Lean Manufacturing Strategy to Improve Efficiency of Goods Preparation and Delivery with PDCA Method

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ABSTRACT

This study focuses on the implementation of Lean Manufacturing principles to enhance the efficiency of goods preparation and delivery processes in a warehouse setting. The primary objective is to reduce the time taken for preparation and delivery while simultaneously increasing productivity. The research employs the PDCA (Plan-Do-Check-Act) methodology to systematically identify and address factors contributing to delays and waste in the preparation and delivery processes. In the "Plan" phase, an analysis of the current operational processes is conducted using Lean tools such as 5W + 1H and fishbone diagrams to identify inefficiencies. The "Do" phase involves implementing improvements, including reorganizing the warehouse layout and introducing stock leveling techniques to optimize item placement. The "Check" phase evaluates the effectiveness of these changes, revealing a 33% reduction in preparation and delivery time, alongside a 38% increase in productivity. The findings indicate that the application of Lean Manufacturing through the PDCA method has successfully streamlined the goods preparation cycle, leading to enhanced operational efficiency in the warehouse. This improvement not only meets but exceeds the initial targets set for preparation time and productivity, ultimately contributing to higher customer satisfaction through timely and reliable deliveries. The study concludes that Lean Manufacturing strategies can serve as a valuable framework for other organizations aiming to improve their operational performance and achieve competitive advantages in the market.

Keywords: Lean Manufacturing, PDCA, Warehouse, Efficiency.

INTRODUCTION

In the era of globalization and increasingly fierce business competition, companies are required to continuously improve operational efficiency and meet customer demands quickly and precisely. One area that often becomes a bottleneck in the supply chain is the warehouse, where the process of preparing and shipping goods can significantly affect the overall performance of the company. Delays in this process not only have the potential to cause financial losses but can also damage the company's reputation in the eyes of customers.

Lean Manufacturing, an approach that focuses on reducing waste and increasing value for customers, has proven effective in improving efficiency across a wide range of industries. This methodology emphasizes the elimination of non-value-added activities, providing a solid foundation for optimizing operational processes, including those in the warehouse. Numerous studies have highlighted the importance of Lean practices in enhancing warehouse efficiency. For instance, Womack and Jones (1996) outline five principles of Lean: value, value stream, flow, pull, and perfection, which serve as a framework for identifying and eliminating waste in various processes. In the context of warehousing, waste can manifest in forms such as excess inventory, unnecessary motion, and waiting times. By applying Lean principles, organizations can streamline their operations, reduce lead times, and improve service levels.

A widely recognized methodology for implementing Lean practices is the PDCA (Plan-Do-Check-Act) cycle. According to Deming (1986), the PDCA cycle provides a structured approach to problem-solving and continuous improvement. In the "Plan" phase, organizations assess their current processes and identify areas for improvement. The "Do" phase involves implementing changes, while the "Check" phase evaluates the

effectiveness of these changes. Finally, the "Act" phase focuses on standardizing successful practices and planning for further improvements.

Research by Muda et al. (2017) demonstrates that the application of Lean principles in warehouse operations can lead to significant reductions in preparation and delivery times. Their findings indicate that organizations adopting Lean practices experience enhanced productivity and improved customer satisfaction. Furthermore, studies by Seddighi et al. (2019) reveal that reorganizing warehouse layouts and optimizing stock levels can further enhance operational efficiency.

This research aims to implement Lean Manufacturing in the warehouse area with a focus on reducing goods preparation and delivery times. Through the PDCA approach, this study will identify the root causes of delays and waste, implementing improvements designed to increase efficiency. It is expected that the results of this research can not only contribute to the improvement of the company's operational performance but also provide guidance for other companies facing similar challenges. Thus, this research will present an in-depth analysis of the application of Lean Manufacturing and the PDCA method in the context of warehouse management and its impact on the preparation and delivery time of goods.

