Identifying and Reducing Waste in the Chicken Carcass Production Process at PT Ciomas Adisatwa

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Abstract

PT. Ciomas Adisatwa unit Berbah is one of the Poultry Slaughterhouses (PSh) in Yogyakarta, producing 2,000 chickens/hour. However, some production steps do not increase the value of the finished product. Because of that, wasteful and non-value-added production processes must be eliminated to reduce the risk of contamination in PSh products and make the production process more efficient. Therefore, this study aims to identify the causes of waste and find an appropriate system to reduce the waste process. The methods used in this study include the Value Stream Analysis Tools (VALSAT) technique and future state mapping. Lean manufacturing is a concept used to reduce or eliminate waste in a production process. The wastes identified in the PT Ciomas Adisatwa production process include waiting activity, inappropriate processing, and unnecessary motion. The material weighing process identified the waiting activity because it was waiting for the Delivery Order (DO). Inappropriate processing occurs in hair removal rework in a clean area. The third waste is unnecessary motion, movement that is not needed occurs in cutting operators and dirty processes. The proposed improvements to address these wastes include enhancing the integration of information flow systems using a computer network, adding a plucker machine, and clarifying the division of tasks for each workstation to avoid unnecessary motion.
Keywords: *Chicken carcass; lean manufacturing; value stream mapping; waste*

1. INTRODUCTION

Chicken is one type of poultry where the Indonesian public favors almost every part of its body, such as meat, eggs, and innards. Chicken meat is widely consumed due to its high nutritional value and affordability (Fauzi and Wijaya, 2021). According to the Central Bureau of Statistics (2024), the production of broiler chickens in Indonesia amounted to 3.1 million tons in 2021 and increased to 3.9 million tons in 2023. This indicates a growing demand for chicken meat each year. Generally, the produced chicken meat is sold directly or used as raw material in the production of frozen food (Lenap et al., 2023). Chicken producers must increase their production to meet demand, which needs more costs. Producers must try to reduce production costs to keep profitability by improving production efficiency. By increasing efficiency, producers can produce more chicken meat in less time. Efficiency not only impacts the quantity but also the quality of chicken meat. A hygienic and fast slaughtering process will result in better-quality meat.

PT Ciomas Adisatwa is one of the Poultry Slaughterhouses (PSh) in Yogyakarta, operating in the commercial farming and slaughterhouse sectors under the umbrella of PT Japfa Comfeed Indonesia. Its production capacity reaches 2,000 chickens per hour or 20,000 chickens per day. In its production process, activities that do not add value or create waste have been identified like waiting, inappropriate processing, and unnecessary motion, this causes the production process to be inefficient. The PSh serves as a strategic link in the supply chain of SHIH (safe, healthy, intact, and hygienic) chicken carcasses, and the products it produces are categorized as high-risk. According to Dewi et al. (2016), meat is a perishable product that is at high risk of being contaminated by microbes. If the product has been contaminated with microbes, the product has been damaged

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which is not suitable for consumption because it will cause disease, so it requires a fast and hygienic production process. Therefore, it is necessary to eliminate waste activities using the lean manufacturing concept. Lean manufacturing is an approach that can be used to address waste in a company, thereby reducing production lead time (Setiawan and Rahman, 2021). The advantages of the lean manufacturing concept are that it can design effective and efficient production processes with small inventories, cheaper, and faster production processes with minimal space (Firdaus and Wahyudin, 2023). To reduce the identified waste, it is necessary to use Value Stream Mapping (VSM) which is a tool in the lean concept, which is a tool used to describe or map the production flow of a product from small components to finished products.

The application of lean manufacturing is expected to identify waste, the causes of waste, and ways to reduce or eliminate it. According to Lestari and Susandi (2019), waste refers to activities that do not add value to the product and must be eliminated. Lean manufacturing, as a value-driven production philosophy, has proven to be the foundation for improved efficiency and productivity (Kumar et al., 2022). Through the elimination of waste, this concept enables organizations to achieve a competitive edge. With the advancement of technology, the implementation of lean manufacturing is further enriched by the integration of digital solutions. As researched by ergeeva et al., (2024) the utilization of advanced technologies in industrial settings not only supports loss reduction efforts but also unlocks new opportunities for innovation and process optimization. This research aims to identify waste within the production process and propose improvements to reduce it.

2. MATERIAL AND METHODS

The research was conducted at PT. Ciomas Adisatwa, Berbah unit, located within the Agrotechnology Innovation Center (PIAT) of Universitas Gadjah Mada in Madurejo Village, Tanjung Tirto Street, Kalitirto, Berbah, Sleman Regency, Special Region of Yogyakarta. This study is descriptive research that describes the activities, characteristics, and relationships within a chicken carcass production system. The analysis of issues in the production process was conducted through a Focus Group Discussion (FGD) with several division heads at PT. Ciomas Adisatwa, Berbah Unit They are The HRD manager, the head of the inventory division, the head of the QA division, and the head of the production division of PT. Ciomas Adisatwa, this was done twice each approximately 2 hours.

The stages of the research implementation are as follows: 1) Preliminary survey, 2) Problem formulation and goal setting, 3) Literature review and field study, 4) Creation of value stream mapping, 5) Identification of the value stream, 6) Identification of key issues using a Pareto diagram, 7) Waste workshop, 8) Waste identification using VALSAT, 9) Identification of waste causes using fault tree analysis, and 10) Creating a future state map.

