Optimization of Shipping Services with Waste Analysis Using Lean Service

Maylinda Ayu Setyarini, Yugowati Praharsi, and Devina Puspita Sari
Business Management Department
Shipbuilding Institute of Polytechnic Surabaya
60111, Surabaya, Indonesia
maylindaayu@student.ppns.ac.id, yugowatipraharsi@ppns.ac.id, devina.puspita@ppns.ac.id

Abstract

This company is experiencing a problem, where it is necessary to improve and adjust the service flow which causes customer complaints. The purpose of this study is to analyze the waste that occurs and optimize services by providing recommendations for improvement. This study used the concept of Lean Service which is supported by Analytical Network Process (ANP) methods and Value Stream Mapping (VSM). The results of this study are the identification of 5 waste criteria and 15 waste sub-criteria with a policy of prohibiting goods transporting vehicles for entering the office area as the dominant waste. Based on the identification of root causes, 13 root causes of dominant waste were obtained and 5 of them were chosen as priority root causes, including the absence of a systematic regulatory system related to customer procedures to enter the office, the limited number of workers, security guards only on the inside of the building, land use is not optimal, and lack of supervision. Then the 5 priority root causes are given suggestions for improvement by implementing a new system that contributes to quality optimization in reducing non-value added activities and optimizing payment duration.

Keywords

Analytical Network Process (ANP), Lean Service, Value Stream Mapping (VSM), Waste.

1. Introduction

Indonesia is a maritime country, where according to UU no. 32 of 2004, Indonesian waters cover two- thirds of the entire territory of Indonesia, which is explained in more detail in the Regulation of the Coordinating Minister for Maritime Affairs and Investment of the Republic of Indonesia Number 6 of 2020 concerning the Strategic Plan of the Coordinating Ministry for Maritime Affairs and Investment for 2020-2024, that Indonesia's territorial waters are 6,400,000 km2 or 77% of the total area of Indonesia, which is 8,300,000 km2. Based on PP no. 20 of 2010, transportation in the waters has a very important role in expediting the wheel of the economy. Water transportation has a strategic function, namely to support trade and economic activities (ship follows the trade) and stimulate economic and regional growth (ship promotes the trade), so that transportation in waters serves as a strategic infrastructure for Indonesia as an archipelagic country. The activities of transporting and/or moving goods using ships are closely related to shipping companies.

This company provides goods shipping services. Goods are packed in bags and then shipped by ship. In goods delivery services, customer satisfaction needs to be maintained. However, this company is experiencing a problem, where it is necessary to improve and adjust the service flow which causes customer complaints because if this condition is not corrected immediately, it can result in a decrease in revenue and reputation's company.

There have been many published studies that related to service quality improvement using lean service concept, but most lean methodologies refer to manufacturing industry, where a tangible product exists. Within service environments, although there is engagement with the principles of lean, many of the techniques used in the manufacturing context are not immediately applicable. Lean service emphasizes the active role of the customer, integrating the customer into the service creation. The customer participates in the production process. This presence of the customer in the service delivery system brings an element that is new for manufacturing operations because, in service activities, the value must be defined by the customer, which customer expectations and satisfaction are highly subjective, not measurable through indicators, in contrast to the manufacturing environment. (Andrés-López et al, 2015). In addition, no research that specifically analyzes waste from the flow of goods delivery services using the lean service concept. Identification of dominant waste using Analytical Network Process is also one of the novelties of this research. That is why the researcher intends to identify waste by using lean service concept, dominant waste, and root causes priority of dominant waste. Thus, proposed improvements can be recommended for optimization.

This paper first describes the actual situation that occurs in the company. The next section presents the theoretical review, with the main previous works that support this research. In section 3, the authors describe the steps which are taken in this research. Then, section 4 explains the data collection method used by the author. In section 4, the results and discussion of the research are shown. Finally, this paper ends with overall conclusions.

1.1. Objectives

This study aims to identify service waste, dominant waste, and priority root problems. It has been intended to improve service process flow. Research results should contribute to the optimization of shipping services.

2. Literature Review

The main basis of this theoretical review is the practices of Lean Service. This concept is used to improve a process so that it can produce products or services more efficiently, faster, and at lower costs (Laureani & Antony, 2017). The lean method was chosen because it focuses on the focus on services and the efficiency of the flow of a service (Amrina et al, 2019).

