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Efficiency Unleashed: Lean Manufacturing Strategies in Analyzing The Plastic Packaging Production Process

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ABSTRACT

The production process of plastic packaging plays a crucial role in modern manufacturing industries. PT. ABC, as a manufacturer of plastic packaging, strives to enhance production efficiency and productivity through the implementation of Lean Manufacturing methods. This study discusses the implementation of Lean Manufacturing within the plastic packaging production process at PT. ABC. The Lean Manufacturing methodology is employed to identify and reduce wasteful practices in the production process, aiming to enhance efficiency, quality, and customer satisfaction. The outcomes of this research provide insights into the impact of Lean Manufacturing implementation on optimizing the plastic packaging production process, yielding substantial benefits for the company and contributing to the development of a sustainable manufacturing industry. Consequently, this study holds the potential to make a valuable contribution to the field of Mechanical Engineering and General Engineering as a whole.

Keywords: Plastic Packaging Production, Lean Manufacturing, Efficiency Improvement, Productivity Enhancement, Waste Reduction.

ABSTRAK

Proses produksi plastik kemasan memiliki peran penting dalam industri manufaktur modern. PT. ABC, sebagai produsen plastik kemasan, berupaya meningkatkan efisiensi dan produktivitas produksi melalui penerapan metode Lean Manufacturing. Penelitian ini membahas implementasi Lean Manufacturing dalam proses produksi plastik kemasan di PT. ABC. Metode Lean Manufacturing diterapkan untuk mengidentifikasi dan mengurangi pemborosan dalam proses produksi, dengan tujuan meningkatkan efisiensi, kualitas, serta kepuasan pelanggan. Hasil penelitian ini memberikan wawasan mengenai dampak penerapan Lean Manufacturing dalam mengoptimalkan proses produksi plastik kemasan, dengan manfaat yang signifikan bagi perusahaan dan kontribusi pada pembangunan industri manufaktur berkelanjutan. Dengan demikian, penelitian ini berpotensi memberikan sumbangan berharga pada bidang Teknik Mesin dan Keteknikan secara luas.

Kata kunci: Produksi kemasan plastik, Lean Manufacturing, Peningkatan efisiensi, Peningkatan produktivitas.

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1. Introduction

The manufacturing industry is currently experiencing rapid development, where efficiency, quality, and innovation are the main keys to staying competitive in a competitive global market. In this context, one of the sectors that has a central role in the manufacturing industry is the production of packaging plastics. Plastic packaging has an irreplaceable role in providing functional and aesthetic containers for consumer products in various sectors, including food, beverages, cosmetics, and a number of other industries [1][2].

In effort For increase efficiency production , maintenance quality products , as well respond change rapid market demand, company increasingly modern manufacturing adopt approach new in management production [3][4]. One approach that is attracting attention is Lean Manufacturing, also known as Lean Production or Lean Management. This method is derived from the Toyota Production System (TPS) concept and has been successfully applied in various industries with the aim of eliminating waste in the production process, resulting in significant improvements in efficiency and product quality [5][6].

The challenges faced by manufacturing companies such as PT. ABC, which is one of the main players in the production of plastic packaging, include increasing production costs, intense competition, and diverse and rapidly changing customer demands. In facing these challenges, PT ABC has made a commitment to continuously innovate in its production process.

This research will explore the implementation of Lean Manufacturing methods in the plastic packaging production process at PT ABC. Through the application of Lean Manufacturing principles, the company is expected to identify and eliminate waste in every stage of production, which in turn will improve operational efficiency, product quality, and customer satisfaction. Thus, this research is expected to provide an in-depth understanding of how the implementation of Lean Manufacturing can substantially improve the efficiency and competitiveness of PT. ABC's plastic packaging production process in the highly dynamic global market stage. [7][8][9].

Lean Manufacturing, also known as Lean Production or Lean Management, is an operations management approach or methodology that aims to optimize product efficiency, quality, and delivery through the elimination of waste in the production process[10][11]. This approach was first developed by Toyota in its production practices and is often referred to as the "Toyota Production System." The main principle of Lean Manufacturing is to produce products more efficiently and responsively to market demand by eliminating various forms of waste in the production system. These forms of waste include things like overproduction, waiting time, unnecessary movement, production of defective goods, excessive stock, and so on [12].