RESEARCH METHODOLOGY

To solve a problem in research, a systematic step called 8-step PDCA is needed so that the problems that arise can be clearly described. The steps used are as follows:

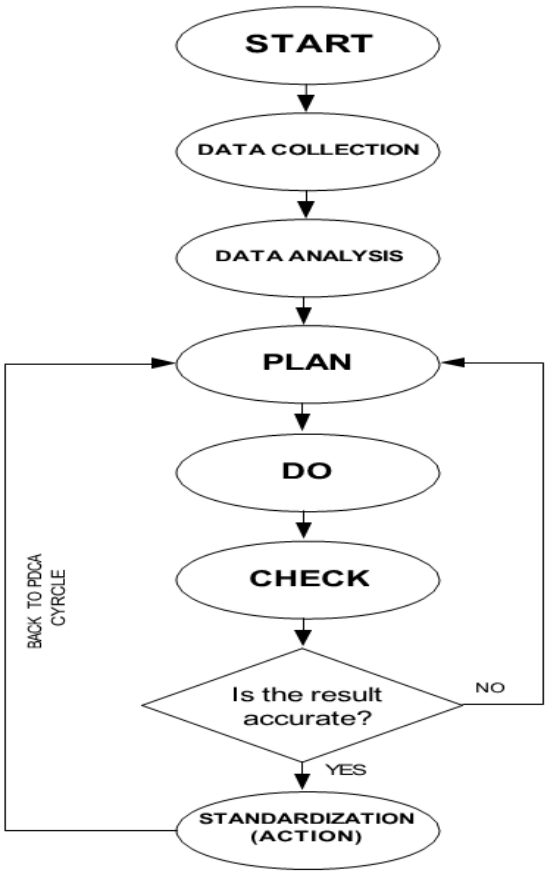


Figure 1 Flow of Research

Based on the picture above, the stages of research that will be carried out are as follows:

1. The Plan stage begins with understanding the basic theory that will be used in the implementation, followed by a survey of conditions in the production section. After that, data is collected and processed to assess the condition of productivity in the company. The results of this analysis are then used to describe the existing situation in the company and set targets for improvements to be made.

2. In the Do stage, the implementation of improvements is carried out as the first step of the plan that has been designed in the previous stage. This step involves implementing the improvement strategies or methods that have been determined to achieve the desired productivity or efficiency targets. In this stage, various corrective actions are implemented, including changes in work procedures, rearrangement of layouts, or development of tools that support the production Volume 8, Issue 11, November 2023 International Journal of Innovative Science and Research Technology ISSN No:-2456-2165 IJISRT23NOV1791 www. ijisrt.com 1 5 6 7 process.
3. At the check stage, an evaluation of the results of the improvement implementation is conducted to assess the extent to which the improvement has succeeded in achieving the desired targets. This evaluation process includes analyzing performance data after implementation, such as productivity, efficiency, or product quality, which is compared to the targets set in the Plan stage. If the evaluation results show that the targets have not been achieved, a review of the conditions and problems that may still exist or arise during the implementation process is conducted. This stage also allows for the identification of areas that require additional adjustments or improvements to effectively achieve the desired results.
4. In the Action stage, if the results of the improvement have met the desired targets, then the improvement steps will be standardized and integrated into the company's work procedures permanently. This standardization process includes documentation of successful methods, procedures, and practices, so that the entire team can implement improvements consistently. Standardization also includes training for employees to ensure proper understanding and application in daily work. Thus, the improvements that have been made become part of the company's work culture and serve as a foundation for continuous performance improvement in the future.

RESULT AND DISCUSSION

To overcome the problems that occur in the company, a method is needed that can overcome problems with targeted analysis. In this research, the PDCA method (Plan, Do, Check, Act) is used where each stage will be explained as follows:

Planning Stage (Plan)

The first step is to determine the research theme based on the existing problems. The research was conducted in the Warehouse area because the area is the last area of goods before being sent to the customer, so there are many important things that must be considered to ensure that the goods sent can meet the demands of the customer. The most important aspect is the delivery aspect because it is closely related to the customer's need for the goods to be ordered. Based on the warehouse department's Key Indicator Performance (KPI) data, it is known that the delivery aspect with the delivery preparation time indicator is not achieved. The target preparation time determined is 7 minutes / box, but the actual reaches 9 minutes / box. Long preparation time will affect decreased productivity. The target data for goods prepared is 60~70 boxes/day. But the actual is only an average of 55 boxes/day.

