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Design Implementation of Lean Supply Chain Management: A Case Study on Loading Process of Fertilizer at PT Petrokimia Gresik Port

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Abstract. Petrokimia Gresik is one of the largest fertilizer producer in Indonesia which has a cross-country network of supply chain and distribution throughout the archipelago, either in bulk fertilizer or in bag fertilizer. This research was conducted at PT. PG port which is the main point of the logistics activities in the firm itself, either loading or unloading. This research focus on the process of loading the in bag fertilizer. Problems that occur in this process are due to the inefficiency of the flow of the Supply Chain, caused by the presence of waste and non-value-added activities. The purpose of this study was to determine what kind of waste that occurs during the process, as well as suggestions for improvements using the concept of Lean Supply Chain and Value Stream Mapping, and look for the cause of the problem using the 5 Whys method. The most influential types of waste during the process stream is Waiting Time (20.42%), and Non-Value Added activies of 51.9%. By using 5Whys, the largest cause of waste found are the length of the truck waiting for the cargo, numbers of crane are already inproper, and the absence of the scheduling and charge allocation. Recommended solutions are scheduling and allocation, creation of special line in the warehouse, and supplying cranes with appropriate load speed. Based on improvement suggestions, total NVA predicted to be reduced to 59.8%.

INTRODUCTION

Competition between firms is directly related to the firm's success in market competition, where several factors play role in firm's ability to survive in the competition [1]. These factors include the level of effectiveness and efficiency in a firm [2]. One of the components or parts of the firm PT. PKG itself that needs to be highlighted in both cases is the Department of Ports or so-called TUKS (Terminal Untuk Kepentingan Sendiri) in the internal environment of the factory. TUKS for PT. PKG is one vital component because the flow of the supply chain begins and ends at TUKS. The initial activity occurred is the process of raw materials unloading from suppliers' ship, while the end of the process is loading the finished fertilizer on the distribution vessel.

In the loading process, there are still many wasteful processes. With Value Stream Mapping, waste that happens in the process of this port can be viewed [3]. From types of waste existed, identification will be conducted to identify waste that are most often occur, the type of waste that is the most difficult to handle, and the type of waste that is most harmful, so the type of waste that are most influential in the process flow of in bag fertilizer will be identified. Then, required improvements will be designed and eliminate the waste to create effective and efficient work flow [4].

According to observation data in the form of a questionnaire deployed in several Ministries related to the process flow, such as the Department of Management of Ports, Port Planning, Stevedoring Supervisor, Port Administration, Distribution Region II, and the Department of Distribution Region I, it was found that the largest types of waste are Waiting Time (20.42%) followed by Transportation Time (17.14%), waste Inventory (16.43%), Defect (14.79%), Over processing waste (12.21%), Overproduction Waste (11.27%), and Waste Movement (7.75%).

Therefore, with many waste still occurred at TUKS, it is needed for research that can improve the productivity of firms in terms of effectiveness and efficiency, especially in the process of loading, to increase the activity that has

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added value in each process, and eliminate waste to improve firm's productivity. This research purposes to apply the concept of Lean Supply Chain through the use of Value Stream Mapping method to determine what types of waste that occurs in the process of loading at the Port of PT. PKG, and propose improvement.

RESEARCH METHOD

The present study seeks to investigate and analyze the waste along loading process of in bag fertilizer at PT Petrokimia Gresik Port. For the purpose this study uses survey method by using questionnaire on some member that involved to the process of loading.

The research was initiated by analyzing obstacles taking places along the process of loading fertilizer in baf in PT PG port by identifying the problems happening in each activity with questionnaire. These questionnaires are given to head of departments related to each activities or direct observation. Right after obtaining the data then the researcher will draw Value Stream Mapping to find out the waste in process flow and predict the possible improvement. Based on the obtained questionnaires, the researcher will understand the most impactful waste that fulfills 3 criterias including: waste that is most likely to happen, most difficult to get rid of, and causing the most expense. Afterward there will be suggestion about improvement given based on the Value Stream Mapping so that the process flow will be more effective, efficient and will be smoother.

LEAN SUPPLY CHAIN, VALUE STREAM MAPPING, WASTE, AND 5 WHYS

Lean is a systematic approach that means to a continuous improvement that has a purpose to eliminate the waste or a nonvalue added activity [5]. Lean works by smoothing the product flow (material, work in processes, output) and information using a pull system to achieve not only a perfection but a better version [6][7]. Basically, lean has a great purpose to increase value of a product to the customer (customer value) by increasing the value-added ration of the waste continuously [8].