3. RESULTS AND DISCUSSION

Current State Map

The selection of products that will be mapped in this research is based on the number of products that are mostly produced at PT Ciomas Adisatwa. From FGD the product chosen to be analyzed and identified in this research is the CU-9 the chicken carcass specification is 1.3 Kg for 8.000 birds per day or 40% of the total birds. Current State Map or Value Stream Mapping (VSM) This is a diagram that illustrates a simplified production flow, allowing for the identification of its value stream (Setiawan et al., 2021). According to Ma'ruf and Dahdah (2021), the data generated from mapping through Value Stream Mapping (VSM) includes systematic physical flows throughout all production activities, operational times (lead time and cycle time), as well as the distances between each area. The information contained in the VSM can be used to see the existence of waste activities in the production process and used as the basis for eliminating or reducing these activities to obtain the ideal time for each stage of the activity process. The value stream of the chicken carcass production process at PT. Ciomas Adisatwa can be seen in the following Figure 1.

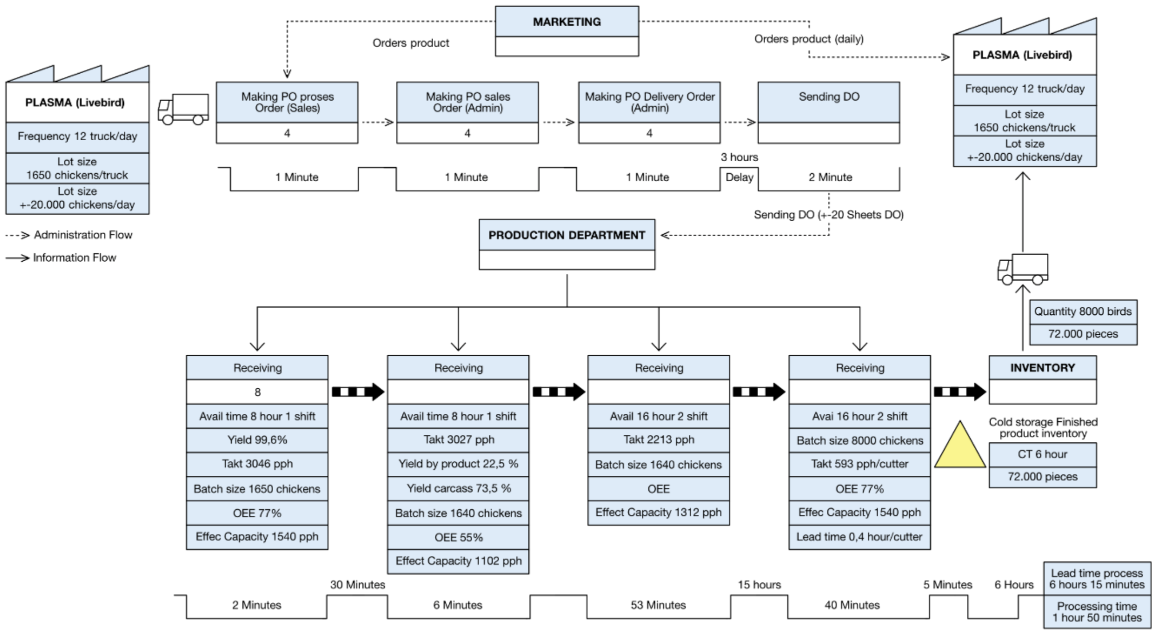

Figure 1. Current State Mapping of PT Ciomas Adisatwa

Based on Figure 1, Physical and administrative flow activities at the PT Ciomas Adisatwa, Berbah unit are fully explained below.

Material Flow

The physical or material flow begins with the raw materials (living chicken) which are provided daily by farmers (plasma or non-plasma), where the physical or material flow starts. Plasma farms are farms that follow a partnership pattern with livestock companies or other companies, while non-plasma farms do not follow this partnership pattern. The delivery of chickens amounts to over 20,000 birds every day or 12 trucks. Figure 2 below shows the physical flow of producing chicken carcasses.

