Value Stream Mapping in MEP Work on the Pondok Tjandra Project – Surabaya

Felicia Tria Nuciferani*, Siti Choiriyah, Feri Harianto, Mila Kusuma Wardani, Siti Nuraini

Institut Teknologi Adhi Tama Surabaya

*Email: felicia@itats.ac.id

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Abstract

During construction, waste often occurs, not only material waste, but waste can also occur in activities that do not provide added value. Waste can result in cost losses and time delays in implementing a construction project. Value Stream Mapping (VSM) is a method that can be used to minimize waste by classifying activities into value added, non value added but necessary, and non value added. Mechanical engineering work was identified in the Pondok Tjandra Sidoarjo project, namely value added as many as 69 activities (67.65%), and non value added s as many as 17 activities (16.67%), while non value added but necessary as many as 16 activities (15.69%). The largest percentage of Non Value Added (NVA) is in AC work, namely 23.53%. The activities that are classified as waste are the preparation of labor & tools/equipment, work delays due to waiting for the dismantling of formwork left over from structural work, breaking down light brick walls for refrigerant pipe lines & conduilt pipes, and activities for the process of breaking down light brick walls again.

Keywords: *Value Stream Mapping, Value added , Non Value Added, Non Value Added But Necessary*

1. Introduction

Carrying out construction activities by achieving quality, cost and time targets will certainly experience various problems, one of which is waste or what is called waste. So an appropriate control management method is needed to reduce the risks posed [1].

Waste in the construction process is divided into three types according to its shape and form, namely material loss, time loss and finally waste in the form of value loss [2]. Material loss is waste caused by excess remaining material. Time loss is a waste of time that can cause project delays and value loss is waste caused by budget overruns. One of the tools used to minimize waste is the Value Stream Mapping (VSM) approach.

VSM can identify non-value added activities. Non value added means activities that do not add value to the final result [3]. VSM is a method that describes the entire process of a construction project along with the time and type of work [4]. The stages in the research begin by describing the detailed flow of a job, complete with the duration/length of the job, the time the job is completed, resulting in a flow of the job process. The workflow is called Value Stream Mapping which is equipped with identification of value added (VA), non value added but necessary (NVAN), non value added (NVA) [5]. VA is a work activity that provides added value, NVAN is a work activity that does not add value to the work process but is absolutely necessary and cannot be avoided, and NVA is a work activity that does not add value and must be eliminated [6].

This research reviews the Mechanical Engineering work on the project in Pondok Tjandra Sidoarjo. Identify waste in ME work by analyzing activities including value added (VA), non value added (NVA), necessary non value added (NVAN) followed by weighting the highest waste.

2. Literature Review

Value Stream Mapping

VSM is a process that runs from manufacturing, production, to product distribution [4]. The scope of VSM starts from the supply of raw materials – assembly – production – final distribution. Value stream mapping is defined as a method that is outlined visually to map the process flow including materials and information from each workstation [7]. This was confirmed by Intifada & Wityantyo's research in 2012 that value stream mapping is useful for depicting production (from ordering raw materials to products ready to be distributed) along with value streams, to produce information flow maps along with physical flows based on existing system patterns. . This can also be used to identify activities that cause waste, as well as describe the lead time for each activity characteristic [8].

The advantages of Value Stream mapping are that it makes maps easy and fast, without using special applications or software, easy to understand by all groups, and can provide a visual depiction of the flow of commands accompanied by information communication [6]. One of the shortcomings of Value Stream Mapping lies in the flow image, which can only be done on one product in the same time period. [7]

Process activity mapping

Process activity mapping (PAM) is useful for knowing the overall activities that take place during the production process and classifying them based on the type of waste. PAM aims to eliminate activities that are not needed and do not add value, identify efficient processes, and be used to improve flow by minimizing or reducing waste which can be in the form of time or costs [9].

Process activity mapping consists of five stages that need to be carried out, namely:

1. Observation of work activities
2. Process flow analysis.
3. Activity Mapping
4. Identify and classify activities that constitute waste.
5. Rearranging processes to make them more efficient.
6. Eliminate activities that do not produce final value [10].