The principles of Lean Manufacturing include, Value Identification, Focus on recognizing value from the customer's perspective and identifying activities that actually contribute to that value. Value Stream Understanding: Mapping the entire process flow from upstream to downstream to identify potential waste. Value Stream Management: Redesigning the process flow to optimize production flow by reducing waiting time, inventory, and unnecessary movement [3]. Demand-Driven Production Produce products only based on customer demand, avoiding overproduction. Timely Production: Strive for production to match customer schedules and demands. Elimination of Waste: Constantly seek and eliminate all forms of waste in the production process. Continuous Improvement, Encourage a culture of continuous improvement and innovation at all levels of the organization. Employee Empowerment, Provide training and involvement to employees in decision-making to improve quality and efficiency. Process Visualization, Use visual tools such as kanban boards to monitor workflow and production status. Quality Focus, Encourage the production of high quality products by preventing defects [1].

Lean Manufacturing has become the basis for many organizations to increase productivity, reduce production costs, and provide higher satisfaction to customers. Its principles have also been applied in various sectors other than manufacturing, including services, healthcare, and software development [5].

2. Research Methods

The main objective of this research is to deeply investigate and describe the application of Lean Manufacturing methods in the production stage of plastic packaging at PT ABC. To achieve these objectives, this research will follow a series of methodological steps outlined as follows.

This research will adopt a descriptive approach enriched with quantitative analysis as a core element that provides support for the course of the research process. The descriptive approach will enable the researcher to in detail describe the characteristics, processes, and circumstances that exist in the plastic packaging production stage of this company. Quantitative analysis, on the other hand, will provide a solid basis for measuring the impact of implementing Lean Manufacturing methods.

Field studies will be conducted to observe the company's operational conditions, with the main focus on the fine flexible packaging production process. The field study aims to gain an in-depth understanding of the series of production processes and how quality control is implemented in the context of such production. In addition, a literature study will be conducted to formulate relevant theories and support the development of Lean Manufacturing analysis methods that are suitable for the challenges faced by PT ABC. References from previous scientific publications will provide a strong foundation for developing the analysis framework. This research will be conducted at PT ABC, located at Jl. Raya Serang No. 26. Primary data will be obtained through direct interviews with experienced managers and production staff. Secondary data will be obtained from company information and relevant literature. The documentation technique will involve collecting and recording reports and related documents from the company.

During the interview process, verbal communication will be used to gain in-depth insights from the interviewees. Interviews will be a means to gather valuable information regarding the implementation of Lean Manufacturing in the production of plastic packaging at PT ABC.

By using a combination of descriptive approach, quantitative analysis, field study, literature study, and interviews, this research aims to provide a comprehensive picture of the implementation of Lean Manufacturing methods in the production stage of plastic packaging at PT. ABC. It is expected that this methodology will result in a deeper understanding of the company's efforts in improving production efficiency and quality, as well as the impact generated through the application of Lean Manufacturing principles.

3. Results and Discussion

This research focuses on plastic packaging products and their production process. The production process flow is described in figure 1 below:

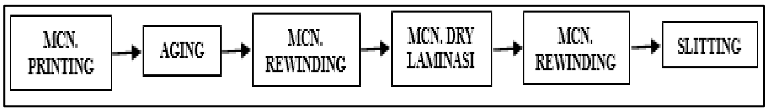


Figure 1. Plastic Packaging Production Process .

Figure 1 explains in detail each stage of the process, from raw material preparation to plastic packaging products ready for distribution. Through this visual explanation, it is expected to better understand how plastic packaging products are made and identify potential improvements or enhancements in production efficiency and quality.