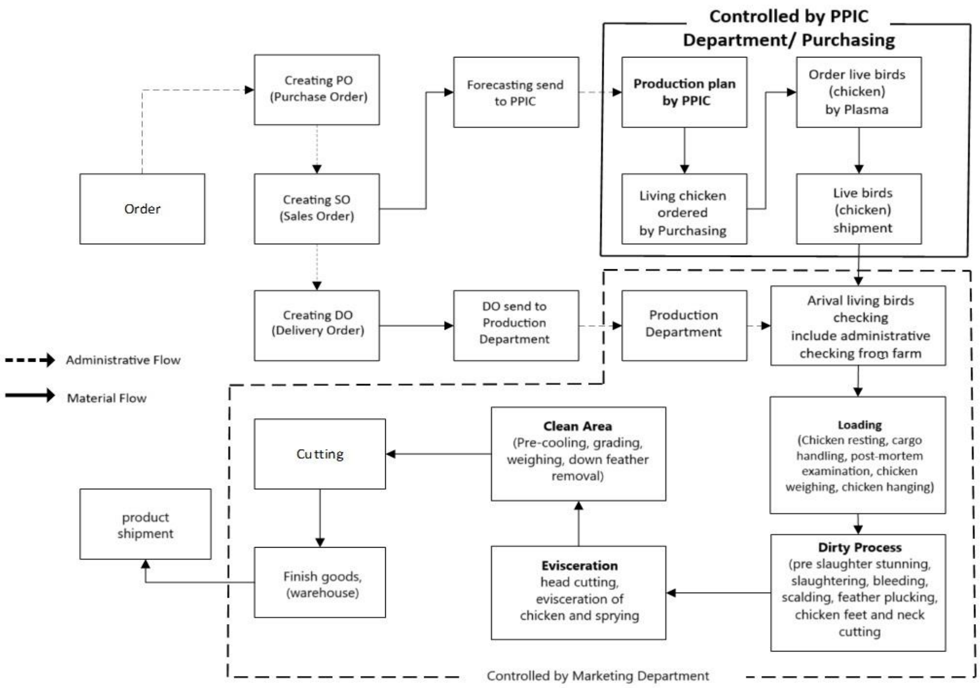

Figure 2. Material Flow of PT Ciomas Adisatwa

The chicken carcass production process begins in the receiving area and continues in the dirty area, which includes the processes of resting the chickens, receiving the chickens, performing antemortem inspections, weighing the chickens, hanging, stunning, Slaughtering, bleeding, scalding, defeathering, neck cutting, foot cutting, head removal, eviscerating or removing the internal organs, and finally spraying. The process then moves into the clean area, which includes pre-cooling, grading, weighing ingredients, cutting, marinating, and blast freezing. Based on Figure 2 the physical flow of the chicken carcass making process starting from the DO given from marketing to production and SO forecasting from marketing given to PPIC. The forecasting made by marketing is a prediction of the products that will be ordered the day after tomorrow. This forecast is made based on SO data from the previous period

Administrative Flow

The administrative flow begins with the sales department's receipt of customer orders, which is then processed through the input of purchase orders (PO). The administrative document then creates Sales Orders (SO) and Delivery Orders (DO). This data is subsequently handed over to the production department for processing. This information helps develop value stream mapping and understanding of document movement or administrative flow. This information is used to identify waste or waste contained in the administration flow of a system. The following Figure 3 illustrates the administrative flow of chicken carcass production at PT. Ciomas Adisatwa.

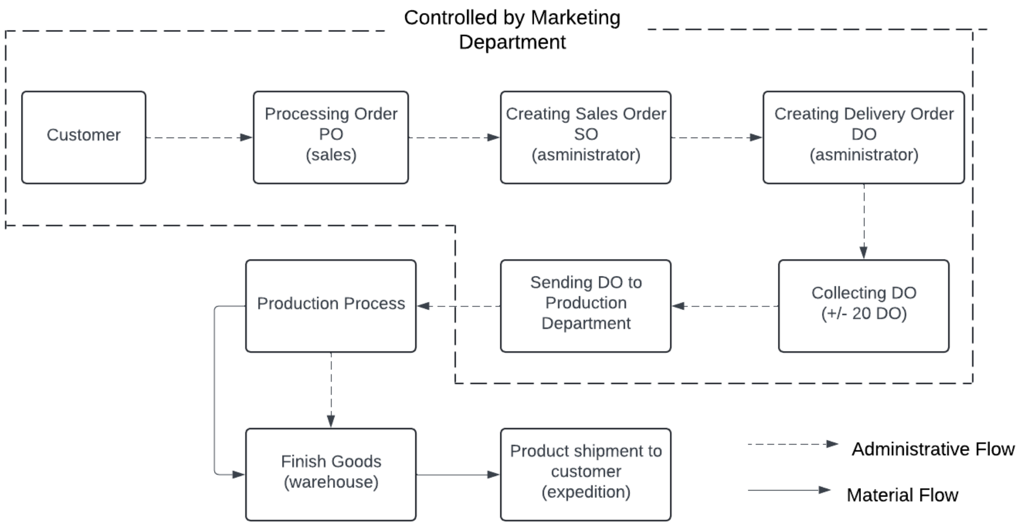

Figure 3. Administrative Flow of PT.Ciomas Adisatwa

Key Issues Identification

The HRD manager, the head of the inventory division, the head of the QA division, and the head of the production division of PT. Ciomas Adisatwa, Berbah Unit participated in a Focus Group Discussion (FGD) to identify the difficulties. Late arrival of chickens, rework in feather removal, delays at the chicken weighing station (TTA) because of waiting for the creation of the delivery order (DO), hot conditions in the production area (dirty area), limited water and ice supply, and machine downtime are some of the issues discussed in the production process. A Pareto diagram study then identified the main problems.

Rosyidi (2022) explains that a Pareto diagram is created to identify the key causes or issues in problem-solving based on the frequency of occurrences and cumulative percentage. The left X-axis lists the contributing factors, the right Y-axis shows cumulative percentage data, and the Y-axis represents the frequency of each cause. Figure 4 displays the findings of the Pareto diagram used to identify the main issues in the manufacturing of chicken carcasses at PT. Ciomas Adisatwa, Berbah unit.