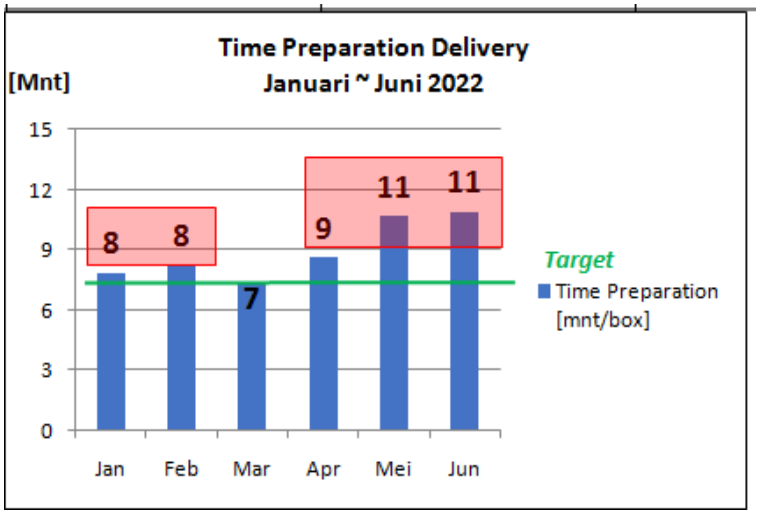


Figure 2 Time Preparation Delivery Histogram

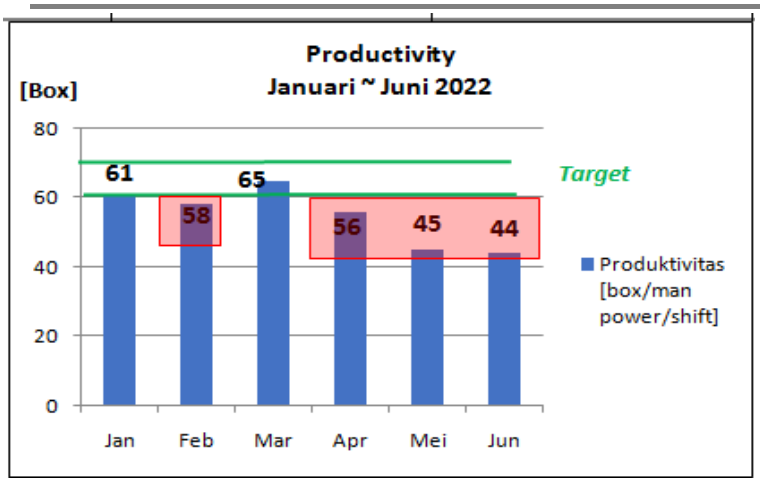


Figure 3 Productivity Histogram

Based on the graph above, it is known that the average delivery preparation time exceeds the predetermined target and affects the number of items prepared in 1 day (productivity graph). This can cause considerable loss costs. Throughout January to June 2022, the company has lost IDR 4,760,000, - caused by the delivery time target that was not achieved. This research is targeted to be able to overcome the problems that occur. The target is needed as an indicator of the success of the system/improvement that has been determined. Based on previous data, this research targets a 22% decrease in preparation time and an 18% increase in productivity .\