3.1. Customer Request Data and Takt Time

In order to meet the number of units required by the customer, the production team must calculate the required production speed. This concept is often referred to as "Takt Time". Monthly demand data of 535,450.60 kg was obtained from the May 2022 production report. Assuming there are 26 working days in a month, the results are as follows:

$$\text{Customer Request}=\frac{535450.60\text{kg}}{26\text{ day}}=20594.253\text{ kg/day}$$

There are 3 shifts with working hours of 8 hours per day.

then :

$$\text{Total working time per day}= 8\times3 = 24\text{ jam}\times 60\text{ minutes}= 1440\text{ minutes} \times 60\text{ seconds} = 86400\text{ seconds}$$

$$\text{Takt Time}=\frac{\text{Working time per day (seconds)}}{\text{Customer demand per day (kg)}}=\frac{86400}{20594.253}=4.20\text{ seconds/(kg)}$$

3.2. Data on Number of Machines and Types of Machines

There are three machines used in the printing production stage at PT. ABC, while there are three *rewind machines, and the dry lamination process uses five machines.* In addition, there are three machines for the slitting stage. Details regarding the type and number of machines at PT. ABC can be seen in table 1 below:

Table 1 Data on Number of Machines and Types of Machines

No	Machine Type	Number of Machines
1	Printing Machine	4
2	Rewinding Machine	3
3	Dry Lamination Machine	6
4	Slitting Machine	4

(**Source** : PT. ABC, 2022)

3.3. Labor and Operator Data

Table 2 contains data on the number of workers in each work station area. The information in the table provides a detailed picture of the distribution of labor across the various work station areas involved in the process or operation.

Table 2 Number of Workers

No	Machine Type	Number of Operators
1	Printing Machine	8
2	Rewinding Machine	7
3	Dry Lamination Machine	6
4	Slitting Machine	4

(**Source**: PT. ABC, 2022)

Table 3 is information number of work shifts at PT. ABC with regular working day Monday-Saturday .

Table 3 Number of Operator Work Shift Hours

Shift 1	Shift 1	Shift 1
08.00 – 15.00	15.00 – 23.00	23.00 – 08.00

(**Source**: PT. ABC, 2022)

Following is calculation working hour rates at PT. ABC, which requires data on the City Minimum Wage (UMK), working hours and amount day work per month For count tariff operator hourly wages:

1. UMK=Rp. 4527688
2. Working Days = 26 days
3. Working Hours = 8 hours
4. Working Hour Rate = $\frac{\frac{4527688}{26}}{8}$ = Rp. 21768

3.4. Cycle Time Process Data

Printing Machine

Data collection was carried out ten times during the printing process. Data is taken by observing printing steps without considering time lag and settings. Time data collection was carried out on the 20th May 20 22 using *a stopwatch*. Table 4 below is the result of data collection:

Table 4 Printing Process Measurement Data

No	Machine 3 (second)	Machine 5 (second)	Machine 6 (second)
1	0.9	0.8	1.2
2	0.6	0.7	1.5
3	0.7	0.6	0.8
4	0.8	0.9	0.9

No	Machine 3 (second)	Machine 5 (second)	Machine 6 (second)
5	0.9	0.8	1
6	0.7	0.9	0.06
7	1	0.9	0.7
8	0.6	0.7	0.08
9	0.8	0.6	0.9
10	0.5	0.8	0.6

(**Source**: PT. ABC, 2022)

machine time 3=$\frac{7.5}{10}$= 0.75 sec

machine time 5=$\frac{7.7}{10}$= 0.77 sec

machine time 6=$\frac{7.74}{10}$= 0.774 sec

Cycle Time of Printing Machine $\overline{X}$=0.76sec

Rewinding Machine

Data collection occurred on ten occasions during the rewinding process. The data was obtained through the observation of each step in the rewinding procedure, excluding considerations for waiting time and the setting process. Time-related data was gathered on May 20, 2022, utilizing a stopwatch as the measuring instrument. Table 5 below presents the recorded time measurement data.

Table 5 *Rewinding* Process Measurement Data

No	**Machine 1 (second)**	**Machine 3 (second)**	**Machine 5 (second)**
1	1.0	0.9	1.0
2	1.2	0.6	0.9
3	0.7	0.9	0.8
4	1.0	0.7	0.7
5	0.9	0.8	0.9
6	0.8	0.9	1.0
7	0.8	0.8	0.9
8	1.3	0.8	0.8
9	0.8	0.7	0.9
10	0.9	1.0	0.8

