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THE APPLICATION OF LEAN SERVICE APPROACH TO ANALYZE WASTE FROM PALM KERNEL EXPELLER LOADING AND UNLOADING ACTIVITIES

Nurlaela Kumala Dewi[1*], Budi Nur Siswanto[2], Anggie Darwinanti[3]
[1]Department of Transportation Management, Universitas Logistik dan Bisnis Internasional, Indonesia
[2,3]Department of Logistic Management, Universitas Logistik dan Bisnis Internasional, Indonesia
*nurlaelakumala@ulbi.ac.id

ABSTRACT
This research aims to analyze waste from the loading and unloading activities of the palm kernel expeller using a lean service approach. The methodology used is descriptive analysis. Data collection was obtained through observation and interviews. Then identify the factors causing waste in the palm kernel expeller loading and unloading activity using a fishbone diagram. The most influential waste is in transportation, with a weight of 96.957%. The factors that influence the length of the palm kernel expeller loading and unloading activity are human factors, material factors, machine factors, and then environmental factors. Based on the fishbone diagram, it was found that the root of the problem of transportation waste was caused by loading and unloading workers carrying out their activities according to the work plan that had been prepared previously. The actual lead time result is 746,917 seconds, while the proposed lead time is 421,680 seconds. This means that after the proposed improvements were made, the difference between the initial lead time and the proposal was 325,237 seconds. The comparison of process cycle efficiency in actual conditions is 98.17%, while process cycle efficiency in proposed conditions is 98.39%. so that the difference between the initial process cycle efficiency and the subsequent process cycle efficiency is 0.22%.

Keywords: Lean Service, Waste, Lead Time, Value Stream Mapping, Process cycle efficiency

1. INTRODUCTION
The transportation system plays an important role in opening up trade both at the national and international levels. To create modern trade, a systematic, effective, and efficient transportation system is needed via land, sea, air, and rail. Sea transportation, in particular, is an option that is in great demand because it is capable of transporting large volumes of goods at relatively low costs. This has an impact on reducing product sales costs, so currently, sea transportation has become a mainstay in the modern trading system [1]. International and national trade that relies on sea routes reaches a very high proportion, namely around 85% for international trade and 90% for national trade. Ports, as the main gateway for trade by sea, have a very vital role in monitoring the movement of imported and exported goods that pass through them. Transportation activities, including sea transportation, have a crucial role in the economies of countries, including Indonesia. Without a transportation system that functions well as an economic supporter, economic sectors that are a source of government income can be hampered in their growth [2].

Ports serve as the hub of the local economy and typically offer ship services such as piloting, tugging, anchoring, and mooring, as well as bulk, dry bulk, liquid bulk, general cargo, and roro loading and unloading, embargo operations, and passenger debargation [3]. Loading and unloading activities are logistical activities to support the loading and unloading activities of goods originating from and/or onto ships, including activities such as unloading goods from stevedoring, cardodoring, receiving, and delivery, with the aim of reducing loading and unloading costs [2].

There are many obstacles to carrying out the activity process at the port; delays are one of the obstacles that must be avoided in order to increase effectiveness. There are many things that will provide added value if effectiveness can be carried out, namely in terms of providing materials on time, in the right quantity, and at a low cost. This effectiveness will certainly increase consumer trust, so it is an important thing to pay attention to. If there is a delay in loading and unloading activities, it is certain that obstacles will arise, which will cause waste [3].

agricultural industrial company that operates in the field of processing palm oil and its derivatives to produce cooking oil, while the by-products are exported to New Zealand in the form of palm kernel expellers. In exporting palm kernel expellers, it works with a palm kernel expeller capacity of 17,000 MT per ship. has a standard time for carrying out the palm kernel expeller loading and unloading process, namely 5760 minutes/17,000 MT or 345,600 seconds/17,000 MT, with a delay tolerance standard of 1440 minutes or 86,400 seconds, so that the maximum time for carrying out palm kernel expeller loading and unloading activities is 7200 minutes/17,000 MT or 432,000 seconds/17,000 MT.

At first, the company's palm kernel expeller loading and unloading activities ran smoothly. In March 2023, the company took 5924 minutes (17,000 MT) to carry out the Palm Kernel Expeller loading and unloading activity. In April 2023, the company took 6432 minutes (17,000 MT) to carry out the Palm Kernel Expeller loading and unloading activity. Furthermore, in May 2021, the company's Palm Kernel Expeller loading and unloading activity took 5477 minutes, or 17,000 MT. From the data above, it can be seen that from March 2023 to May 2023, the company is still within the time limits determined by the company in carrying out its activities.