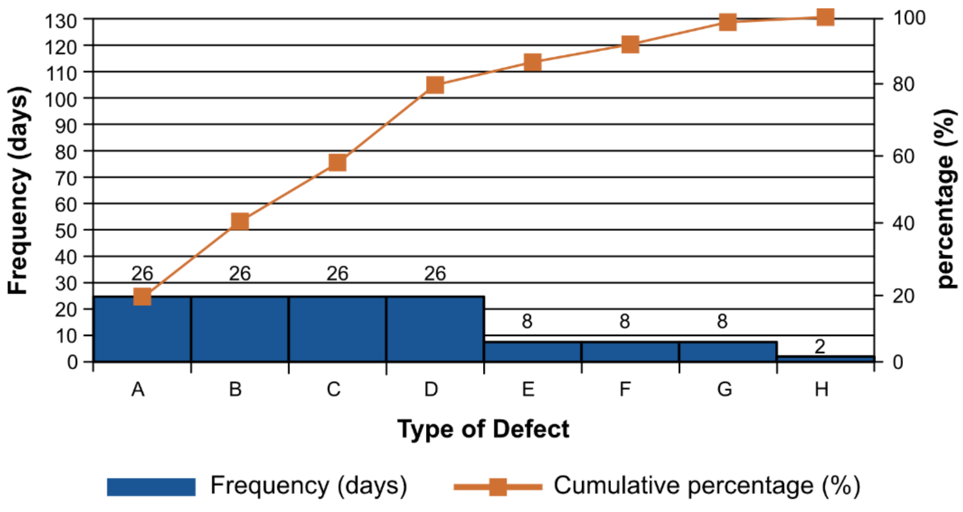

Figure 4. Main Issues at the Production Process

Description:
A: rework on feather plucking
B: high production room temperature at dirty area
C: delayed processed at a chicken weighing station (TTA) due to prolonged DO process
D: workers low performance at cutting section
E: late arrival of chicken
F: limited ice supply
G: limited water supply
H: machine downtime

The results from the Pareto diagram show that the issues falling within the 80% cumulative percentage include rework in feather removal, high working environment temperature in the dirty area, delays in the process at the chicken weighing station (TTA), and low performance of the cutting workforce.

Waste workshop

The waste workshop, using the seven wastes approach, was conducted to gather information on waste activities within the value stream of the production process. According to Hibatullah et al. (2021), the seven wastes approach classifies waste activities into seven categories: overproduction, unnecessary motion, unnecessary inventory, inappropriate processing, excessive transportation, waiting, and defects. Data collection was carried out through discussions and interviews with representatives from the QA department, the Production department, the Warehouse department, as well as the branch manager. The final data consisted of scores for each type of waste, provided by each division and recorded in the provided questionnaire. The scoring used a scale from 1 to 5, with the following details: 1 = no waste, 2 = occasional waste, 3 = some waste, 4 = significant waste, and 5 = very significant waste. The results of the seven-waste scoring at PT. Ciomas Adisatwa, Berbah unit, can be seen in Table 1.

Table 1. Results of Waste Scoring Questionnaire

No	Type of Waste	Score				Total Score	Average Value	Rank
		QA Dept	Production Dept	Warehouse Dept	Branch Manager			
1	Overproduction	3	3	2	5	13	3,25	6
2	Unnecessary motion	3	4	4	4	15	3,75	3
3	Unnecessary Inventory	3	3	3	5	14	3,5	4
4	Inappropriate processing	3	4	5	4	16	4	2
5	Transportation	2	4	4	2	10	2,5	7
6	Waiting	3	4	5	5	17	4,25	1
7	Defects	4	3	3	4	14	3,5	5

Based on the scoring results, the three highest-ranked wastes are waiting, inappropriate processing, and unnecessary motion. The waste classified under the waiting category was identified at the chicken weighing station (TTA). Delays in the process due to the waiting time for the creation of the delivery order (DO) result in live birds remaining on the production floor for an extended period. The high temperatures in this waiting area make live birds susceptible to heat shock. According to Mangan and Siwek (2024), poultry is more prone to heat shock due to its inability to regulate temperature through sweating. High temperatures, as reported by Goo et al. (2019) and Hirakawa et al. (2020), can lead to weight loss and decreased immunity in poultry. Generally, heat shock in poultry can increase the likelihood of disease occurrence, potentially leading to poultry mortality (Oluwagbenga and Fraley, 2023).

The second type of waste is inappropriate processing. This improper process occurs during the rework activity of feather removal in the clean area. Feathers are a part of the chicken's body that is contaminated and thus serve as a source of contaminants. Feathers, which have a high potential for contamination, should not enter the clean area. The third type of waste is unnecessary motion, referring to movements that are not required. This waste was identified in the cutting operators and the workforce involved in the dirty process. When the chicken carcasses to be cut are depleted, the cutting operator will retrieve the carcasses from the previous workstation (feather removal), causing the cutting process to halt during the retrieval activity.

Value Stream Analysis Tools (VALSAT)

To identify the locations of waste and facilitate understanding of the wastes identified within the value stream, a detailed mapping selection was conducted using VALSAT. The selection of the tool was carried out by multiplying the scores obtained for each type of waste by the VALSAT matrix. The 7 waste assessment score data obtained from distributing the questionnaire is data waste weighting which will then be multiplied by the multiplier factor in the method tools table VALSAT. There are 7 tools recognized in VALSAT, namely Process Activity Mapping (PAM) is a tool for mapping the production process in detail that is used to determine the proportion of activities grouped in value added (VA), necessary non-value added (NNVA), and non-value added (NVA), Supply Chain Response Matrix (SCRM) is a graph that connects between cumulative inventory with cumulative lead time on the distribution channel used to determine the increase or decrease inventory levels and lead time lengths at the time of distribution of each supply chain area, Production Variety Funnel (PVF) is a visual mapping technique where in a sequence of processes there is an increase in product variation, Quality Filter Mapping (QFM) is a tool used to map where quality problems arise in an existing supply chain, Demand Amplification Mapping (DAM) a tool used to map patterns or demand changes in each supply chain, Decision Point Analysis (DPA) is the point where there is a change in the trigger of production activities that initially based on the forecast to be based on orders and

Physical Structure (PS) is a tool that used to understand the condition of the supply chain on the production floor. The results of the calculation between waste and tools in VALSAT aim to obtain a selection ranking on tools, namely the highest ranking used to analyze waste.

