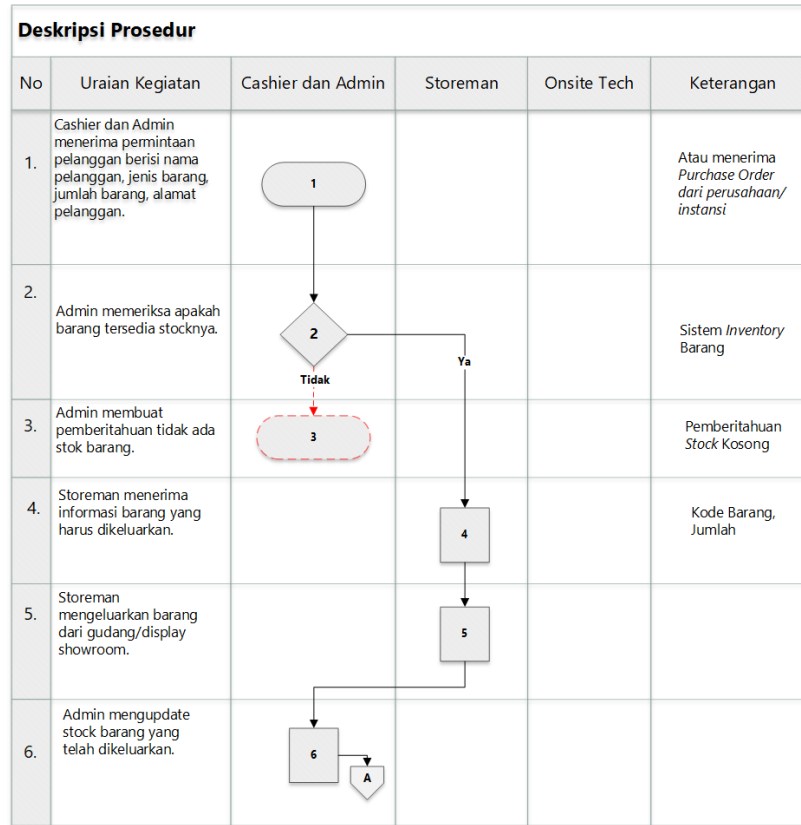


Figure 10. SOP Outbound

The description of the accompanying symbols in the SOP Outbound is as follows, terminator (Oval) signifies the starting or ending point of a process. Process (Square) signifies the activity or work steps performed. Decision (Rhombus/Diamond) signifies the point where a decision needs to be made that will determine the next flow (Yes/No). Off-Page Reference (pentagon) connects processes in different worksheets.

Table 4 Outbound SOP Procedure Details and Person in Charge

No.	Procedure Description	Person In Charge
1	Admin and cashier receive customer requests containing customer name, item type, and customer address.	Admin & cashier
2	Admin checks whether the item is in stock.	Admin
3	If the stock is empty, the admin creates a notification of no items.	Admin
4	Storeman receives information on items that must be issued.	Storeman
5	Storeman removes goods from the warehouse.	Storeman
6	Admin updates the stock of goods issued	Admin
7	Admin tells the type of customer whether user or reseller.	Admin
8	Specifically for users, then put stickers on the product first	Storeman
9	Do a live test and video it while it's on	Onsite Tech
10	Repackage updated items	Storeman
11	Admin asks if the user uses installation services	Admin
12	Admin issues delivery order	Admin
13	Technician delivers and installs at customer's location according to delivery order	Onsite Tech
14	Technician gives signed delivery order to admin	Onsite Tech
15	Admin opens the invoice and invoices the customer for payment.	Admin & cashier
16	Admin updates the transaction status on the system.	Admin & cashier

Feasibility testing and SOP implementation

The results of the SOP design are then carried out feasibility tests aimed at ensuring that the SOP that has been made can be implemented, in other words the SOP made has passed the verification and validation test. The SOP trial scenario was adopted based on previous research (Rahmaningias & Hati, 2020). There are two scenarios in testing the SOP carried out in this study, which can be seen in the following table:

Table 5 SOP Testing

Scenario	Objective	Method	Goal
Scenario 1	The validity of the information defined and included in the SOP is checked through procedural verification steps.	Discussion	The authority to determine what is needed, form policies, and decide on matters related to the company's operations rests with the Operations Manager, who plays a key role in the operational structure.
Scenario 2	Validation was conducted by testing whether the designed SOPs could be effectively applied in real-life situations, as well as to detect areas that needed improvement.	SOP implementation and interviews (17 February to 17 March 2025 or 30 days working period)	Implementation of SOPs, viz: a) Inbound b) Storage c) Stock-taking d) Outbound