In current conditions, companies carrying out palm kernel expeller loading and unloading activities often exceed the predetermined tolerance limits, with the average time delay for palm kernel expeller loading and unloading activities being 2,300 minutes or 138,000 seconds, giving rise to various problems such as not fulfilling the agreement with the customer, which results in complaints, other work activities being delayed, additional costs for loading and unloading labor due to overtime costs for loading and unloading labor, as well as other costs.

During the August period, the palm kernel expeller loading and unloading activities were still running according to the time limits set by the company. However, the execution of these activities became incredibly unstable from September 2023 to January 2024, exceeding the company's maximum time limit.

implementation of lean service using the WAM and VALSAT methods to minimize waste in loading steel plates. In general, the approach to waste identification methods and improvement analysis differs between the research design that the researcher has proposed and earlier research. Previous research used the WAM method to minimize waste and VALSAT to select detailed mapping tools used for improvement analysis. Meanwhile, in this research, the author uses a lean service approach with the VSM method to see the lead time in palm kernel expeller loading and unloading activities.

Waiting time is the amount of time the business needs to take from the moment the client places an order until the product is delivered to the customer. Next, identify waste using a fishbone diagram. The aim of this research is to identify what factors cause delays in palm kernel expeller loading and unloading activities, so that it is necessary to look for suggestions for improvements in minimizing waste in order to find an accurate solution to help the company overcome the problem and become a consideration for the company so that the activity of loading and unloading can be isolated in achieving effectiveness and efficiency in the time and costs incurred.

2. LITERATURE REVIEW

Lean is a collection of tools or techniques intended to get rid of waste, shorten lead times, boost productivity, and cut expenses. The goal of lean methodology is to maximize process efficiency and remove waste from a given operation. Lean is a way of thinking, methods, philosophy, and strategies to improve management to be more efficient in the production section of a manufacturing industry. This approach, which is based on the Toyota production system, aims to maximize customer value and boost business profitability by getting rid of non-value-adding operations [4]. Five guiding principles are the foundation of lean methodology: determining the worth of goods and/or services from the standpoint of the consumer, who demands high-caliber goods and/or services at reasonable costs with prompt delivery. Determine which products (goods and/or services) each have value stream mapping (process mapping of the value stream) [5].

Remove waste that doesn't contribute value from every step of the value-stream process. Use a pull system to arrange things so that products, information, and materials move through the value stream process easily and

effectively. To attain greatness and ongoing improvement, never stop looking for new tools and methods [6]. Within the field of operations management, waste pertains to any endeavor that consumes resources without producing extra value. This includes mistakes that need to be fixed, overproduction, pointless procedures, holding off on actions till after prior outcomes, and so on. There are seven different categories of waste: inventory, overprocessing, waiting, transportation, overproduction, needless motions, and faulty goods. Every kind of waste has a detrimental influence on an organization's effectiveness and operational efficiency. Therefore, identifying and reducing waste is an important step in increasing productivity and reducing costs [7].

Fishbone is a method of cause-and-effect analysis for solving a problem with a diagram shaped like a fishbone. There are five factors that can be causes in a fishbone diagram, namely human factors, method factors, machine factors, material factors, and environmental factors. This diagram depicts symbols and lines that show the relationship between the root of the problem and the results, so corrective action must be taken [8].

Value stream mapping (VSM) is a visual tool used to map a product's production path, including the data and materials from every work station. Value stream mapping is used to identify activities that give value (VA) and eliminate activities that do not provide value (NVA) in lean implementations. Value stream mapping (VSM) can provide a detailed flow diagram of an activity [9]. This tool can also function to identify critical areas of activity that result in more processing time and can improve process flow to make it more effective and efficient and avoid waste. The value stream mapping concept is also used to assess waste that occurs. With this concept, companies can improve and redesign several activities as a communication tool to facilitate the implementation of the lean concept [10].

Using process activity mapping (PAM), all activities that occur during the manufacturing process are identified, and these activities are then categorized according to the kind of waste. With the help of this tool, one can decrease waste by looking for ways to improve processes, eliminate pointless operations, and determine whether they can be made more efficient [11].

All known actions, including operations, transit, inspection, delay, and storage, are mapped using this technology. The available activity types are further grouped by this tool into three categories: non-value-adding activities (NVA), required but non-value-adding activities (NNVA), and value-adding activities (VA). Value stream mapping can also be thoroughly explained with this tool, allowing you to determine which tasks require more time than others [12].

3. METHOD

The methodology used in this research is a descriptive analysis method with a quantitative approach, which means that this research emphasizes the analysis of numerical data or numbers, and the descriptive method is the method used to make broader conclusions. The data obtained was carried out by direct observation and interviews related to data to support research on palm kernel expeller loading and unloading activities. Creating a current state map is used to analyze activities that do not provide added value to the palm kernel expeller loading and unloading activity. Then identify the factors causing waste in the palm kernel expeller loading and unloading activity using a fishbone diagram. Next, make recommendations for improvements to minimize the waste that occurs.