Table 2. Scoring Result of Value Stream Analysis Tools

No	Waste	Total	PAM	SCRM	PVF	QFM	DAM	DPA	PS
1	Overproduction	13	13	39		13	39	39	
2	Waiting	17	153	153	17		51	51	
3	Transportation	10	90						10
4	Inappropriate processing	16	144		48	16		16	
5	Unnecessary motion	14	42	126	42		42	42	14
6	Excess inventory	15	135	15					
7	Defects	15	15			135			
	Total		592	333	107	132	132	148	24

Based on the analysis in Table 2, the selected detailed mapping tools are Process Activity Mapping (PAM), which ranks first, and Supply Chain Response Matrix (SCRM), which ranks second.

Process Activity Mapping (PAM)

Process Activity Mapping is defined by Zulfikar and Rachman (2020) as a tool that serves to identify and evaluate activities within the production process that provide value (value-added), those that do not provide value (non-value-added), and those that are necessary but do not add value (necessary but non-value-added).

Based on the observations made and the measurement of the cycle time for each process, there are four types of activities within the physical flow of the production process: operation, inspection, transportation, and storage. These activities are subsequently classified of value-added (VA), non-value-added (NVA), and necessary but non-value-added (NNVA). The data on the time and percentage of each activity performed in the chicken carcass production process is presented in Table 3.

Table 3. Activities in Material Flow

Activities Category	Total Activity	Time (minutes)	Percentage
Value added (VA)	14	75	16 %
Non-Value-added time (NVA)	6	2	3 %
Necessary but Non-Value Added (NNVA)	5	362	81 %

Table 3 shows that activities classified as necessary but non-value-added account for 81% of the total time. The activity that consumes the most time in the production process is waiting for the delivery of the finished chicken carcasses, the longest activity during the process of waiting for delivery of ready-to-ship is 5 hours. Based on the results of interviews and discussions, this does not disrupt the production flow, as a designated area is provided for the finished carcasses to await the delivery process.

Process Activity Mapping is also utilized to analyze the administrative flow. Based on the Process Activity Mapping (PAM), there are activities classified into value-added, non-value-added, and necessary but non-value-added categories within the administrative flow of the chicken carcass production process. The activities present in the administrative flow include the creation of Purchase Orders (PO), Sales Orders (SO), Delivery Orders (DO), collection of DOs, and delivery of DOs to the production department by the marketing admin. The percentage of activity types in the physical flow at PT. Ciomas Adisatwa Unit Berbah can be seen in Table 4.

Table 4. Activities in Administrative Flow

Activity Categories	Total Activity	Time (minute)	Percentage
Value added time (VA)	3	3	8,5 %
Non-Value-added time (NVA)	1	180	85 %
Necessary but Non-Value-Added Time (NNVA)	1	2	5,5 %

The category of activities with the highest percentage in the administrative flow is Non-Value Added (NVA), which accounts for 85%. This waste occurs during the stacking or collection process of Delivery Orders (DO). Once the DOs are printed by the marketing admin, they are not sent immediately; instead, they are stacked or held until a total of 20 sheets are collected. Once there are enough DOs, the marketing admin will deliver them to the production department. This practice causes delays in the weighing process in the TTA area, as it has to wait for the completion of the DOs. Delayed orderscan disrupt production schedules, leading to imbalances in production flow. This can result in idle resources, increased downtime and decreased overall productivity (Yasin, 2023).

Supply Chain Response Matrix (SCRM)

The Supply Chain Response Matrix (SCRM) is a graph that illustrates the relationship between inventory and lead time, enabling the identification of increases or decreases in inventory levels during distribution across each area of the supply chain (Marie et al., 2017).

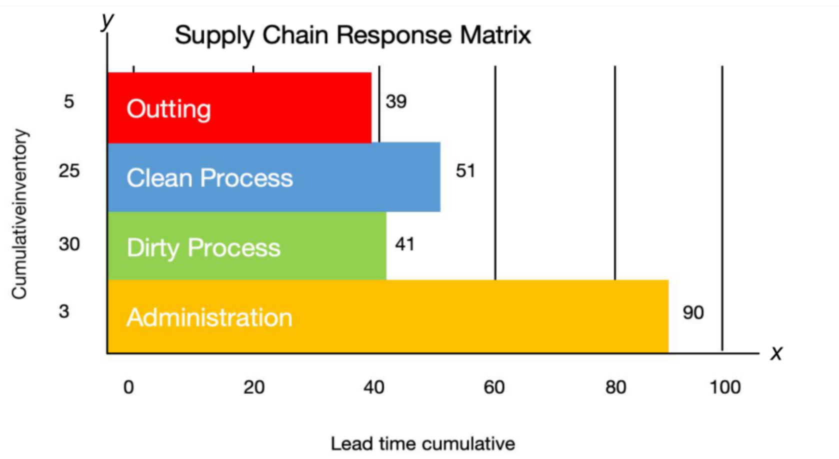

Figure 5. Supply Chain Response Matrix

Figure 5 illustrates the results of the supply chain response matrix mapping at PT. Ciomas Adisatwa Unit Berbah. The total cumulative lead time is 5.2 hours, with the longest cumulative lead time identified in the administrative process, which takes 90 minutes. The physical stock days were identified as 6.5 hours. Physical stock days are defined by Restuningtias et al. (2020) as the average daily duration that inventory remains in the order fulfillment system. The higher the physical stock days, the longer the accumulation of inventory throughout the system chain. The prolonged waiting time results in an extended lead time required in the production process.