Socialization and implementation of Standard Operating Procedure (SOP) Inbound, Storage, Stock Take, and Outbound at PT XYZ. The results of the analysis made with the SOP implementation monitoring table for the period 17 February 2025 to 17 March 2025 which adopts the results of research Anjani & Hati (2021) and a comparison of the implementation of the SOP with the old system at PT. XYZ, as follows:

Table 6 Warehouse Operations SOP Implementation Table

No	Procedure Description	Implementation per week				Description
		1	2	3	4	
Inbound						
1	Coordination of arrival plan	X	-	-	✓	Partially implemented
2	Preparing the required area	X	-	-	✓	Partially implemented
3	Counting and comparing physical goods with documents	✓	-	-	✓	Implemented with either
4	Finding non-conforming goods	-	-	-	-	Does not occur
5	Reporting Goods Handover	✓	-	-	✓	Implemented with either
Storing						
1	Perform loading and unloading	✓	-	-	✓	Implemented with either
2	Inspection and sorting of goods	✓	-	-	✓	Implemented with either
3	Writing the receipt code	✓	-	-	✓	Implemented with either
4	Update goods to inventory system	✓	-	-	✓	Implemented with either

5	Repacking of updated items	✓	-	-	✓	Implemented with either
6	FIFO storing	✓	-	-	✓	Implemented with either
	Stock Take					
1	Provide Hardcopy Stock List	✓	✓	✓		Implemented with either
2	Checking in a coherent manner according to the knowledge that checks	✓	✓	✓		Implemented with either
3	Ensure that the stock stored is in accordance with the zoning of the goods	✓	✓	✓		Implemented with either
4	Matching physical items with the stocklist	✓	✓	✓		Implemented with either
5	Notify the admin if there are items that are not recorded in the stocklist and items that are damaged	✓	✓	✓		Implemented with either
6	Reporting stock-taking activities carried out by storeman to the admin	✓	✓	✓		Implemented with either
	Outgoing Goods					
1	Cashier & admin receive customer requests	✓	✓	✓	✓	Implemented with either
2	Stock check	✓	✓	✓	✓	Implemented with either
3	Notification if stock is empty	✓	✓	✓	✓	Implemented with either
4	Storeman receives information on goods to be issued	✓	✓	✓	✓	Implemented with either
5	Storeman releases goods according to the information provided	✓	✓	✓	✓	Implemented with either
6	Update the goods that have been issued	✓	✓	✓	✓	Implemented with either
7	Providing warranty stickers for users	✓	✓	✓	✓	Implemented with either
8	User life test (machine)	✓	✓	✓	✓	Implemented with either
9	Repacking	✓	✓	✓	✓	Implemented with either
10	Delivery Order (DO) issuance	✓	✓	✓	✓	Implemented with either
11	Delivery and installation based on user instructions and DO	✓	✓	✓	✓	Implemented with either
12	Provide signed DO to admin	✓	✓	✓	✓	Implemented with either
13	Open Invoice and billing	✓	✓	✓	✓	Implemented with either
14	Update Transaction status in the system	✓	✓	✓	✓	Implemented with either

Table 7 Comparison of Sop Implementation with Old System

Comparison Element	Before SOP Implementation	After SOP Implementation
Process	Not standardized, undocumented, inconsistent, based on direct instruction/experience	Standardized, documented (SOP Inbound, Storage, Stock take, Outbound), consistent, structured
People	High on key personnel recall, double workload on admins	Reduced, allows for more effective task delegation
Environment	Difficult and time-consuming, depending on the memory of the last person who placed the item.	Easier and faster with clear layout, labelling and new stock-taking format.
Methods	Ineffective, unorganized storage, placement of items relying on memory, not always FIFO	More effective, organized storage with clear layout & labelling, consistent FIFO application, detailed stock-taking format.
Time Efficiency	Average stock-taking: 349.5 minutes. Average inbound execution: 298 minutes.	Average stock-taking: 128.7 minutes (63% improvement). Average Inbound execution: 194 minutes (34.5% improvement).
Stock accuracy	Average stock-taking accuracy: 70%.	Average stock-taking accuracy: 92% (24% improvement).

The socialization and implementation of the Standard Operating Procedure (SOP) for the Inbound, Storage, Stock take, and Outbound processes at PT XYZ was carried out over a one-month period, from 17 February to 17 March 2025. Table 6 (Warehouse Operations SOP Implementation Table) monitors the implementation of these procedures on a weekly basis during that period.