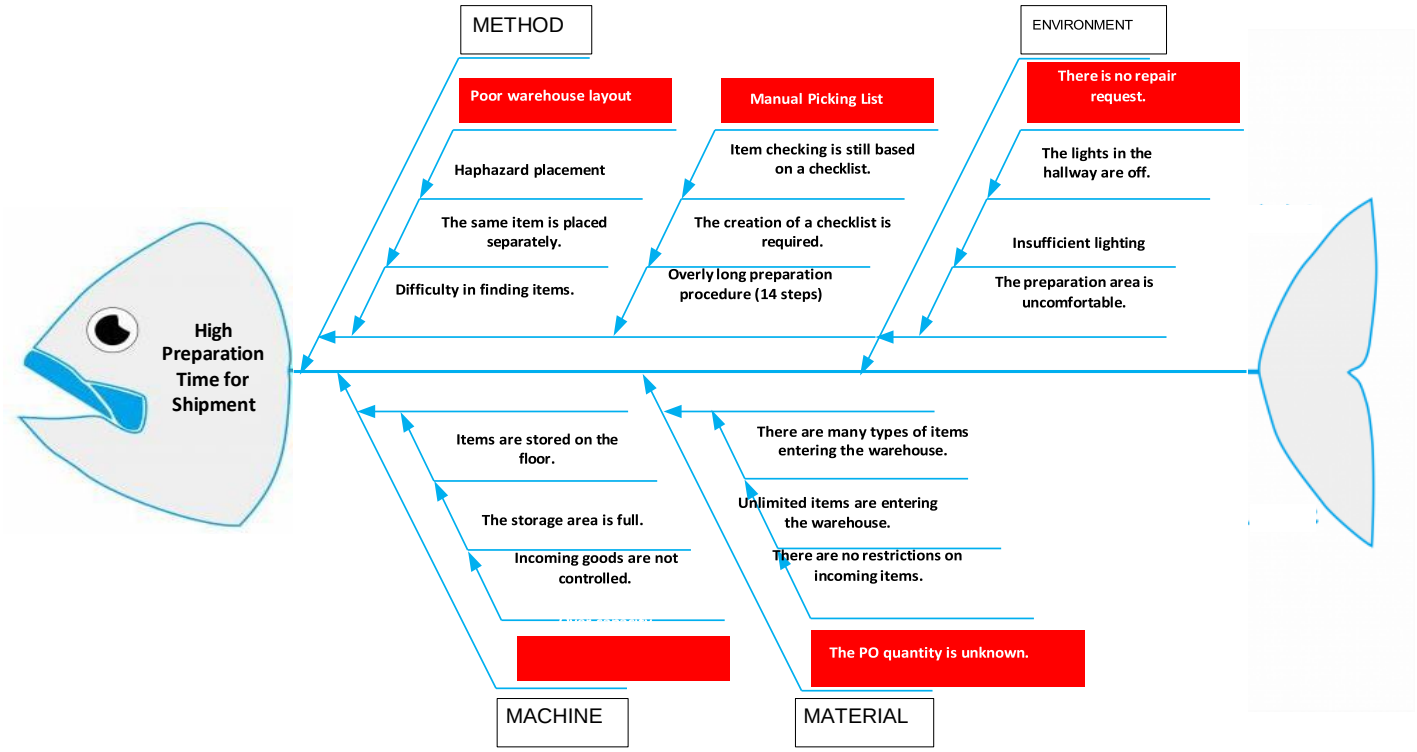


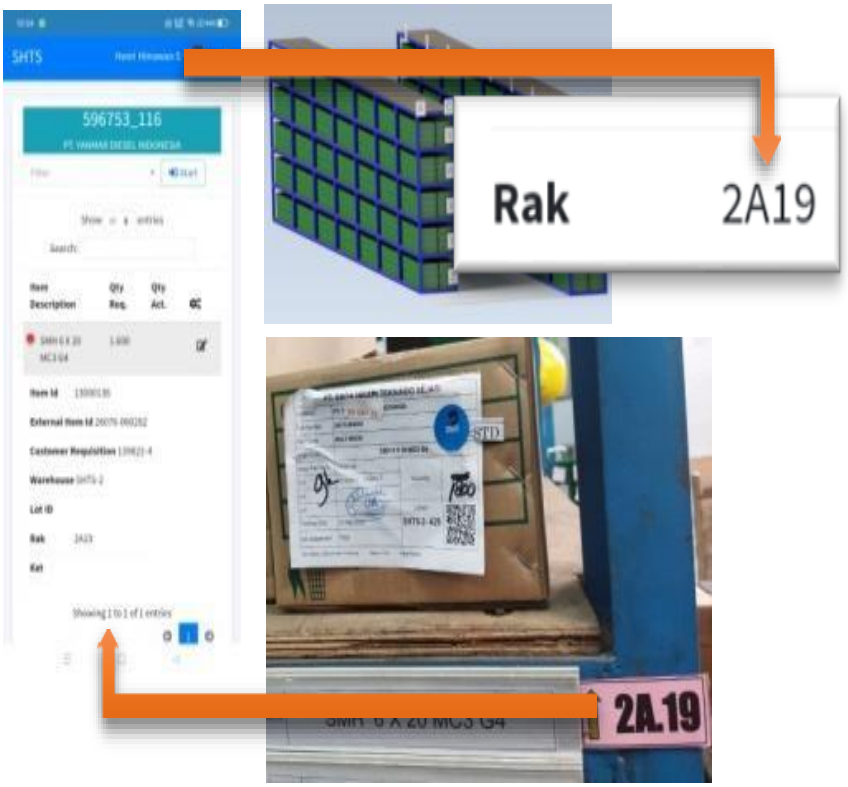
Figure 4 Fishbone Diagram

Based on the fishbone diagram above, several root causes of the problem were found. From several root causes found, then sorted based on the priority scale of which aspects must be resolved first. Some important points to focus on are poor layout (Method), manual picking list (Method), and over capacity (Machine). These important points will then become the target of improvement and evaluation.

Action Stage (Do)

After identifying the existing problems, the research continued with corrective actions based on the Kaizen concept. The corrective actions taken in the Warehouse area can be seen in the following table:

Tabel 1. Improvement Result

<table>
<tr><td>Before</td><td colspan="2" rowspan="2"> 
</td></tr>
<tr><td>The placement of goods is not appropriate because many similar goods are separated. Making it difficult or operators to find items.</td></tr>
<tr><td>After</td><td colspan="2" rowspan="2">
<table>
<tr><th>Customer</th><th>Item Number</th><th>Item name</th><th>Before</th><th>After</th></tr>
<tr><td>PT. YANMAR DIESEL INDONESIA</td><td>10000040</td><td>(A)HSMH 8 X 20 MC3+ 7T K12</td><td>2A20</td><td>2A20</td></tr>
<tr><td>PT. YANMAR DIESEL INDONESIA</td><td>11000058</td><td>FB 6 X 10 MC3 G7 YDI</td><td>2B31,2A34,2A36</td><td>2A36</td></tr>