(**Source**: PT. ABC, 2022)

machine time 1=$\frac{9.4}{10}$= 0.94 sec

machine time 3=$\frac{9.4}{10}$3=$\frac{8.1}{10}$= 0.81 sec

machine time 5=$\frac{9.4}{10}$5=$\frac{8.7}{10}$= 0.87 sec

Cycle Time Machine Printing $\overline{X}$=0.87sec

Dry Lamination Machine

Data was collected in ten drylamination process experiments. The data was taken through direct observation of the drylamination steps without considering the waiting time and setting process. Time data was collected on May 20, 2022 using a stopwatch as a tool. The following is table 6, containing the time measurement data:

Table 6 *Dry Lamination* Process Measurement Data

No	Machine 3(d)	Machine 4(d)	Machine 5(d)	Machine 6(d)	Machine 7(d)
1	0.6	0.6	0.7	0.6	0.9
2	0.7	0.5	0.8	0.8	0.8
3	0.8	0.7	1.0	0.7	0.7
4	0.9	0.8	0.9	0.6	0.6
5	0.5	0.5	0.7	0.5	0.9
6	0.9	0.6	0.5	0.8	0.7
7	0.7	0.6	0.8	0.9	0.5
8	0.8	0.6	0.6	0.6	0.8
9	0.9	0.8	0.9	0.8	0.9
10	0.6	0.7	1.0	0.8	1.0

(**Source**: PT. ABC, 2022)

machine time 3= $\frac{7.4}{10}$ = 0.74 sec

machine time 4= $\frac{6.4}{10}$ = 0.64 sec

machine time 5= $\frac{7.9}{10}$ = 0.79 sec

machine time 6= $\frac{7.1}{10}$ = 0.71 sec

machine time 7= $\frac{7.8}{10}$ = 0.78 sec

Cycle Time Machine Printing $\overline{X}$=0.73 sec

Slitting Machine

Data was taken ten times during the slitting process. Data was taken through direct observation of the slitting steps without taking into account waiting time and the setting process. Time data collection was carried out on May 20 2022 using a stopwatch as a tool. Below is table 7 which contains the results of the time measurements that have been taken:

Table 7 *Slitting* Process Measurement Data

No	Machine 4 (second)	Machine 3 (second)	Machine 5 (second)
1	0.9	0.7	0.7
2	1.0	0.8	0.8
3	0.8	0.9	0.8
4	0.7	0.8	0.9
5	0.9	0.6	0.8
6	0.8	0.7	0.9
7	0.8	0.8	1.0
8	1.0	0.8	0.6
9	0.8	0.9	0.7
10	0.9	0.8	0.9

(**Source** : PT. ABC, 2022)

machine time 4= $\frac{8.6}{10}$ = 0.86 sec

machine time 3= $\frac{7.8}{10}$ = 0.78 sec

machine time 5= $\frac{8.1}{10}$ = 0.81 sec

Cycle Time Machine Printing$\overline{X}$=0.82 sec

3.5. Data on Production Quantities and Delivery to Customers

Within the scope of this research, the data collected involves various information that summarizes the actual production results and delivery processes that have been carried out on high quality plastic packaging. Table 8 which is available and the images displayed have a vital role in illustrating and explaining important details relating to various aspects, but not limited to the actual number of products successfully produced and packaging successfully delivered to customers.

Table 8 Production and Delivery Data

2021		2022	
Production Yield (kg)	Total Delivery (kg)	Production Yield (kg)	Total Delivery (kg)
520847.05	487523.56	365708.90	425862.50
416135.77	450727.09	370183.57	436978.07
524652.65	465585.27	576563.70	457869.64
535835.67	575825.90	376553.65	447088.38
475174.47	456244.70	436810.75	476459.38

(**Source**: PT. ABC, 2022)