Waste is an activity or object that needs to be eliminated because it causes deviations from the perfect process. The perfect process can be defined as the success of a process to deliver value to customers by fulfilling customer desires, both in terms of quantity and quality (Netland & Powel, 2017). Therefore, reducing waste is seen as a way to increase efficiency, profitability, and customer value (Bashin and Burcher in Noto & Consenz, 2020). The service industry has a unique character, namely intangibility, heterogeneity, inseparability, simultaneity, and perishability. This causes the application of the lean concept to the service industry and the manufacturing industry to differ. The purpose of applying lean principles in the service industry is to increase process speed by eliminating non-value added activities in each business process (Gupta & Sharma, 2018). Among the practices that can be considered Lean Service, the following stand out: education service (Waterbury, 2015), healthcare service (Skeldon et al, 2014), financial service (Li et al, 2017), and maritime logistics service (Amrina et al, 2019). According to Andrés-López et al (2015), eight wastes that often occur in the service industry, consist: (1) overproduction (2) delay (3) unneeded transport or movement (4) over-quality/duplication (5) excessive variation/lack of standardization (6) failure demand/lack of customer's focus (7) underutilized resources (8) manager's resistance to change. But most lean methodologies refer to the manufacturing industry. Kusrini et al. (2019) studied the activities that contribute to waste in consulting service companies and recommendations to minimize the occurrence of dominant waste from the causal factors. The waste criteria used in the research include waiting, overprocessing, overproduction, defects, transportation inventory, and motion. Then, Putri and Heitasari (2021) also studied a lean concept, it is known that there are 3 categories of waste, namely delay, idle, and transportation..

Value Stream Mapping (VSM) is a tool that has reliability in visualizing all waste that occurs in the value stream so that waste that has the potential to appear in the future can be handled immediately (Cavdur et al, 2018). There are three parts to VSM, namely the process or production flow, the communication or information flow, and the timelines and travel distances. Several tools are often used to support the achievement of lean, including Kaizen and Value Stream Mapping (Sultan, 2020). However, Value Stream Mapping has the advantage, that it can know the visualization of the actual process, so that waste can be identified and improvement solutions can be designed (Noto & Consenz, 2020). VSM has been widely applied to the service sector such as health services (Apriliana & Astuti, 2018), information management (Arola & Baglee, 2019), transportation services (Villareal, et al. 2015), and maritime logistics services (Amrina et al, 2019).

Frequency distribution or frequency table is a table that divides existing data into several classes. The data needs to be compiled into a frequency distribution are generally large and irregular or varied data (Nuryadi et al, 2017).

ANP is a multi-criteria decision-making technique that can describe the interdependence relationship between higher level elements and lower level elements as well as between elements in one level (Bhadani et al, 2016). This method is one of many methods that can be used to help make decisions or determine waste ranking priorities. Other methods that can also be used such as ANP include the Analytical Hierarchy Process (AHP) method (Hussain, M.,

2016) and the Failure Mode and Effects Analysis (FMEA) method (Sutrisno et al, 2018). ANP can also be used to determine priority root causes. In addition to the ANP method, the method that is often used to obtain priority root causes is the FMEA method (Praharsi, 2021).

3. Methods

This research begins with field research to obtain information related to shipping services in general and the problems that occur in these services. Data collection is carried out to obtain data, both primary and secondary data. Primary data collection is done through observation and interview process with the company. The primary data obtained is in the form of a process flow for the delivery of goods according to the conditions in the field as well as the time of the service process. Meanwhile, secondary data was obtained from the company. Time measurement is done using a stopwatch. As a first step, the calculation of the load class data. After the class data is known, time measurements are carried out. When each class of payload data has been represented, then the load average and time average data are calculated to be used as input to the CSM.

3.1. Identify Waste

At this stage, the preparation of a current state map is carried out to categorize a process into VA, NVA, or NNVA based on field observations, personal documentation, notes supported by company data, and also interviews. Interviews were conducted involving 3 experts. The preparation of CSM refers to the average cycle time that has been obtained. Then, the activities identified as NVA and NNVA are grouped based on the theory of 8 wastes in lean service.