<tr><td>PT. YANMAR DIESEL INDONESIA</td><td>11000074</td><td>FB 6 X 12 MC3 G7 YDI</td><td>2B29,2A36</td><td>2A36</td></tr>
<tr><td>PT. YANMAR DIESEL INDONESIA</td><td>11000085</td><td>FB 6 X 16 MC3 G7 YDI</td><td>2A26,2A35</td><td>2A35</td></tr>
<tr><td>PT. YANMAR DIESEL INDONESIA</td><td>11000110</td><td>FB 6 X 25-18 MC3 G7 K10 YDI</td><td>2A34,2A35</td><td>2A35</td></tr>
<tr><td>PT. YANMAR DIESEL INDONESIA</td><td>11000151</td><td>FB 6 X 65-18 MC3 G7 YDI</td><td>2A34</td><td>2A34</td></tr>
<tr><td>PT. YANMAR DIESEL INDONESIA</td><td>11000240</td><td>FB 8 X 75-22 MC3 G7 YDI</td><td>2A32</td><td>2A32</td></tr>
<tr><td>PT. YANMAR DIESEL INDONESIA</td><td>11000011</td><td>FB 10 X 20 MC3 G7 P1.5 YDI</td><td>2A32</td><td>2A32</td></tr>
<tr><td>PT. YANMAR DIESEL INDONESIA</td><td>11000016</td><td>FB 10 X 25 MC3 G7 P1.5 YDI</td><td>2A31</td><td>2A31</td></tr>
<tr><td>PT. YANMAR DIESEL INDONESIA</td><td>11000022</td><td>FB 10 X 28 MC3 G7 P1.5 YDI</td><td>2A31</td><td>2A31</td></tr>
<tr><td>PT. YANMAR DIESEL INDONESIA</td><td>11000301</td><td>FB 10 X 50-26 MC3 G7 K14 P1.5 YDI</td><td>2A31</td><td>2A31</td></tr>
<tr><td>PT. YANMAR DIESEL INDONESIA</td><td>14000001</td><td>SMH 1/2 X 4 + NUT KZ</td><td>2A25,2A28</td><td>2A28</td></tr>
<tr><td>PT. YANMAR DIESEL INDONESIA</td><td>13000502</td><td>SMH 8 X 10 MC3 P1.0 45K</td><td>2A19</td><td>2A19</td></tr>
</table>
Address Grouping