Lean Thinking

Lean Thinking is a new way of thinking that give a focus on decreasing waste or nonvalue added activity of a flow processes [9]. Therefore, the systems thinking of lean is a crucial factor, because it makes a new way to achieve high efficiency and productivity of work [10].

There are five main principals in Lean Thinking [9]:

- Value Specification
  The real value comes from the customer needed instead of perception of manufacturers. Lean thinking should begin with awareness to precisely define the value of a product with the capabilities or qualities offered.
- Identifying the Value Stream Mapping
  Value Stream is a collection of things that are needed to make a certain goods or services through three management tasks: the problem-solving tasks (detail-design-production launch), the information management task, and the physical transformation. Value stream is certainly aims to eliminate the waste
- Flow
  After defining the value specification and identifying the value stream, the next thing is to make sure that the value-creating step flows continuously.
- Pull System
  With a lean system, one of the most visible effect is the saving of time in each processes. There is also an inventory reduction.
- Perfection
  The most important thing for lean perfection is constantly reducing time, space, cost, defect, and offers products, services, and systems in accordance with the customer needed.

Value Stream Mapping

Value Stream Mapping (VSM) is a quality management tools that makes up the current state of a process by giving an opportunity to create improvement and waste reduction. Value stream mapping is an effective way to find waste

and showed improvement processes [9].Value stream mapping (VSM) used as a tool by identifying the stages of value added in a process flow, and eliminate the nonvalue added stages/activity (waste) [9] [10].

Waste

There are 7 types of waste based on Toyota Production System [11]:

- Overproduction is a wastage caused by excessive activity of producing goods with some large quantities more than consumers booked.
- Waiting time is a wastage that occurs because of the awaiting further processes activity.
- Transportation is transferring activities of material or work in process (WIP) from one another work station using a forklift, conveyor, or a truck.
- Over processing is an activity occurs when the working methods or working processes is not good or less flexible.
- Inventories are less necessary supplies. The point is that too much material saving, work in process product is too much between one another processes and thus require a lot of space to store them, the main risk extremely possible to this waste is a high buffer.
- Unnecessary movement is an activity / movement less necessary that operators do but it won't create value.
- Defects is a product that I not in accordance with the specification. This will lead to less effective rework process, high complaints from customer, as well as a very high level of inspection.

5 whys

5 whys method is one of the techniques used in Root Cause Analysis. This method works by making a list of questions on the causes of problem. Answers were found in the question is the basis for further inquiries.

RESULT AND DISCUSSION

Problem Identifying and Value Stream Mapping

Based on the observation, it observes cycle time for each activity that will be explained on the following table:

TABLE 1. Loading Fertilizer Activities

No.	Activities	Times (min)
Distribution Order		
1	Memo from Distribution region 2 to the harbor distribution	
2	Preparing moorage	98
3	Waiting for Pandu Tunda	22
4	Pulling the ship	56
Loading Ferilizer from Truck to warehouse		
5	Preparing for trucks	10,2
6	Retrieving fertilizer from warehouse	13
7	Waiting the fertilizer being retrieved	72,4
8	Loading the fertilizer in to the truck	100
9	Transporting the fertilizer to harbor	15
10	Truck waiting to be loaded	84
11	Loading and arranging the fertilizer to the ship	5
12	Waiting for Pandu Tunda	23
13	Pulling the ship	12
14	Waiting for administration	36
15	Transporting fertilizer to warehouse	49,45

Based on the cycle time, value stream mapping will be drawn to identify types of waste.

Value Stream Mapping picture above tells the value added activity is for 259,45 mins, while nonvalue added activity is for 280,6 mins. Based on those results, the nonvalue added activity is over the max limit which is 50% from the value added activity. The result shows that the nonvalue added activity is 51,9% of the total activities.

Selecting the Most Influential Waste

Identifying waste based on Lean concept is to spread the questionairre to understand the type of waste that is most influential and should be handled quickly considering the intensity, difficulty, and the expense. The questionairre will be ranked by using weighted method. The following table represents the rank based on 3 criterias.