Fault tree analysis (FTA)

According to Mangngenre et al. (2019), Fault Tree Analysis is a quality control method in the form of a tree diagram used to systematically trace defects by analyzing system errors from a collection of interacting objects. The identified wastes are waiting inappropriate processes, and unnecessary motion. The following is a fault tree analysis of the reasons for each waste:

a. Waiting Activity

The material weighing area is where the waiting activity takes place. The reason for this waiting is the delayed Delivery Order (DO). The distribution procedure of the DO from the marketing department to the production department isn't functioning properly, which is the reason why the DO is waiting at the chicken weighing station (TTA), according to the Fault Tree Analysis diagram. The following are the causes, shown in Figure 6:

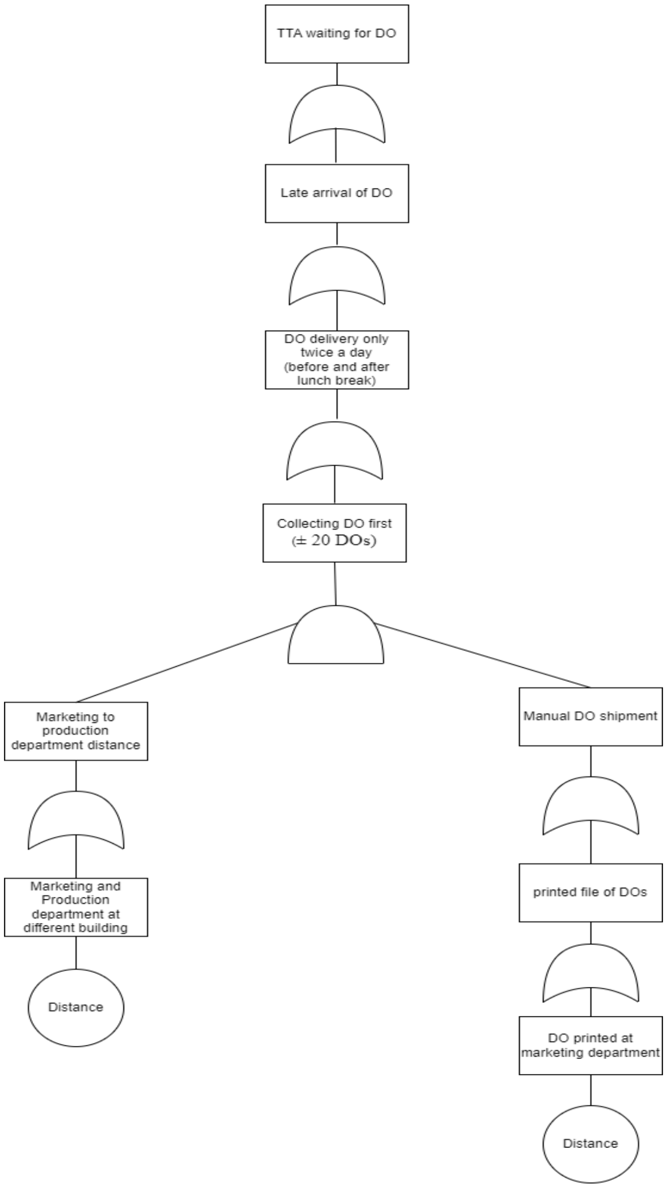

Figure 6. Fault Tree Analysis of Waiting Process at TTA

1) Manual delivery of DO

The Delivery Order (DO) is a document containing customer orders issued by the marketing department as official proof of product creation. Workers (admin) consider the technique of accumulating DOs before sending them more effective than sending each DO individually, as they are responsible for delivering the DOs themselves.

2) Delivery scope distance

The manual delivery of DOs overwhelms the marketing department when they have to deliver each DO individually to the production department, as the production area is located in a separate building from marketing.

b. Inappropriate processing

The reason for the feather plucking rework is that the output carcass from the plucker machine is not perfectly clean. This cause is shown in Figure 7:

1) Conveyor Speed

The high conveyor speed shortens the chicken scalding process, leading to incomplete feather plucking. This speed is used to meet the company's slaughter target. The high slaughter target is due to increased product demand, and to achieve the production goal, the conveyor speed then needs to be increased.