</td></tr>
<tr><td>Result Effect</td><td>Searching for items will be easier, and the new layout is more ergonomic.</td></tr>
</table>

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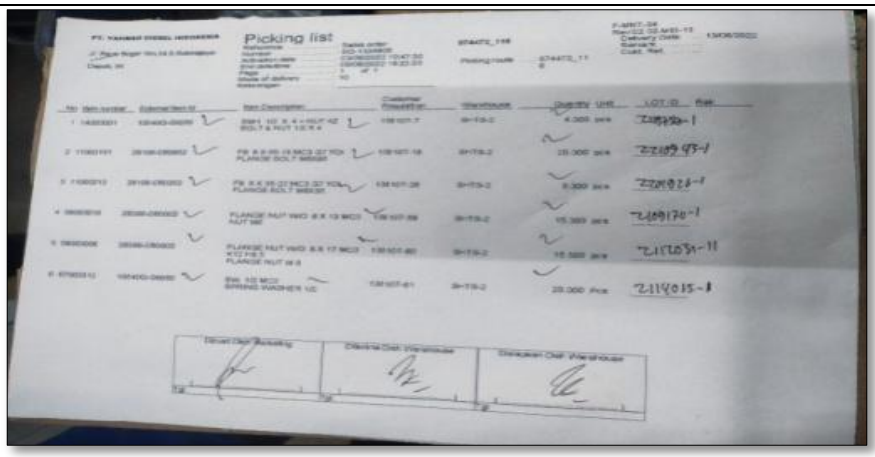
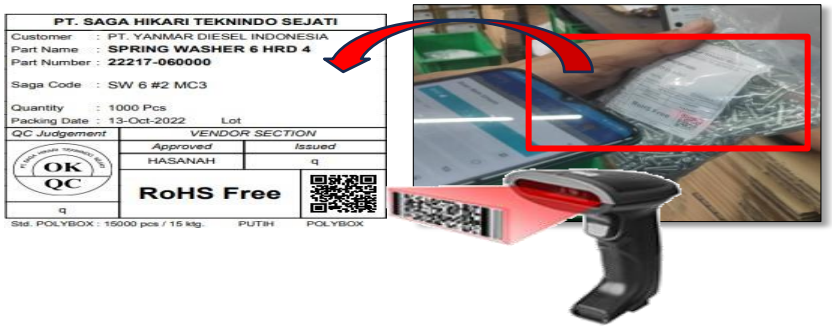
Before Picking List is still printed manually. Operators need many steps to prepare and check documents	
After Creation of e-picking list application	
Result Effect	Make it easier for operators to check the picking list, reduce paper usage, and eliminate nonvalue work that causes waste.
Before The large area Required (41.5 m2) causes a waste of warehouse area. Total columns required are 18 columns. 1x preparation requires 10 motions.	
After The concept of Leveling Stock by changing the placement of goods on shelves according to the category and types of goods (Slow moving, moving, and fast moving)	
Result Effect	With Stock Leveling, the required area is reduced (saving 7m2 area), a total of only 15 columns are required, and it reduces the motion in preparing goods.

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Check Stage

The check stage is the stage of re-examining whether the improvements that have been made can be carried out properly and produce significant effects or not. The check stage evaluates the results of the improved research results and is presented in the form of tables and graphs.