Based on table 6, most of the procedures in the Storing, Stock take, and Outbound flows were consistently implemented on a weekly basis (marked with '✓'). This indicates a good level of compliance and adaptation of the staff to the new SOPs during the pilot period with a total implementation at 61% which based on the interview with the Operations Manager, the implementation expectation is 50% so the SOP implementation rate has met the target. For the Inbound procedure, the implementation of steps (such as arrival coordination and area preparation) was recorded in week 4, indicating that these steps were carried out as needed when there was a scheduled receipt of goods from vendors, while the step of counting and reporting the handover was carried out in weeks 1 and 4. Specific steps to deal with non-conforming goods did not occur during the observation period. Overall, Table 5 shows that the designed SOP can be implemented in the daily operations of the PT XYZ warehouse during the implementation period.

The design of the Standard Operating Procedure (SOP) for warehouse operations at PT XYZ was based on an in-depth evaluation of the previous non-standardized business processes and the company's need to overcome problems such as ineffective stock management, difficulty finding items, and work inconsistencies. The SOP was then validated through discussions with the Operations Manager to ensure it was in line with the company's needs and policies. Implementation and testing of the SOPs took place over a period of one month (17 February - 17 March 2025). Observations during this period (as seen in Table 6) showed that the warehouse staff (storeman) and administration (admin & cashier) were able to carry out the established procedures for receiving, storing, stock-taking, and issuing goods.

The effectiveness shown during the SOP trial period is inseparable from the careful design process in the previous stages. In the Define, Measure, and Analyze phases, the identification of operational problems and needs was conducted in-depth through direct observation and semi-structured interviews with key personnel such as the operations manager, admin, and marketing staff. The direct involvement of these stakeholders ensured that every procedure designed in the improvement phase was aligned with the operational reality and real needs of the company. In addition, the initial validation of the design through discussions with the operations manager of (as described in Scenario 1 of the feasibility test) served as a critical verification step that minimized potential obstacles during implementation. Thus, a strong analytical foundation and early procedural

validation were the main reasons why the pilot test was able to run effectively and proceed directly to the implementation stage without requiring redesign iterations.

Based on its implementation, it can be concluded that the new SOP provides significant improvements over the old system, as seen from comparative elements such as more structured processes, standardized work methods, and improved people/staff performance. This positive impact is clearly measured in Table 7 of the stock-taking activities, where there was a 63% increase in time efficiency (average duration fell from 349.5 minutes to 128.7 minutes) and a 24% increase in accuracy (average accuracy rose from 70% to 92%) after the implementation of the SOP. To maintain sustainability and maximize the benefits of this SOP, PT XYZ is advised to regularly monitor and evaluate the implementation of the SOP to ensure continuous training for all staff, continuous performance monitoring, feedback mechanisms, and periodic review and update of the SOP.

Discussion

Based on the results of the evaluation of the warehouse operations business process at PT XYZ, it was found that there was no standardized Standard Operating Procedure (SOP). The work process runs based on verbal instructions or past experience, causing inconsistencies, difficulties in stock management, and inefficiencies, especially when searching for items that take significant time. This finding is in line with several previous studies that also identified operational problems due to the absence of standardized procedures (Aryanto & Maksum, 2022).

This condition emphasizes the importance of process evaluation and improvement to improve operational performance. This is in line with the basic principles of operations and warehousing management, which show that the implementation of SOPs can make the process more structured, effective, and efficient (Rahmaningtias & Hati, 2020; Sari et al., 2023). SOP development is a crucial step to standardize and ensure consistent service quality. The warehouse operational business process at PT XYZ before the intervention can be categorized as less effective compared to the potential after the implementation of the designed SOP. SOP serves as an essential guide to ensure operational activities can run smoothly and consistently (Beyene et al., 2022).

In this study, the Six Sigma DMAIC method provides a structured framework for analyzing root causes and designing measurable improvements. The selection of this method is based on its proven effectiveness in various contexts, such as in the field of warehouse and logistics (Adeodu et al., 2023; Pacheco et al., 2023) as well as in other sectors (Mulyana & Soleha, 2024; Sari et al., 2023). The initial condition of the warehouse operations business process at PT XYZ was not standardized, causing inefficiencies and irregular workflows. Through the DMAIC approach, researchers used fishbone diagrams at the analyze stage to identify the root of the problem, a method that is in line with previous research (Aryanto & Maksum, 2022). Based on the results of the analysis, a solution was designed in the form of a Standard Operating Procedure (SOP) for the inbound, storing, stock-taking, and outbound processes.