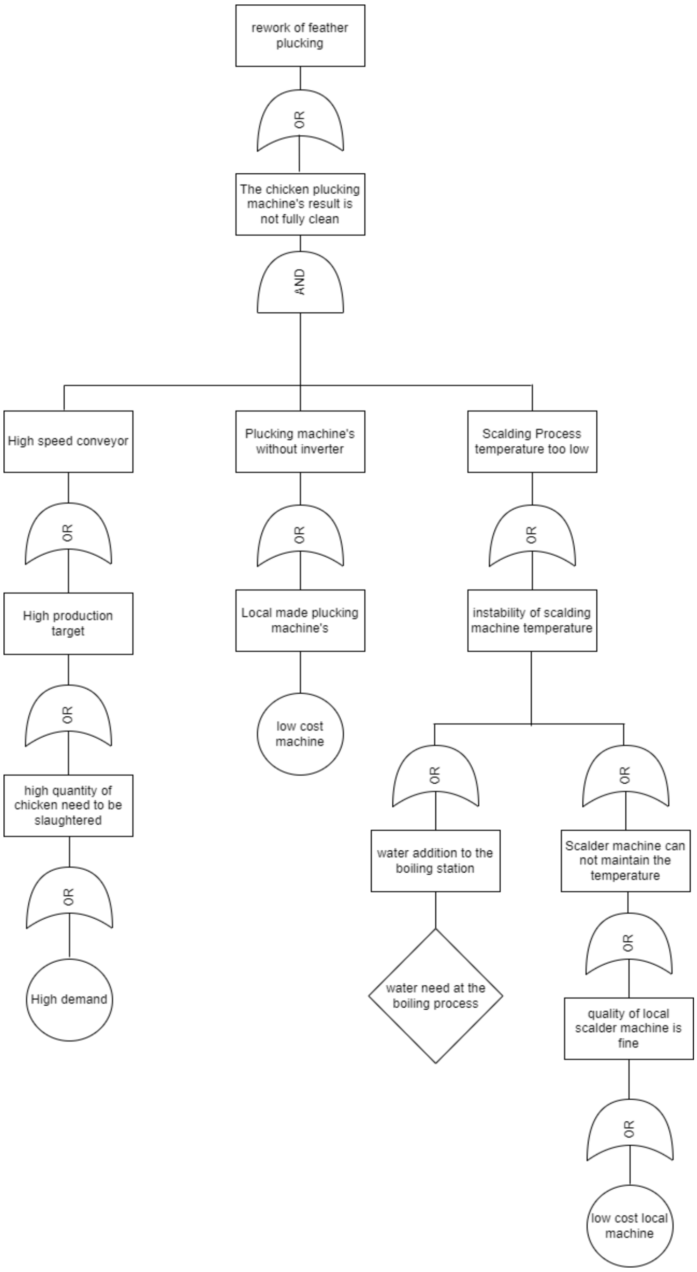

Figure 7. Fault tree analysis rework of feather plucking

2) Instability of scalder machine temperature

The instability of the scalding using hot water with a temperature of approximately 68℃ for 1.5-2 minutes is caused by the water addition activity performed by the scalder operator.

c. Unnecessary Motion

This unnecessary movement has been identified by the cutting operator and the workforce present in the dirty area (where the scalder/scalding machine is located). The causes of this issue are shown in Figures 8 and 9:

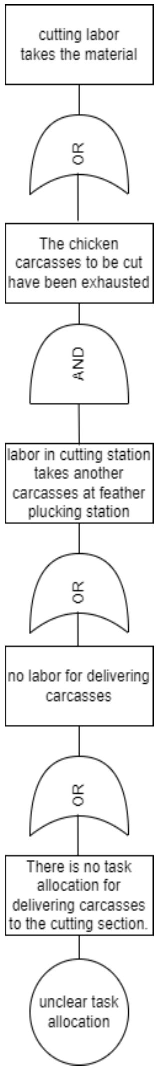

Figure 8. Fault tree analysis of unnecessary motion operator in the cutting process

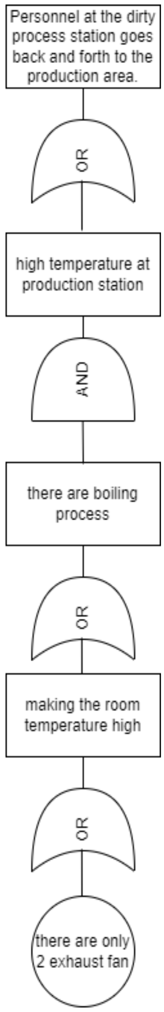

Figure 9. Fault tree analysis of unnecessary motion in dirty process

1) Unnecessary Motion by cutting operator

The cutting operator makes movements to retrieve the carcasses for cutting because there is no worker assigned to distribute the carcasses after the feather plucking (sorting) process to the cutting area. Therefore, as soon as the carcasses run out, the cutting operator has to retrieve them by themselves. During the retrieval of carcasses, the cutting process comes to a halt, and this happens repeatedly. When the carcasses being cut are exhausted, the cutting operator will go back to retrieve more. This issue is caused by unclear task allocation.

2) Unnecessary Motion in a dirty area

Workers in the dirty area, where the scalding process occurs, frequently enter and exit or rotate positions (rolling) with other workers after processing two trucks. This happens because the high temperature in the room makes the workers uncomfortable and often leads to fatigue. The processes that occurred in that area include neck and head cutting, which require concentration during the cutting operation. The high room temperature and fatigue can lead to injuries among workers. The removal of hot air is not functioning effectively because there are only two exhaust fans.