TABLE 2. Waste Ranking

No	Type of waste	Weight			Total Weighted Score	Rank
		Intensity	Difficulty	Loss		
1	Overproduction	0.112	0.102	0.114	0.330	6
2	Waiting	0.204	0.208	0.202	0.614	1
3	Transportation	0.171	0.195	0.182	0.548	2
4	Overprocessing	0.122	0.113	0.117	0.352	5
5	Movement	0.077	0.084	0.099	0.261	7
6	Inventory	0.164	0.163	0.142	0.470	3
7	Defect	0.147	0.131	0.142	0.421	4

Based on the table above, the waste acitivity with biggest influence (considering the intensity, difficulty, and the expense) is waiting time with total weight 0,61466.

Solution and Suggesting Improvement

Solution concept used in this research is using the 5 whys in order to get into the root of problem which is waiting time.

TABLE 3. Identifying the Root of Waiting Time

	Why	Why	Why	Why	Why
Main Problem: Waiting Time	Truck is waiting too long until it gets loaded	There are not any fertilizer allocations in warehouse	Lack of coordination	Lack of communication between related department	There are not any post work evaluations
	The operator are too slow	There is a possibility that accident happens while transferring the fertilizer	There are not any tools to load the fertilizer	Lack of periodical evaluations	There is no system existing
	There are a lot of old cranes	There are not any periodical maintenance	More cranes are needed	The good and existed cranes are not enough	Company demands
	Tools for loading are not available	They are shared with other departments	There are not any allocations for existed tools	Lack of schedules for the tools	Tools are rented from the third party

Based on the current state from VSM before, it is found out that the most influencial waste is waiting time. Seeing the fishbone diagram, and 5 whys analysis, these are a few recomendations for PT Petrokimia Gresik:

TABLE 4. Recapitulation of Suggesting Improvement

	Sub Problems	Suggestions
Main Problem: Waiting Time	Truck waiting to get loaded	Scheduling and allocations
		Monthly work evaluation
		There should be special line inwarehouse
	Operators are not available	Peridodic work evaluation
		Ability of worker
	Operator transporting the fertilizer are not skilled	Peridodic work evaluation
	Lack of fertilizer stocks to load	Scheduling and allocations
	There are a lot of unhealthy cranes	Providing ships with suitable loading speed
		Healthy cranes
	Truck is not ready	Availability of trucks
	There are not any material handling tools in warehouse	Availability of tools
		Periodic work evaluation
		Equipment scheduling

Aside of suggestions for main problems (waiting time), there are a lt of improvements that can be done to minimize other type of waste beside waiting time to complete the process, there are:

TABLE 5. Improvements of Other Types Waste

Types of waste	Improvements
Transportation Time	Truck scheduling
	Improving factory layout
Inventories	Procuring shade in case of bad wather
Over Processing	Truck loading scheduling
	Special line in warehouse
Movement	Training and evaluations
	Tools for occupational health and safety

Based on those suggestions above to complete the process flow there will be made a future state mapping to predict how much the impact made by the suggestions for filling the in bag fertilizer process flow.

According to *Future State Value Stream Mapping*, we can see that the suggestions can reduce the time of nonvalue added activity for 59,8%. Picture 5.2 shows that current state value stream mapping, total time for nonvalue added activity is 280,6 mins and future state value stream mapping is able to reduce the time until it reaches 112,8 mins. But this is only a predicted state because the suggestions have not yet been applied by PT Petrokimia Gresik.

CONCLUSION AND FURTHER RESEARCH

Based on the result, type of waste that is in the loading in bag fertilizer process flow in PT Petrokimia Gresik is waiting time (20,42%) followed by transportation time (17,14%), invenroty waste (16,43%), Defect (14,79%), Overprocessing Waste (12,21%), Overproduction Waste (11,27%), and Movement Waste (7,75%). The most influential waste (considering the intensity, difficulty, and loss) is waiting time with 0,61466 weight.

Contributing factors of this waste is the method factor, for example there are not any clear allocations and scheduling for both material and transportation. Material factor including the stock of fertilizer, and for man factor there are a lot of operator who are not available and not skilled, and for equipment factor there are a number of cranes that are no longer in a good condition.

Suggestions to reduce this type of waste is scheduling and allocating the fertilizer and making a special line in warehouse, availability of the materials and transportaion, availability of the ships with suitable loading speed, cranes with a good condition, and monthly work evaluation.

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