This SOP document was designed by combining flowcharts and narratives to ensure clarity of instructions. The use of this mixed method is in line with previous research (Rahmaningtias & Hati, 2020). This design is also complemented by supporting improvement proposals such as a rearrangement of the warehouse layout and a new stock-taking format to address the specific problems found. The application of the DMAIC approach ensures that the SOPs designed are based on data analysis and the real needs of the company. This is in line with the main objective of the method which focuses on fact-based improvement (Antony et al., 2016).

To evaluate the impact of SOP implementation, the researcher conducted a comparative analysis of conditions before and after implementation at PT XYZ. This analysis uses a comparative framework that observes four main elements: Process, People, Environment, and Method, an approach that is in line with previous research (Rahmaningtias & Hati, 2020). The results of the analysis showed a significant positive impact on operational performance after the SOP was implemented.

- 1) In terms of Process, workflows became more standardized, structured, and consistent than before. Standardized work is the foundation of lean and key in reducing variability. (Leksic et al., 2020)
- 2) 2) In terms of people, employees now have clear work guidelines, reduce reliance on memory and potential errors (waste defects), and are expected to improve discipline. (Adeodu et al., 2023)

- 3) 3) In terms of Environment (Warehouse), the rearrangement of the layout creates a more organized work area, reducing unnecessary motion and search time. (Pacheco et al., 2023)
- 4) 4) In terms of Methods, the implementation of SOPs standardizes the way each warehouse activity is carried out, including a more consistent application of FIFO and better stock-taking procedures. (Anietie et al., 2024)

Observations during the implementation period (Table 6) showed that the designed SOPs were mostly consistent implemented by staff, proving that the procedures were applicable and well adopted during the pilot period. This consistency of implementation is evidence of successful standardization, an important step in continuous improvement. This is supported by the highly visible impact of the SOP implementation on improving stock-taking performance. Data shows a 63% decrease in the average duration of stock-taking (from 349.5 minutes to 128.7 minutes) and a 24% increase in average accuracy (from 70% to 92%). Similar improvements were also seen in inbound performance, with data showing a 34.5% decrease in the average duration of inbound operations (from 298 minutes to 194 minutes). This reduction in lead time and improvement in accuracy is a direct result of the standardization of work methods.

This improvement is significant and consistent with the findings of other studies implementing DMAIC or lean in warehouses, where a 41.4% reduction in lead time was reported (Pacheco et al., 2023) and an increase in Process Cycle Efficiency (PCE) from 40% to 70.4% (Adeodu et al., 2023). Thus, it can be concluded that the implementation of SOPs and related improvements have a positive and strong impact on the warehouse operations of PT XYZ.

CONCLUSION

The application of the Six Sigma (DMAIC) method has successfully overcome operational problems in PT XYZ's warehouse caused by the absence of standardized procedures. This success was achieved by designing and implementing Standard Operating Procedure (SOP) for inbound, storage, stock-taking, and outbound processes. The implementation was supported by an improved warehouse layout and an updated stock-taking format. As a result, operational performance improved significantly, as measured by the 63% increase in stock-taking time efficiency, 24% increase in stock accuracy, and 34.5% increase in inbound processing time efficiency. Overall, these improvements resulted in a more structured and efficient warehouse workflow.

To ensure the sustainability of the improvements, the researcher suggests that PT XYZ consistently implement the designed warehouse operational Standard Operating Procedure (SOP). In addition, the company needs to continue the DMAIC cycle to the Control stage, which includes continuous performance monitoring and conducting regular SOP reviews and updates. Furthermore, the researcher also recommends that PT XYZ examine the application of this systematic approach to other operational areas in order to achieve comprehensive process standardization.

REFERENCE

- Adeodu, A., Maladzhi, R., Katumba, M. G. K.-K., & Daniyan, I. (2023). Development of an improvement framework for warehouse processes using lean six sigma (DMAIC) approach. A case of third party logistics (3PL) services. *Heliyon*, 9(4). <https://doi.org/10.1016/j.heliyon.2023.e14915>
- Anietie, F., Offiong, A., Markson, I. E., Alexander, ;, Akpan, F. A., Offiong, A. A., & Ihom, A. P. (2024). Development of Standard Operations and Procedures for Inventory Control for Selected Brewery Industries. *International Journal of Multidisciplinary Research and Publications (IJMRAP)*, 7(2), 101–105.