3.2. Identify Dominant Waste

After the waste is identified, the relationship between the wastes is identified. Then the questionnaire was distributed to 3 experts. From questionnaire 1, the output is a relationship model for each waste which is used as input for the ANP model. Then, the questionnaires were distributed back to the same respondents as the first questionnaire respondents. Then, the obtained questionnaires were processed using Superdecisions Software. If each of the expert assessment questionnaires found a CR value > 0.10, then the questionnaire was redistributed. If not, then the next step is the Geomean calculation to find out the average rating of the three experts. Then the Geomean value is reprocessed using Superdecisions Software. After the ANP calculation is complete, it can be seen the dominant waste that will be searched for the root cause of the occurrence.

3.3. Identify Root Cause Priority of Dominant Waste

After the dominant waste is identified, the root cause of the dominant waste is identified through interviews with experts. Then the results of the interview are described through fishbone. After the root causes have been identified, the next step is to distribute questionnaire 3 to determine the relationship between the root causes. Then after the relationship between the root causes was identified, interviews with the same experts were carried out as in the previous process to find out the reasons for each relationship. The relationship between the root causes that have been obtained from the distribution of questionnaire 3 is used as a reference in making the ANP model. Furthermore, questionnaires were distributed to the same 3 experts, and then the questionnaires were processed using Super Decision Software. If each of the expert assessment questionnaires found a CR value > 0.10, then the questionnaire was redistributed. If not, then the next step is the Geomean calculation to find out the average rating of the three experts. Then the Geomean value is reprocessed using Superdecisions Software. After the ANP calculation is complete, it can be seen 5 priority root causes that will be given recommendations for improvement.

4. Data Collection

The analysis refers to a 7-month period, from December 2021 to July 2022. Data collection in this study was carried out in several ways. The first way is by field observation. This is done to get the service processing time data. The second is interviews, that were conducted with 3 company experts. Interviews were conducted to obtain waste classification and identify root causes. The third is the distribution of the Analytical Network Process questionnaire. Questionnaires were distributed to the same 3 experts as in the interview process. The distribution of the ANP questionnaire was carried out 2 times, where ANP questionnaire 1 was to identify dominant waste and ANP questionnaire 2 was to identify priority root causes. In addition, in this study, questionnaires were also distributed to the same experts to identify the relationship between waste and the relationship between the root causes so that the structure of the ANP model could be generated.

5. Results and Discussion

5.1. Identify Waste

The first step is to take a sample of the data processing time for the service through direct observation in the field using the help of a stopwatch. Observations were made for 14 days. Load samples from observations in more detail are shown in Table 1.

Table 1. Load Samples

Class	Weight (Kg)	Sample (Kg)	Frequency
1	50-105	58, 98, 100, 50, 73, 100, 100, 50, 73, 53, 100	11
2	106-161	107, 133,150	3
3	162-217	213, 200, 181, 203	4
4	218-273	243, 234, 222, 260	4
5	274-329	280, 308	2
6	330-385	361	1
7	386-441	408	1
8	442-497	454	1
9	498-553	500, 500	2
10	554-609	562, 580	2
11	610-665	650	1
Total		**7604**	**32**
Load Average		**238**	

Based on Table 1 it can be seen that from observations obtained as many as 32 samples were obtained with each loaded class represented by at least one charge so that a load average of 238 kg was obtained. Then, CSM is made based on the classification of activities according to their type, namely value-added activities (VA), non-value-added activities (NVA), and important but not value-added activities (NNVA). Figure 1 shows the actual CSM of the shipping service process.