3. Method

Data collection

Data collection consists of primary and secondary data. The explanation of primary and secondary data collection is:

1. Primary Data

   Primary data was obtained by conducting direct observations accompanied by interviews with contractor implementers. This is done to obtain an overview of the work process on the project. The criteria for interview sources is a minimum of 2 years of work in the field of Mechanical Engineering.
2. Secondary Data

   In secondary data research, the S curve and daily reports are used to determine the suitability between the implementation of work in the field and the plan, along with the time limits.

Research stages

The research stages in data processing are as follows:

1. S Curve Analysis to determine time limits for research and get the type of work in my jobs.
2. Work breakdown based on report data is intended to obtain details of each work process.
3. Interviews with implementing parties for a cross-check process between planned and actual work
4. Identify Value Added (VA), Non Value Added (NVA), and Non Value Added but Necessary (NVAN) jobs. The job identification criteria are as follows:
   a) Work is classified as Value Added (VA) if the activities observed provide benefits or added value accompanied by a validation process by the construction implementer during the implementation process.

b) Work is classified as Non Value Added (NVA) if the activities observed do not provide added value accompanied by a validation process by the construction implementer during the implementation process.
c) Work is classified as Non Value Added but Necessary (NVAN) if the activity observed has a positive impact on an activity but does not provide added value to the implementation process.

5. Delineation of Value Stream Mapping (VSM), by mapping all processes that occur during construction on each job.
6. The results of the value stream mapping depiction are used by researchers in the process of calculating the weighting of Non Value Added (NVA) jobs.

4. Results And Discussion

Data Discussion

Based on the stage of material arrival flow and the time required. So, next, the ME work will be broken down into small jobs which will then be described as activity flow mapping. One example of flow mapping can be seen in Figure 1 regarding AC work mapping. At this stage of work, each work percentage weight can be identified for activities that provide added value (VA), work that does not provide added value or (NVA) and work that does not provide added value but is needed for the continuity of the work process (NVAN).

Based on the mapping of ME work which consists of AC, fire alarm, telephone, sound system, CCTV, hydrant & sprinkler work, a classification of activities is obtained along with percentage weights which can be seen in table 1.

Table 1. Recap of VA, NVA, NVAN Activity Weights

Activity	*Totally Activity*	*Activity VA*	*Prosentase VA*	*Activity NVA*	*Prosentase NVA*	*Activity NVAN*	*Prosentase NVAN*
Activity AC	*17*	*10*	*58,82 %*	*4*	*23,53 %*	*3*	*17,65 %*
Activity Fire Alarm	*17*	*13*	*76,47 %*	*2*	*11,76 %*	*2*	*11,76 %*
Activity Telepon	*15*	*9*	*60%*	*3*	*20%*	*3*	*20%*
Activity Sound System	*24*	*18*	*75%*	*3*	*12,50 %*	*3*	*12,50 %*
Activity CCTV	*15*	*9*	*60%*	*3*	*20%*	*3*	*20%*
Activity Hydrant & Sprinkler	*14*	*10*	*71,43 %*	*2*	*14,29 %*	*2*	*14,29 %*
TOTAL	*102*	*69*	*67,65 %*	*17*	*16,67 %*	*16*	*15,69 %*

Source: Data processed by researchers, 2023

In table 1, it is found that AC work has the largest percentage of activities that do not add value to the final result at 23.53%. The largest percentage related to activities that produce value at the end of the product is fire alarm work, while hydrant & sprinkler work has a percentage value of 14.29% for work that supports increasing value at the end of the product.

Figure 1 shows the flow of activities carried out, starting from work preparation, which includes labor and installed materials - until the quality of the materials is tested according to function. In the ME job mapping there is a number symbol (1) which means activities include activities that do not produce value. Number (2) means activities that help increase value in the final result, and finally, symbol (3) means activities that produce value in the final product.

Activities that become waste in Mechanical Electrical work, namely activities that do not produce added value, can be seen in table 2.