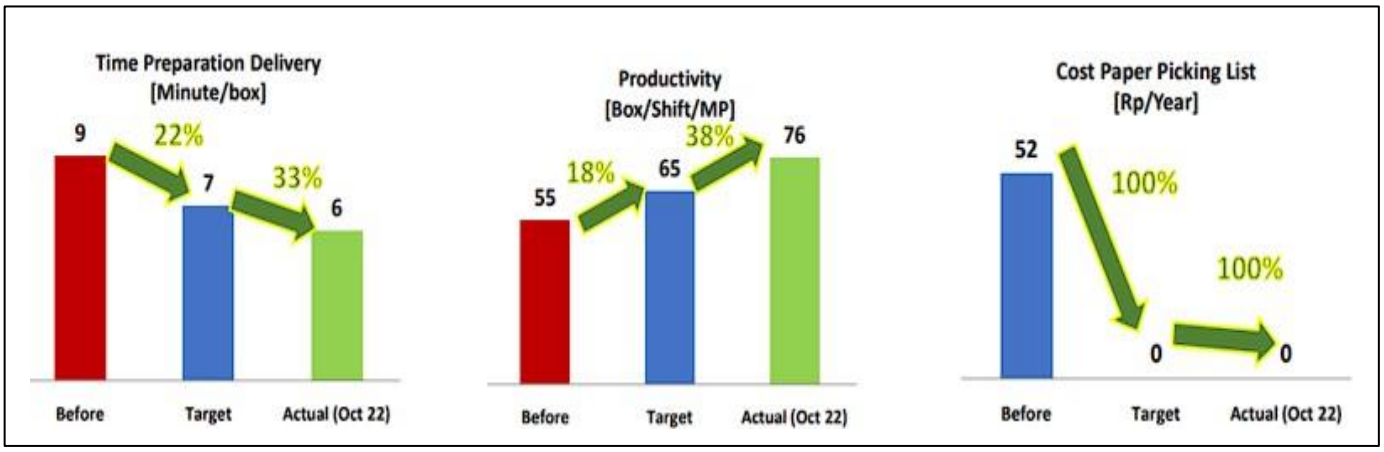

Figure 5 Graphical Observation of Improvement Performance Results

When viewed from the Time preparation delivery chart, there was a decrease in preparation time of up to 33%, exceeding the set target of 22%. The decrease in preparation time has an effect on productivity. The productivity graph shows an increase of up to 38%, exceeding the set target of 18%. In addition to delivery time and productivity, this improvement also has an effect on saving paper usage up to 100%. If it is concluded, the improvements that have been made have succeeded in overcoming the waste contained in the warehouse area so that the Warehouse Department KPI can be 100% achieved.

No	Indicators	Target Value	Act [2022]	Judg
1	D = On Time Delivery	100%	100%	OK
2	P=Productivity UP	5% Min.	38%	OK
3	Q= Reduce Claim	25%	0%	OK
4	S= Accident	0 Case	0 Case	OK

Figure 6 Table of KPI Achievements

Action

The next stage is the action stage in the form of standardization or follow-up of the results of improvements that have been made, so as to reduce the possibility of problems recurring in the future. Some of the standardization that has been done is:

1. The delivery preparation work instruction (IK) was revised from manual preparation to IK preparation + IK e-picking list application to make it easier for operators to use the application.
2. Socialization to all related members, including leaders, foreman, and warehouse supervisors so that the improvements that have been made can be consistently carried out and maximize the controlling function.

CONCLUSIONS

This research shows that the implementation of Lean Manufacturing strategies using the Plan-Do-Check-Action (PDCA) method can significantly improve efficiency in the warehouse department's goods preparation and delivery processes. Through analysis and continuous improvement at each stage of PDCA, this study

successfully identified and eliminated non-value-added activities and optimized the use of resources. At the Plan stage, evaluation of KPIs showed a mismatch between targets and actual results, especially in time preparation delivery and productivity. Implementation at the Do stage includes grouping goods into one address group to make it easier for operators to find goods, creating an e-picking list to reduce excess motion due to manual creation and checking, and Leveling Stock to reduce the storage area of goods. Evaluation of the improvements that have been made shows significant improvements in the form of a decrease in delivery preparation time by 33%, an increase in productivity by 38%, and savings in paper raw materials by 100%. Finally, the Action stage resulted in effective process standardization to be implemented on an ongoing basis. In conclusion, the PDCA method as part of the Lean Manufacturing strategy has proven effective in improving operational efficiency and supporting the achievement of company targets in terms of delivery time and quality. The results of this study can serve as a reference for other companies in applying a similar approach to improve warehouse operational performance and achieve a competitive advantage in the market.

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