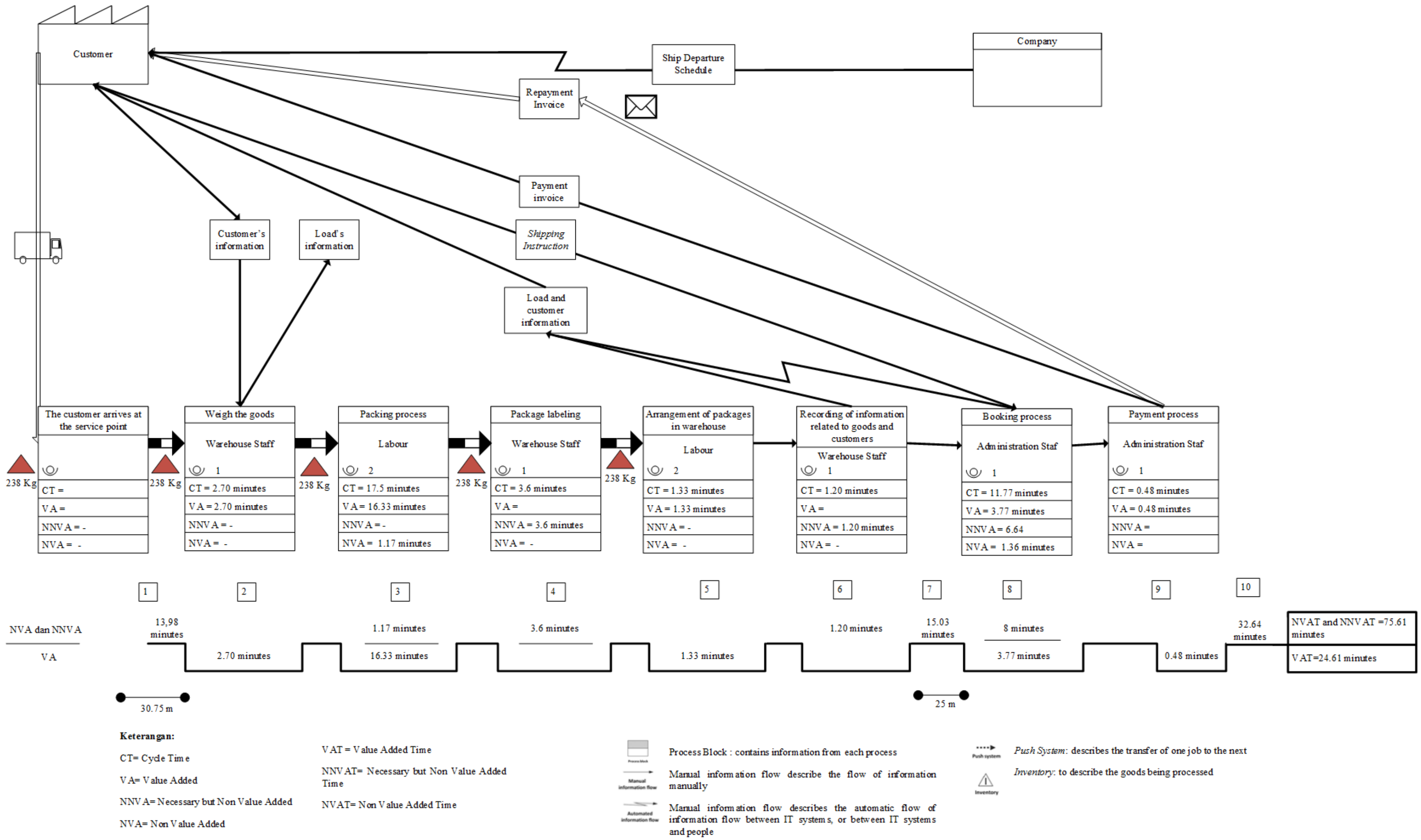

Figure 1. Current State Mapping

Based on Figure 1. it can be seen that total value added time of service process is 24.61 minutes, while the total non-value added time (NVAT and NNVAT) is 75.62 minutes. Thus, this indicates that most of the activities in service process are non-value added activities. The time used to carry out service activities but does not provide added value to the service process indicates that there is waste that has an impact on the service process so the waste needs to be reduced or even eliminated so that services can be more optimal.

After the CSM was created, then interviews were conducted with the experts to classify NVA and NNVA into 8 waste criteria. From the results of the interview, 15 sub-criteria for waste are obtained which are classified into 5 waste criteria, which include: (1) Delay, there are waiting for the booking queue (D1), waiting for the customer to fill out the Shipping Instruction (D2), waiting for customer to make payment (D3). (2) Unneeded transport/movement, there is a confirmation process to the warehouse for the transportation of goods (U1), the process of transporting goods from outside the office to the warehouse using a trolley (U2), the process of transporting goods from outside the warehouse to the warehouse (U3), the process of grouping goods according to the purpose (U4), the process of taking the bag in the bag storage room (U5), the customer goes to the administration room (U6). (3) Overquality/duplication, there are the process of recording goods data and customer data repeatedly (O1), manual labeling process and manual recording of bag numbers (O2), the process of cross-checking the goods data entered by the customer on the SI with the warehouse clerk data (O3). (4) Excessive variation/ lack of standardization, there is a policy for prohibiting goods transporting vehicles from entering the office area (LS1). (5) Failure demand/lack of customer's focus there are a poor condition of the bag (LC1) and the process of taking pictures by the customer to get the bag number information (LC2).