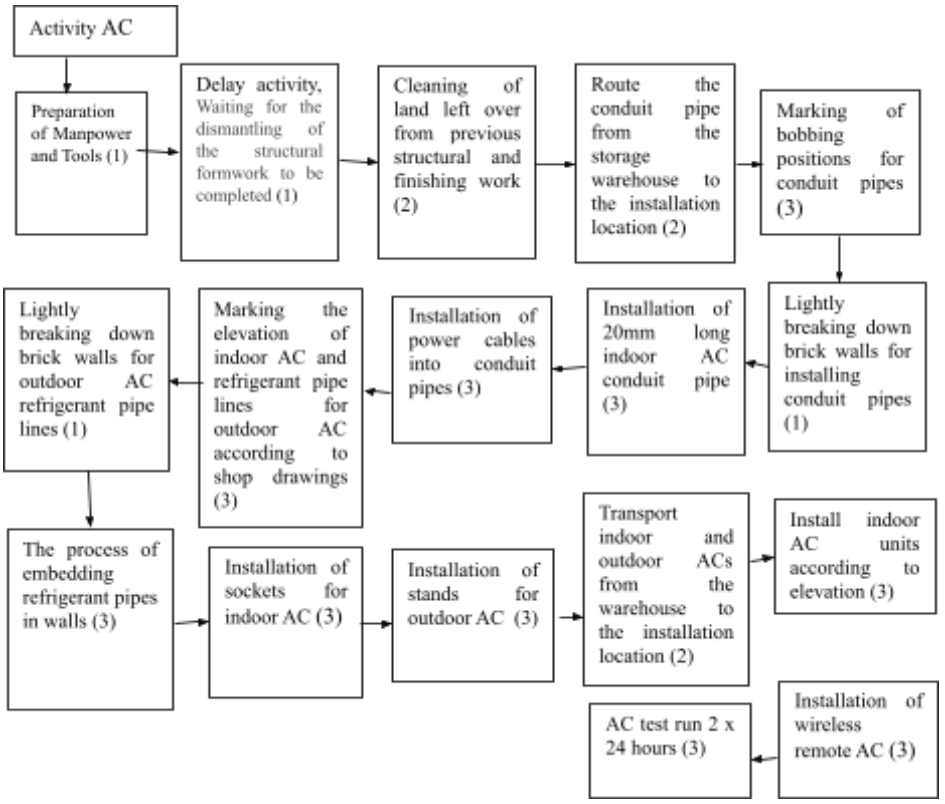


Figure 1. AC Work Mapping

Table 2. Non Value Added Activity

No	*Type of Activity*	*Activity*
1	*Non Value Added Activity*	*Preparation of labor, equipment/supplies*
2		*Work delays awaiting dismantling of structural formwork*
3		*Lightly breaking down brick walls for conduit and refrigerant pipe lines*
4		*The process of demolishing a light brick wall*

Source: Data processed by researchers, 2023

Based on table 2. Non Value Added activities in Mechanical Electrical work, there are 4 activities, namely the first is preparation of labor & tools/supplies because the labor from subcontractors is only limited to supervisors for workers given to the contract foreman, the second is work delays due to waiting for the formwork to be dismantled. remaining structural work, the third is light brick walls breaking down for refrigerant & conduit pipe lines, this is due to the possibility of errors in working drawings and errors in implementation methods in the field, the fourth is the activity of the process of breaking down light brick walls again.

Implementation of construction projects has the potential for waste. Waste can be defined as activities that do not add value to the final result. In research on the construction project of the Main Building of SMK Muhammadiyah 4 Pekanbaru, the percentage of Non Value Added (NVA) was 21.06% [11]. Supported by research on building construction projects with the value of activities that do not produce value of 21.85% [3]. This is reinforced by research on case studies on infrastructure projects where the Non Value Added (NVA) percentage is more than 50% [12].

Conclusion

In construction projects, such as the Pondok Tjandra Sidoarjo project, various types of waste can be categorized using the Value Stream Mapping (VSM) method. The identification results show that most activities in mechanical engineering work add value (value added), but there are also some activities that do not add value (non value added) and those that are necessary but do not add value (non value added but necessary). Based on the calculation results, it was found that AC work had a value of VA = 58.82%, NVA = 23.53% and NVAN = 17.65% from a total of 17 activities; fire alarm work obtained a value of VA = 76.48%, NVA = 11.76% and NVAN = 11.76% from a total of 17 activities; telephone work obtained a value of VA = 60%, NVA = 20% and NVAN = 20% from a total of 15 activities; sound system work obtained a value of VA = 75%, NVA = 12.5% and NVAN = 12.5% from a total of 24 activities; It is known that CCTV work obtained a value of VA = 60%, NVA = 20% and NVAN = 20% from a total of 15 activities; Hydrant & Sprinkler work obtained a value of VA = 71.43%, NVA = 14.28% and NVAN = 14.28% from a total of 14 activities.

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