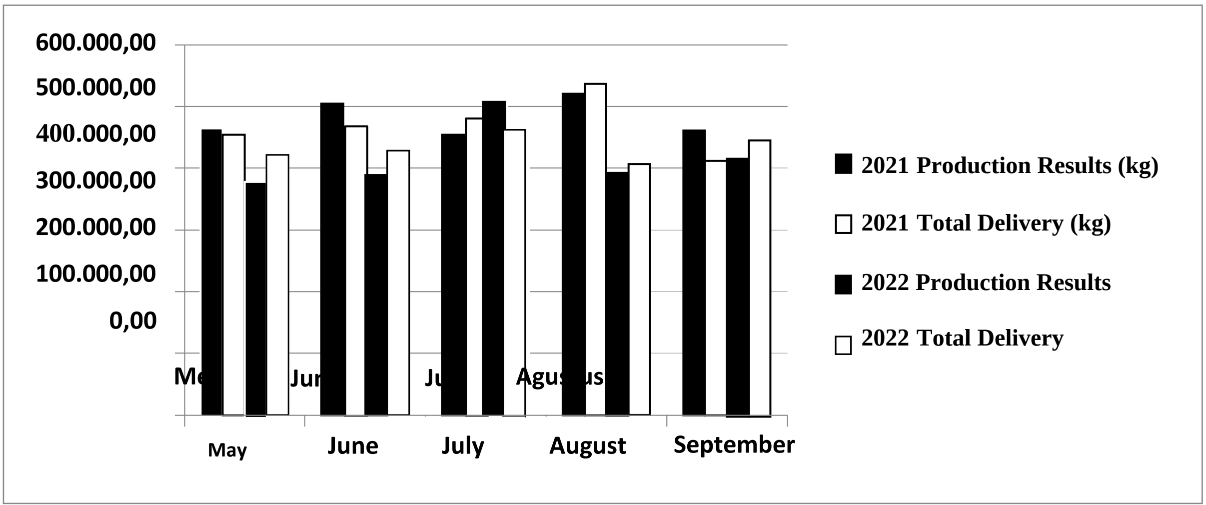
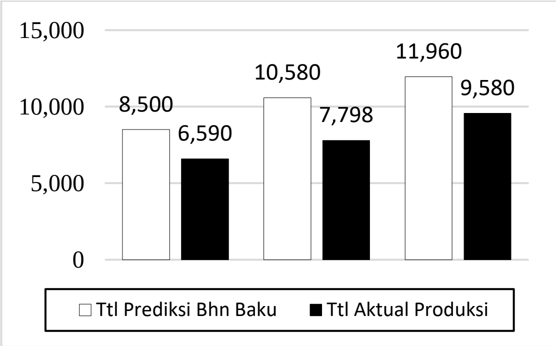


Figure 2 Graph of Production and Delivery Results
(**Source**: PT. ABC, 2022)

From the data listed in the table and figure 2 above, it can be seen that the total number of production and product deliveries to customers during the period 2021 and 2022 indicates that there is a similarity in average demand.

3.6. Data On The Amount Of Plastic PET Material

The use of material data aims to measure the extent of accuracy in material management, with the main aim of preventing potential losses that may arise due to inaccuracies in forecasting raw material needs and maintaining optimal inventory stock availability.



(**Source**: PT. ABC, 2022)
Figure 3 Graph of Pet Material Prediction Results

Table 9 Pet Material Prediction Data

Month	Total Raw Material Prediction	Total Actual Production	Percentage of excess stock of raw materials
May	8,500	6,590	29%
June	10,580	7,798	36%
July	11,960	9,580	25%
Average	10,347	7,989	30%

(**Source**: PT. ABC, 2022)

Based on the data presented in table 9 above, it appears that there are deficiencies in the accuracy of raw material forecasting, which has the potential to cause losses in warehouse stock. Therefore, researchers put forward recommendations to implement more comprehensive forecasting based on data from the previous year. As shown in the table below, production and product delivery results in 2021 and 2022 are nearly identical, indicating that the company should not rely on inaccurate customer forecasts. Instead, focus can be placed on past data, allowing material forecasting for the coming months to be done more precisely.

Table 10 Total Production and Delivery

Production Results		Total Delivery		Difference Percentage	
2021	2022	2021	2022	2021-2022 Production	2021-2022 Delivery
18%	17%	18%	18%	1%	0%
20%	18%	21%	21%	2%	0%
21%	27%	23%	25%	-6%	-2%
26%	22%	25%	20%	4%	5%
22%	23%	19%	25%	-1%	-4%
100%	100%	100%	100%	0%	0%

Table 10 above illustrates that the percentage of the number of products sent to customers is almost the same, so the company is able to forecast materials by utilizing delivery data from the previous period.