5.2. Identify Waste Dominant

The first step in implementing ANP is model construction. In this study, the model of the relationship between waste was compiled based on the results of the questionnaire that was distributed to the experts. Figure 2 below shows the structure of ANP model for the identification of dominant waste

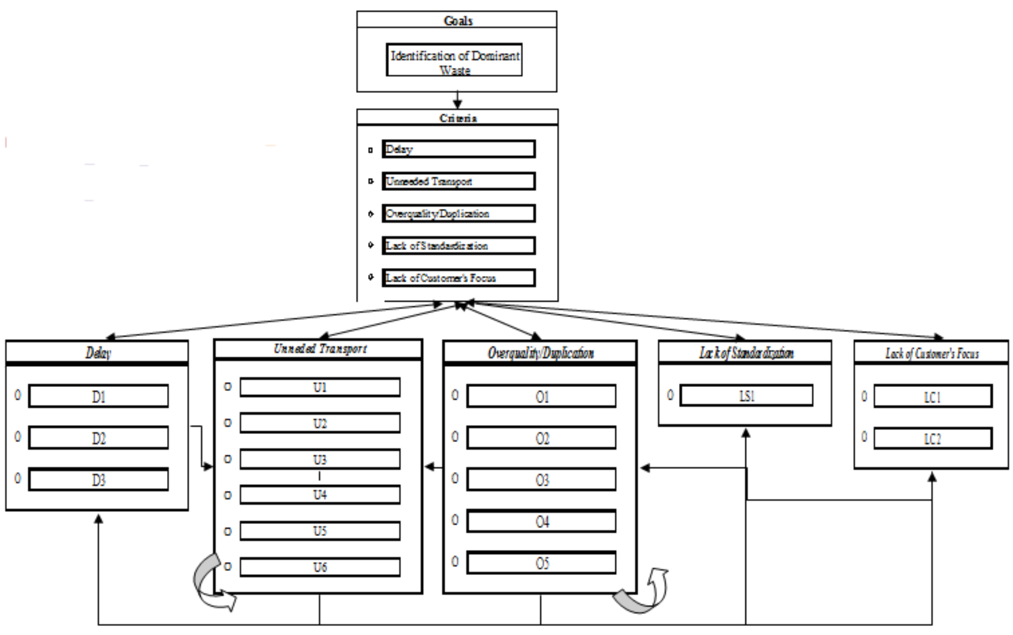

Figure 2. The Structure of ANP Model for the Identification of Dominant Waste

After the model structure is made, the next step is distributing questionnaires to assess the level of influence of each waste sub-criteria. The questionnaires were distributed to the same 3 experts, where experts are asked to assess the level of influence of the sub-criteria waste one another. Then, data processing is performed using Superdecsions software. According to the results of data processing using Superdecisions, it can be seen that the results of the expert assessment are consistent because from all comparisons the inconsistency ratio value is less than 0.1. Table 2 below shows the ranking results of the sub-criteria waste

Table 2. ranking results of the sub-criteria

Sub Criteria	*Limiting*	*Ranking*
D1	0.02371	11
D2	0.02575	9
D3	0.01587	12
LC1	0.00375	15
LC2	0.06361	5
LS1	**0.17735**	**1**
O1	0.05886	6
O2	0.08767	3
O3	0.00878	13
U1	0.03992	7
U2	0.09401	2
U3	0.03261	8
U4	0.00475	14
U5	0.02386	10
U6	0.06603	4

From table 1 above, it can be determined that waste 'The policy of prohibiting goods transporting vehicles from entering the office area' or 'LS1' was chosen to be the most dominant waste with a limiting weight of 0.177353. Similar waste also occurs in shipping companies, where the lack of standardization in work procedures and lack of standardization in HR management have an impact on operational inefficiency in shipping companies (Praharsi et al, 2021). While in the lowest position there is waste 'Bag condition is not feasible' or 'LC1' with a limiting weight of 0.003752.