4. RESULT AND ANALYSIS

Standard time calculations were carried out using a stopwatch by making four observations on the palm kernel expeller loading and unloading activity. After that, calculate the average time measured for each activity, calculate the standard deviation for each activity, calculate the upper and lower control limits, and calculate the data adequacy test. So that the cycle time can be known, the normal time is calculated by considering the adjustment factor, and the standard time is calculated by considering the allowance. cycle time, normal time, and standard time data, which will be used as input to create the current state map. The current state map depiction includes processing time information for each palm kernel expeller loading and unloading activity. The current state map is prepared using the results of standard time calculations.

Utilizing process activity mapping (PAM), one may ascertain every action that occurs during the loading and unloading procedure. Table 1 displays the summary findings of the process activity mapping for the loading and unloading of palm kernel expeller activities.

Table 1: Recapitulation of Process Activity Mapping

Activity	Amount	Total Time (seconds)	Percentage
Operations	8	6282	0.841%
Transportation	7	724191	96.957%
Inspection	3	7748	1.037%
Storage	0	0	0.000%
Delay	7	8696	1.164%
Total	25	746917	100%
VA	10	733254	98.17%
NVA	8	3023	0.40%
NNVA	7	10639	1.42%
Total	25	746917	100%

Source: Data Processing

Table 1 shows that, with a weight of 96.957%, transportation waste is the category with the greatest influence.

Identify waste using a fishbone diagram. The factors that cause transportation waste can be seen in Figure 1.

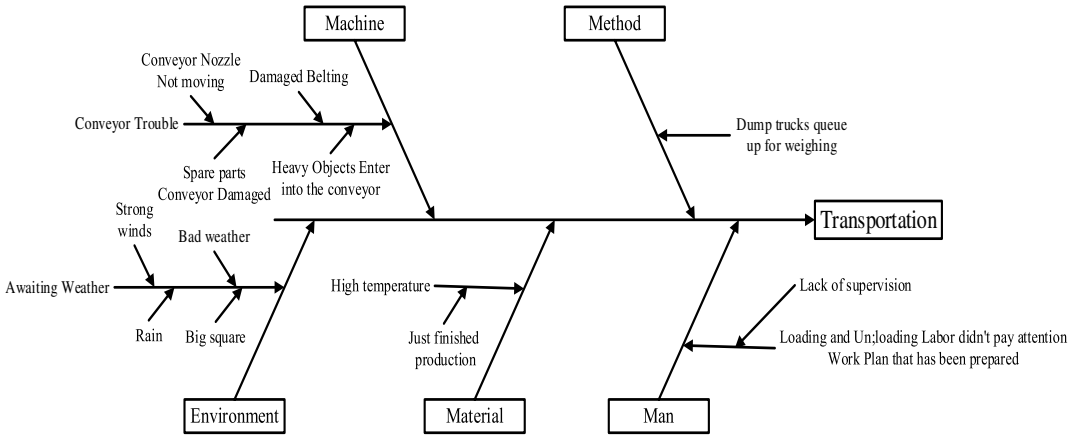

Figure 1: Fishbone Diagram
Source: Data Processing

From Figure 1, there are several causes of transportation waste. First, from a human perspective, the lack of supervision of loading and unloading workers causes a lack of skills and readiness for their work; often, they are not ready to work immediately, resulting in non-compliance with previously prepared work plans, which ultimately hinders further activities. Second, in terms of material, the newly produced palm kernel expeller has a high temperature, so the process of loading it into the dump truck is hampered and requires waiting time. Loading and unloading workers cannot start this activity if the temperature in the palm kernel expeller is not stable or normal. Third, in terms of method, the use of palm kernel expeller weighing facilities is only available in one area, causing queues for dump trucks.

Fourth, from a machine perspective, the process of transporting the palm kernel expeller to the ship uses a conveyor. Trouble with the conveyor is the main factor that causes the machine to stop working and the loading and unloading process to also stop. Causes of conveyor trouble include a nozzle that doesn't move, damaged belting, damaged spare parts, and heavy objects entering the conveyor. Fifth, from an environmental perspective,

weather influences the loading and unloading process of palm kernel expellers because this material is included in the dangerous goods category. Waste occurs due to environmental factors such as strong winds, bad weather, big waves, and rain. If the palm kernel expeller gets wet or exposed to rain, the oxidized proportion has chemical hazards that can create a dangerous situation on board. Therefore, the palm kernel expeller loading and unloading process was stopped until the weather stabilized again.