3.7. Reject Production Data on Printing Machines

Through information obtained from the company's internal quality control department, it appears that there are records regarding rejections *on* printing machines during the period May to August 2022. Details regarding this can be found in table 11 which is presented:

Table 11 *Reject* Production Data on Printing Machines

Month	MCn No	Number of Product Items	Number of Failed Products
May	3	16	
	4	4	

Month	MCn No	Number of Product Items	Number of Failed Products
	5	11	2
	6	16	4
	7		
June	3	85	8
	4	25	7
	5	45	10
	6	60	20
	7		
July	3	65	3
	4	13	5
	5	69	18
	6	68	6
	7	42	12
August	3	10	
	4	7	
	5	31	4
	6	40	6
	7	27	15
Total		**634**	**120**

(**Source**: PT. ABC, 2021-2022)

$$\text{Quality Rate}=\frac{(634\text{-}120)}{634}\times 100\%=81\%$$

3.8. Reject Production Data on Rewinding Machines

In accordance with the internal data provided by the Quality Control division of the company, details pertaining to rejections in the rewinding process were documented for the period spanning from May to August 2022. The recorded information is presented in Table 12 below:

Table 12 *Reject* Production Data on *Rewinding Machines*

Month	Number of Items (*Roll)*	Number of *Defects*
May	6,365	1,826
June	9,301	2,647
July	14,350	3,575
August	11,525	2,560
Total	**41,541**	**10,608**

(**Source** : PT. ABC, 2022)

$$\text{Quality Rate}=\frac{(41.541\text{-}10.608)}{41.541}\times 100\%=74\%$$

3.9. Reject Production Data On The Machine Dry Lamination

According to information provided by the Quality Control department within the organization, there exists data on rejected items during the period from May to August 2022 in the context of the dry lamination process. This data is available in Table 13, delineating instances of production rejection associated with the dry lamination machine.

Table 13 Production Data *Reject Machine drylamination*

Month	Number of Items (*Roll*)	Amount *Defect*
May	7,652	1,633
June	9.105	1,246
July	11,446	2,382

August	11,346	2,105
Total	**38,459**	**7,366**

(**Source**: PT. ABC, 2022)

$$\text{Quality Rate}=\frac{(38.459\text{-}7.366)}{38.459}\times 100\%=81\%$$

This data provides an overview of the number of items (rolls) produced as well as the number of defects that occurred in each month during the period mentioned above. The grand total of items produced and total defects are also listed in table 13.

3.10. *Reject* Production Data On *Slitting Machines*

Based on information obtained from the quality control sector within the company, there is *reject data in the slitting* process during the period May to August 2022, which is documented in table 14.

Table 14 *Reject* Production Data on *Slitting Machines*

Month	Number of Items (*Roll*)	Number of Defects
May	31,415	131
June	23,760	132
July	12,287	144
August	35,322	127
Total	**102,784**	**534**

(**Source**: PT. ABC, 2022)

$$\text{Quality Rate}=\frac{(102.784\text{-}534)}{102.784}\times 100\%=99\%$$

Table 14 describes the number of rolls of items processed and the number of defects detected during those four months. The total amount of production during this period is also shown in the summary.

3.11. Waste Production Data (Waste)

Based on internal data from the company, in the production process which includes *printing, rewinding* and *dry lamination stages* , products that are disposed of or become waste cannot undergo rework. This information is listed in table 15 below:

Table 15 Waste Production Data (Waste)

Month	Printing (meters)	Dry Lamination (meter)	Waste (meters)
May	7,314,211	6,883,757	430,454
June	8,665,899	8,206,510	459,389
July	9,485,600	8,984,320	501.280
August	10,783,860	10,232,577	551,283
Total	36,249,570	34,307,164	1,942,406

(Source: PT. ABC, 2022)

$$\text{Quality Rate}=\frac{(34.307.164\text{-}1.942.406)}{34.307.164}\times 100\%=94\%$$

3.12. Average Data on Availability, Downtime, Performance on Production Machines (Printing and Dry Lamination)

Availability indicators characterize the extent of machine reliability. Availability, in this context, denotes a metric gauging both the duration of machine downtime and the time necessary for setup and adjustment. Table 16 presents information concerning machine downtime data leading to halts, total working hours, and overall product output for the printing and dry lamination machines within the company. This data was acquired through the daily production process at PT ABC, spanning from September 01 to September 30, May 2022.