5.3. Identify Root Cause Priority of Waste Dominant

The next stage is identifying the root cause of the dominant waste. As it is known that the sub-criteria 'Policy forbidding vehicles to transport goods into the office area' has the highest value. This can be interpreted that the 'policy of prohibiting goods transporting vehicles from entering the office area' is the dominant waste that occurs in the service process, so it is necessary to find the root cause of the problem so that improvements can be done immediately. The root of the problem is obtained through interviews with 3 experts, which is the same as the previous process. From the results of interviews, obtained 13 root causes of waste, including security guards only inside of the office (Man1), labor lack of discipline (Man 2), labors are tired (Man 3), lack of supervision (Man 4), the number of workers is limited (Man 5), customer goods are many with varying sizes (Material 1), goods fill the road (Method 1), transport cars cover the road for a long time (Method 2), there is no systematic regulatory system related to procedures for customers to enter the office (Method 3), customers come together (Method 4), customers are free to walk around in the office area (Method 5), labors have not finished handling goods (Method 6), and land use are not optimal (Environment 1).

To identify the priority root causes of the root causes, the ANP method is implemented. As a first step, the questionnaire was distributed to 3 experts, same as in the previous stage. Through the questionnaire, the experts were asked to identify the relationship between the root causes of the dominant waste. Figure 3 illustrates the structure of the ANP model for priority identification of the causes.

After that, another questionnaire was distributed to the same 3 experts to assess the level of influence between related root causes. Assessment of the level of influence of the root causes is also carried out using the Analytical Network Process method. Then the data is processed using Superdecisions. From the calculation of the Superdecisions software, it is known that the assessment of the three experts is consistent, where the value of the inconsistency ratio is < 0.1

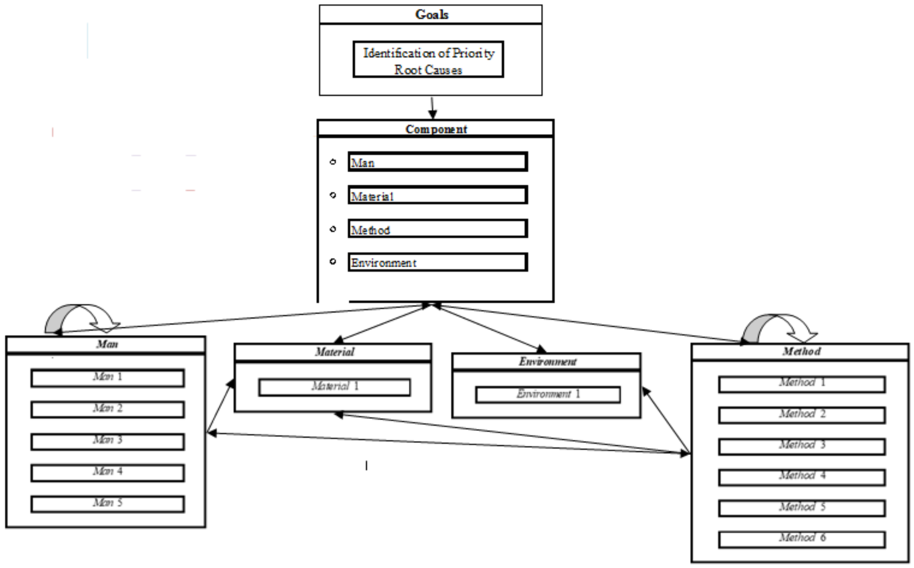

Figure 3. The Structure of the ANP Model for Identification of the Priority Waste Dominant's Root Causes.

At this stage, 5 priority root causes with the highest weights are selected and then proposed improvements are given. Table 3 below shows the results of ranking the root causes of the dominant waste.

Table 3. the results of ranking the root causes of the dominant waste.

Root Cause	***Limiting***	***Ranking***
***Environment* 1**	**0.05998**	**4**
***Man* 1**	**0.07554**	**3**
Man 2	0.02197	12
Man 3	0.02686	11
***Man* 4**	**0.05368**	**5**
***Man* 5**	**0.14317**	**2**
Material 1	0.03877	6
Method 1	0.02912	10
Method 2	0.03327	9
***Method* 3**	**0.21408**	**1**
Method 4	0.01561	13
Method 5	0.03416	8
Method 6	0.03447	7

Based on table 3 above, 5 priority root causes can be obtained, namely first, Method 3 or 'There is no systematic regulatory system related to customer procedures entering the office' with a weight of 0.214078. Second, Man 5 or 'limited number of workers' with a weight of 0.143167. Third, Man 1 or 'Security guards only on the inside of the building' with a weight of 0.075538. Fourth, Environment 1 or 'Land use is not optimal' with a weight of 0.059976. Fifth, Man 4 or 'Lack of supervision' with a weight of 0.053681.