- Anjani, P., & Hati, S. W. (2021, March). *DESIGN OF STANDARD OPERATING PROCEDURES (SOP) AND IMPLEMENTATION AT PT BSP* (pp. 106–115). <https://jurnal.polibatam.ac.id>
- Antony, J., Vinodh, S., & Gijo, E. V. (2016). *Lean Six Sigma for Small and Medium Sized Enterprises*. CRC Press.
- Aryanto, N., & Maksum, A. H. (2022). Analisis Sistem Manajemen Pergudangan dan Perancangan Standard Operating Procedure (SOP) Pada PT. X. *Jurnal Ilmiah Wahana Pendidikan*, 8(5), 17–30. <https://doi.org/10.5281/zenodo.6408370>
- Beyene, K. G., Nadew, S., Ali, W. G., Gebrehiwot, A. G., & Atsibeha, S. G. (2022). How to write standard operating procedures: Values and a practical guide. *International Journal of Drug Regulatory Affairs*, 10(4). <https://doi.org/10.22270/ijdra.v10i4.557>
- Dhiaf, M. M., Atayah, O. F., Nasrallah, N., & Frederico, G. F. (2021). Thirteen years of Operations Management Research (OMR) journal: A bibliometric analysis and future research directions. *Operations Management Research*, 14(3–4), 235–255. <https://doi.org/10.1007/s12063-021-00199-8>
- Khairunnisa, Latief, Y., & Riantini, L. S. (2020). Standard operational procedure (SOP) auditing process in integrated management system to improve the efficiency of organizational performance. *IOP Conference Series: Earth and Environmental Science*, 426(1). <https://doi.org/10.1088/1755-1315/426/1/012018>
- Leksic, I., Stefanic, N., & Veza, I. (2020). The impact of using different lean manufacturing tools on waste reduction. *Advances in Production Engineering And Management*, 15(1), 81–92. <https://doi.org/10.14743/APEM2020.1.351>
- Mulyana, A. E., & Soleha, D. F. A. (2024). Analisis Proses Bisnis Departemen Warehouse & Logistic Menggunakan Metode BPI pada Perusahaan Manufaktur. *Jurnal Akuntansi, Ekonomi Dan Manajemen Bisnis*, 12(1), 63–70.
- Pacheco, D. A. de J., Clausen, D. M., & Bumann, J. (2023). A multi-method approach for reducing operational wastes in distribution warehouses. *International Journal of Production Economics*, 256. <https://doi.org/10.1016/j.ijpe.2022.108705>

- Pereira, C. M., Anholon, R., Rampasso, I. S., Quelhas, O. L. G., Filho, W. L., & Santa-Eulalia, L. A. (2021). Evaluation of lean practices in warehouses: An analysis of Brazilian reality. *International Journal of Productivity and Performance Management*, 70(1), 1–20. <https://doi.org/10.1108/IJPPM-01-2019-0034>
- Rahmaningtias, D., & Hati, S. W. (2020). Perancangan Standard Operating Procedure (SOP) dan Sistem Informasi Barang Masuk dan Keluar pada Ritel PT Krisna Makmur Abadi. *Jurnal Akuntansi, Ekonomi Dan Manajemen Bisnis*, 8(1), 105–114.
- Rathee, M. M., & Rani, P. (2024). *Warehouse Management and Inventory Control System*. Literatureslight Publishing. <https://books.google.co.id/books?id=EcsrEQAAQBAJ>
- Sari, J. P., Sugihartanto, M. F., & Baihaqi, I. (2023). Business Process Improvement of Hospital Administration and Design of Standard Operating Procedures by Using the DMAIC Method: (Case Study: SMEC Eye Hospital). In G. W. Bhawika, G. A. Handiwibowo, N. Nareswari, & M. F. Sugihartanto (Eds.), *Proceedings of the 3rd International Conference on Business and Engineering Management (IConBEM 2022)* (Vol. 249, pp. 236–255). Atlantis Press International BV. https://doi.org/10.2991/978-94-6463-216-3_19
- Schmuck, R. (2022). Operations Strategies. *Regional Formation and Development Studies*, 7(2), 133–141. <https://doi.org/10.15181/rfds.v7i2.2353>
- Sugiyono. (2018). *Metode PENELITIAN Kuantitatif, Kualitatif dan R&D*. Alfabeta.
- Wuryani, E., & Harti, H. (2020). *Cooperative Management Through Standard Operational Management and Standard Operating Procedures to Improve the Performance*. <https://doi.org/10.2991/aebmr.k.200127.037>