Table 16 Average Availability, Downtime and Performance of Printing Machines

No	Date	Mcn (1)	O'clock (minute) (2)	Results (meters) (3)	Downtime (minute) (4)	Cycle time (minutes) (5)	Performance (6) $\frac{(3)\times(5)}{(2)}\times 100\%$	Availability (7) $\frac{(2)-(4)}{(2)}\times 100\%$
1	01-30	3	25680	1,873,500.00	8070	0.01	73%	69%
2	07-30	4	5616	232,200.00	3530	0.01	41%	37%
3	13-30	5	32650	1,425,000.00	9506	0.01	44%	71%
4	19-30	6	26100	1,780,500.00	10166	0.01	68%	61%
5	24-30	7	23274	2,487,750.00	8206	0.01	107%	65%

(**Source**: PT. ABC, 2022)

Table 17 Average Availability and Downtime of Dry Lamination Machines

No	Date	Mcn (1)	O'clock (minute) (2)	Results (meters) (3)	Downtime (minute) (4)	Cycle time (minutes) (5)	Performance (6) $\frac{(3)\times(5)}{(2)}\times 100\%$	Availability (7) $\frac{(2)-(4)}{(2)}\times 100\%$
1	01-30	3	34,850	2,075,690.00	10,234	0.01	60%	71%
2	07-30	4	22,460	1,072,860.00	8,223	0.01	48%	63%
3	13-30	5	27,956	1,864,566.00	7,328	0.01	67%	74%
4	19-30	6	25,769	2,083,735.00	6,578	0.01	81%	74%
5	24-30	7	36,390	3,261,230.00	9,856	0.01	90%	73%

(**Source**: PT. ABC, 2022)

3.13. Repair with Using the OEE (Overall Equipment Effectiveness) Method

Overall Equipment Effectiveness (OEE) is a metric that concentrates on the efficiency of production operations. The outcomes are presented in a standardized format, facilitating comparisons between manufacturing units across diverse industries. OEE measurement frequently serves as a pivotal key performance indicator (KPI) in the implementation of lean manufacturing, providing an illustrative gauge of success. OEE deconstructs manufacturing performance into three quantifiable components: Availability, Performance, and Quality. Each of these components addresses a specific facet of the process that is earmarked for enhancement.

Table 18 Summary Entire Activity Machine *Printing*

Printing Machine No	Performance (1)	Quality (2)	Availability (3)	OEE (4) $=(1)\times(2)\times(3)$
3	73%	95%	69%	48%
4	41%	85%	37%	13%
5	44%	71%	71%	22%
6	68%	55%	61%	23%
7	107%	65%	65%	45%

(**Source**: PT. ABC, 2022)

Table 19 Summary Entire Activity Machine *Drylamination*

Printing Machine No	Performance (1)	Quality (2)	Availability (3)	OEE (4) $=(1)\times(2)\times(3)$
3	60%	95%	71%	40%
4	48%	95%	63%	29%

Printing Machine No	Performance (1)	Quality (2)	Availability (3)	OEE (4) = (1) × (2) × (3)
5	67%	95%	74%	47%
6	81%	95%	74%	57%
7	90%	95%	73%	62%

(**Source**: PT. ABC, 2022)

Summary of the information provided in tables 18 and 19 above, it was found that for printing machines, the main challenge lies in three variables: performance, quality, and availability. The company has set the standard values for availability, performance, and quality at no less than 95%. From these values, it appears that the levels of quality, efficiency, and performance are still low. Therefore, improvements need to be made in these three aspects. From the data listed in the discussion, it can be concluded that in dry lamination machines, the problems are mainly in performance and availability. This can be seen from the performance and availability values which are less than 95%.

4. Conclusion

Based on the results of the research conducted by the author, it is concluded that the application of Lean Manufacturing methods to the plastic packaging production process at PT ABC has resulted in significant improvements in production efficiency, reduction of waste, and improvement in product quality. By identifying and addressing waste in the production flow, the company managed to increase overall productivity, reduce production costs, and produce high-quality products. The results also indicate that the main problem lies in the performance and availability of the drylamination machine, which is evident from the performance and availability scores below 95%.

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