5.4. Proposed Improvements

Furthermore, the 5 priority root causes are given recommendations for improvement that can be applied by the company. The implementation of the improvement recommendations is expected to help the company to eliminate waste 'Policy prohibiting transport vehicles from entering the office area' and even other waste that occurs in the service process. The recommendation for improvement given is the implementation of a new system, where the use of technology is carried out very optimally.

In this flow, the process begins with customer registration through the application. Then, the customer will receive information in the form of proof of registration in which there is a queue number and information regarding the data that must be prepared. Through the proof of registration, the customer can also obtain information regarding the estimated time the customer will be served so that queues can be minimized.

Next, the customer goes to the service point by showing proof of registration at security. Then, booking process can be done immediately. Followed by a flexible payment process by providing various options such as transfer, e-wallet, or QR code. After the payment process is successful, the customer will receive a label to be attached to the bag. Next, the customer takes the bag to the warehouse and the process at the service point has been completed. Customers do their own packing in the bags that have been obtained. Then attach a label to the bag containing complete information regarding the goods, the sender, and the recipient.

After the packing process is complete, the goods are dropped off at the nearest drop-off point according to the goods pick-up schedule. When at the drop-off point, the customer scans the barcode so that the company knows the whereabouts of the goods, then the customer can leave the place. After that, the workers pick up the goods at the drop-off point and bring them to the service point. Upon the arrival of the goods at the service point, the arrangement of the goods according to the destination can be done immediately. This can reduce the workload of labor. The warehouse staff then scans the barcode so that the customer knows that the goods have been taken. Figure 2 illustrates the future state map of the new system's implementation.

6. Conclusion

From this study, it can be seen that there are 15 sub-criteria of waste that occurs in goods delivery services with 'The policy of prohibiting goods transporting vehicles from entering the office area as the dominant waste. There are 5 priority root causes of dominant waste, namely 'There is no systematic regulatory system related to customer procedures entering the office, a limited number of workers', 'Security guards only on the inside of the building', 'Land use is not optimal', and 'Lack of supervision'.

Based on the priority of identified root causes, recommendations for improvement are given with the implementation of the new system. The new system is shown in the Future State Map (FSM) in figure 4. With the new system, the service process becomes more optimal. Service optimization can be demonstrated in 2 aspects, namely quality and time. The new system described in the Future State Map (FSM) provides several updates that have an impact on improving the service quality. There are 6 novelties for the flow service, including: (1) The confirmation process to the warehouse can be eliminated because of the security guard at the front of the office. (2) The process of handling goods in the warehouse is also more effective because the packing of goods is carried out by the customer himself. (3) The process of transporting goods from the front of the office to the warehouse using a trolley can be eliminated due to the availability of land for parking vehicles for transporting goods. (4) The process of taking pictures to get bag number information can also be eliminated because the system has recorded data related to bag numbers. (5) The existence of queue settings through the application can eliminate the process of waiting for the booking queue because through the new system the customer can find out the estimated service time. (6) The booking process also becomes more effective because the data information needed by the customer for booking purposes is available on the application and the input of customer data is carried out directly on the application. with payment options. Thus, with the FSM process flow, non-value-added activities can be reduced because non-value-added activities are eliminated or replaced by other value-added activities. The optimization in the time aspect is due to the recommendation of the new system that there are several payment options, namely via transfer, e-wallet, or QR code so that payments can be made on the spot. This can reduce the processing time waiting for customers to make payments. From Figure 1, it can be seen that the average waiting time for payment is 32.64 minutes, when the new system is implemented and the payment waiting time is less than 32.64 minutes, it can be concluded that the company has succeeded in optimizing the service in terms of time.