Proposed Improvement

The suggested recommendation is to simplify the process steps, particularly in the administrative process, to reduce the lead time. The proposed solutions are expected to have a positive impact on the overall system. Based on the identified issues, the proposed improvements are:

a. Waiting

The suggestion for improvement to facilitate the flow of Delivery Orders (DO) for prompt acceptance by production is to enhance the integration of information systems using a computer network. The use of a computerized system can shorten and reduce lead time in the production process. Shilamaya and Sisdianto (2024) reported that better application of information and technology in an industrial manufacturer resulted in higher operational efficiency and increased productivity.

b. Inappropriate processing

The proposed recommendation to eliminate the feather plucking rework in the clean area is to add additional plucker machines to ensure a cleaner feather removal process, thereby preventing the need for rework. Quantity is one of the important factors to be considered in poultry defeathering mechanization to ensure production effectiveness (Adetola et al., 2023).

c. Unnecessary motion

The proposed recommendation to address unnecessary motion among the cutting operators is to clarify the responsibilities within the organizational structure and enhance the supervision of work methods. Providing clear guidance to employees through SOPs helps minimize confusion, therefore speeding up workflow, increasing productivity, maintaining consistent product quality, and ensuring compliance with production standards (Rahmawati and Suryana, 2024) Additionally, establishing monitoring and communication systems will increase awareness among workers. For improvements in the dirty area, it is suggested to add more exhaust fans, as the current two exhaust fans are insufficient. Poultry processing in closed space exposes the workers to airborne dust, allergens, endotoxins, microorganisms, chemical pollutants, and organic gases which can cause skin allergies, acute respiratory symptoms such as wheezing and sneezing, oversensitive lung disorders, asthma, and other respiratory disorders (Islam et al., 2023).

Future State Map

Based on the results of the future state map, it is evident that the lead time of the process has decreased. Mapping of future state maps based on the identification of waste and proposed suggestions for improvement based on company conditions. These improvement suggestions will be able to reduce waste and activities that do not add value to the product. There is some waste in several parts of the production system, as explained in the analysis of the causes of waste. Mapping the current conditions depicted in the current state map shows that there is waste activity during the DO waiting time in the marketing department, this causes the process of weighing materials to be hampered. Therefore, it is necessary to implement a computer system that makes DO immediately sent to the production department and makes the process lead time shorter. This shorter production process can reduce the potential for contamination of the product and prevent weight loss in the carcass. A plucker machine that has an inverter is expected to produce carcasses that are clean from feather removal in the clean area and in the clean area and the labor, and rework process can be transferred to other processes. The lead time process before is 6 hours 50 minutes and the processing time is 2 hours 8 minutes after. In the future state map lead time process is 6 hours and 15 minutes and the processing time is 1 hour and 50 minutes because there is no DO Collection, rework (inappropriate processing), and unnecessary motion in the dirty area. Therefore, there will be no more feather removal rework, which can make the process lead time shorter. This Future State Map can be seen in Figure 10

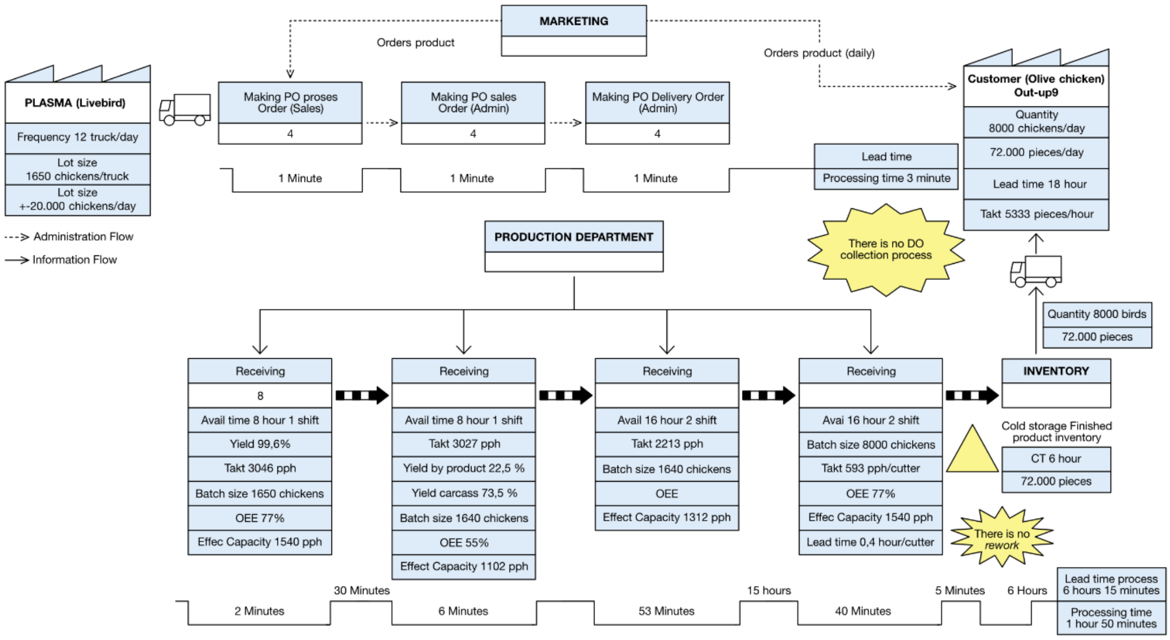

Figure 10. Future State Map

4. CONCLUSIONS

This study aims to identify the causes of waste and find an appropriate system to reduce it. The identified wastes in the chicken carcass production process at PT. Ciomas Adisatwa is waiting for inappropriate processing and unnecessary motion. The proposed improvements include simplifying the process by implementing a computerized system. With the use of a computer network, the lead time is expected to be reduced. Additionally, to address inappropriate processing, adding plucker machines to ensure cleaner feather removal is recommended. Furthermore, clarifying task allocations for each workstation will help eliminate unnecessary motion.

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