In order to make process activity mapping more efficient, it is suggested that each activity be completed for a shorter amount of time, that activities classified as NVA be removed, and that activities that add value (VA) and those that do not but are still necessary for the loading and unloading of palm kernel expellers (NNVA) be combined. It can be seen that the total activities after elimination are 14 out of 25. The total time before reduction was 746,917 seconds, and after reduction it was 421,680 seconds.

The lead time for the palm kernel expeller loading and unloading activity based on the proposed time is 421,680 seconds. The proposed improvements to minimize transportation waste during palm kernel expeller loading and unloading activities can be seen in Table 2.

Table 2: Proposed Improvements to Minimize Waste

The Main Problem	Subproblems	Repair
Transportation Time	Work does not comply with the work plan that has been prepared	Periodic performance evaluation
		Supervision of loading and unloading workers
		given training and knowledge of job descriptions and SOPs
	High palm kernel expeller temperature	Companies must improve and properly schedule the palm kernel expeller processing process
	High temperature palm kernel expeller Dump trucks queue up to be weighed	Companies must improve and properly schedule the palm kernel expeller processing process Use of weighing facilities
Transportation time	Conveyor Trouble	Regular checking and maintenance of conveyors
		Clean the conveyor after use
	Awaiting weather – rain	Procurement of tarpaulins during bad weather

Source: Data Processing

The future state map is a picture of value stream mapping after eliminating waste and is used to find out how big the changes that have occurred are. Making a future state map is carried out based on the results of activities that have been eliminated and time that has been reduced. A comparison of the actual lead time and process cycle efficiency values with the proposed conditions can be seen in Table 3.

Table 3: Actual Comparison with Proposals

No	Mark	Actual	Proposal	Difference
1	Lead Time	746.917 second	421.680 second	325.237 second
2	PCE (%)	98.17%	98.39%	0.22%

Source: Data Processing

The actual lead time result is 746,917 seconds, while the proposed lead time is 421,680 seconds. This means that the difference between the initial lead time and the proposal is 325,237 seconds. The comparison of process activity mapping in actual conditions is 98.17%, while process activity mapping in proposed conditions is 98.39%. so that the difference between the initial activity mapping process and the follow-up activity mapping is 0.22%.

5. CONCLUSION

The most influential waste is in transportation, with a weight of 96.957%. The factors that influence the length of the palm kernel expeller loading and unloading activity are the human factor, namely the lack of supervision of the loading and unloading workers, making the loading and unloading workers not dexterous in their work and sometimes not available to work straight away. The material factor, namely the palm kernel expeller, which has just been produced, has a high temperature. As a result of the high temperature, the process of loading the palm kernel expeller onto the dump truck becomes hampered, requiring waiting time.

The method factor is having palm kernel expeller weighing facilities in only one area, which results in dump trucks experiencing queues. The machine factor is conveyor trouble. The reasons why conveyors often experience problems are that the nozzle does not move, the belting is damaged, spare parts are damaged, and heavy objects enter the conveyor. Furthermore, environmental factors include changes in weather such as strong winds, bad weather, large squares, and rain. If the palm kernel expeller is wet or exposed to rain, then the oxidized proportion has chemical hazards that can create a dangerous situation on board a ship. Therefore, the process of loading and unloading the palm kernel expeller was stopped until the weather stabilized again.

Based on the fishbone diagram, it was found that the root of the problem of transportation waste was caused by loading and unloading workers carrying out their activities according to the work plan that had been prepared previously. To improve this, it is necessary to carry out regular performance evaluations, supervise the work of loading and unloading workers, and provide training and knowledge about the company's job description and SOP. The root of the problem is caused by the high temperature of the palm kernel expeller. The company must properly evaluate and schedule the palm kernel expeller processing process.

Meanwhile, to minimize queues for dump trucks in the weighing area, additional weighing facilities should be added so that load-weighing activities can run smoothly. Problems also occur with conveyors that are having trouble. To overcome this problem, the conveyor must be checked and maintained regularly to ensure it is in good condition without obstacles when used. Cleaning the conveyor is also very important after use to ensure that there are no heavy objects inside the conveyor.

Furthermore, to overcome the root of the problems that occur when the weather changes, such as rain, is to procure tarpaulins, because with the use of tarpaulins, these activities can continue without stopping. The actual lead time result is 746,917 seconds, while the proposed lead time is 421,680 seconds. This means that after the proposed improvements were made, the difference between the initial lead time and the proposal was 325,237 seconds. The comparison of process cycle efficiency in actual conditions is 98.17%, while process cycle efficiency in proposed conditions is 98.39%. so that the difference between the initial process cycle efficiency and the subsequent process cycle efficiency is 0.22%.

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