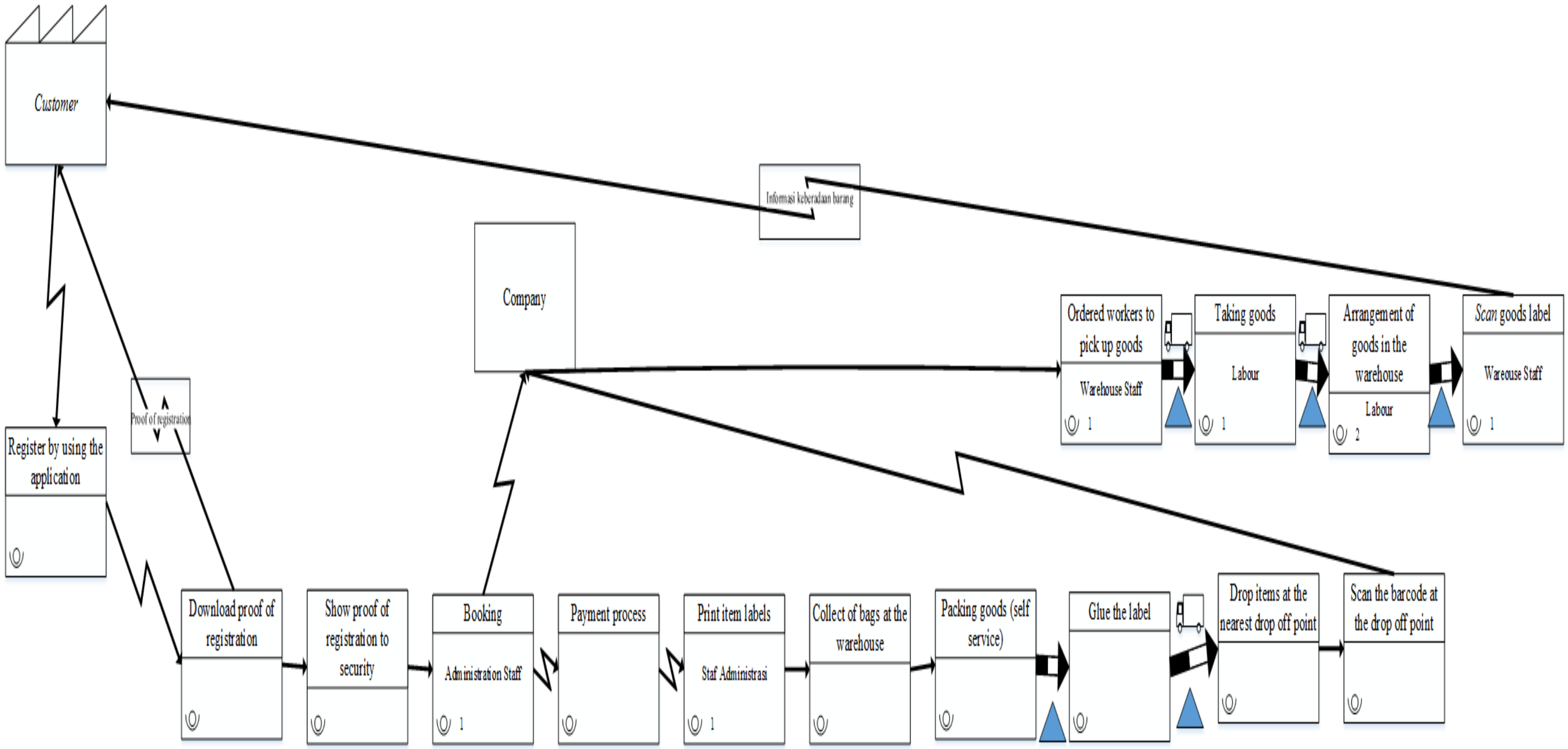

Figure 4. Future State Map (FSM)

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Biographies

Maylinda Ayu Setyarini is a student in Business Management at Shipbuilding Institute of Polytechnic Surabaya, East Java, Indonesia. Her reasearch interest are in the field of quality management, operational management, and supply chain management.

Yugowati Praharsi is an Assistant Professor in Business Management Department at Shipbuilding Institute of Polytechnic Surabaya, East Java, Indonesia. She earned B.Sc. in Mathematics from Satya Wacana Christian

University, Indonesia; M.Sc in Electronic Engineering and Computer Science and Ph.D in Industrial and System Engineering from Chung Yuan Christian University, Taiwan. She has published national and international journals and conference papers. Her research interests are in the field of operation research, production system, quality management, and supply chain management.

Devina Puspita Sari is a Lecturer at PPNS. She holds a Bachelor of Engineering degree in ship control from the SepuluhNopember Institute of Technology and Master of Engineering in ship control from the SepuluhNopember Institute of Technology.