The reduction of waste on pile production process using value stream analysis tool (VALSAT) method

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Abstract. This paper discusses about the reduction of waste on the pile production process in PT. XYZ, a company that run its business in the field of engineering, production installation (EPI) of a concrete industry. The methods of data collection are observation and interview. The analysis that will be employed is Value Stream Analysis Tool (VALSAT). Based on the value stream mapping, it is identified that the cycle time data for product’s manufacturing is 5.847 seconds with lead time of 1.380 seconds. Based on the result of observation and interview, it is identified that the biggest waste is resulted from the waste of excessive transportation. The movement process is executed on the same workstation and among workstations. While, the result of process activity mapping indicates that 27.6% of all activities are included in transportation activities. By conducting the mapping using fishbone diagram, later could be identified the factors that influence waste, in which, from human resource perspectives, it is caused by the less evenly workers distribution at line 2 on pile production, unbalance production process that causes idle time or idled operators, the lack of understanding and workers’ skill on machine utilization as well in handling the problems. In the perspective of method, the issue lies on layout factors and 5S system that runs inappropriately at line two. In terms of machine, it is stressed on the lack of numbers of tools or machines as well as the less upgraded machines. From the perspective of environment, rain definitely could affect the condensation maintaining process and evaporation.

1. Introduction
PT XYZ performs the concrete production process that facilitated with 4 plants/production line. This research is focused on line 2, the making of pile. At this line 2 production process, waste is found and could be minimized. The waste is emerged due to transportation process inside a workstation or among workstations. Hence, this research is carried out to optimize production process and to eliminate waste by employing lean system.

Lean manufacturing is one of the forms of line thinking to mitigate the waste, which is defined as an activity that absorbs resources but does not come up with value. Lean thinks about determining a value, arranging the actions to create best value and performing activities with less efforts, less machines, less time and minimum cost yet able to fulfil customers’ preferences [1]. Waste can be defined as a work activity that unable to add value on production process. There are two types of waste, which are Type One Waste and Type Two Waste. Type One Waste is an activity that unable to add value but still cannot be eliminated for several reasons. While, Type Two Waste is an activity that unable to add value but could be eliminated [2].

Process activity mapping describes real situation on production process. The advantages are to clarify complicated process, highlight non-added value activities and to consider the improvement [3]. Value
stream mapping is a technique to illustrate entire process in the company [4]. The process is noted with certain symbol. The objective of VSM is to identify production process, so it could run smoothly without significant issues, as well as to improve the productivity [5].

Based on above explanation, if lean manufacturing is implemented in a company, it will reduce non-added existing processes. Hence, this research is performed to identify waste at the company’s production line and try to mitigate it by providing improvement recommendation that could be applied by company.

2. Data collection method
Data collection method that applied in this research is observation and interview. Observation is conducted by direct examination, while interview is performed by direct interview with relevant sources.

3. Result and discussions
Through the making process of current state value stream mapping, it could be identified the description of production process. It not only covers the production process but also information flow on the quantity of operators, time of process, total cycle time and lead time, or on other words, it involves existing entire business process. Based on the current state value stream mapping, it is identified that the cycle time of product is 5.847 seconds and the lead time process is 1.380 seconds.

![Figure 1. Current state value stream mapping of pile](image)

3.1. The result of waste identification
The waste is classified into 7 (seven) types, which are, overproduction, defect, unnecessary inventory, inappropriate processing, excessive transportation, waiting and unnecessary motion. From data collecting or interview with experts, it is confirmed that the biggest waste of all pile’s production processes is excessive transportation due to frequent movement of material or tools in the production process.

3.2. The result of identification on process activity mapping
It is found from the result of waste identification that waste of excessive transportation is the biggest waste produced. Correlation between waste of excessive transportation with the VALSAT tool can be depicted from the figure that has the biggest association, which is process activity mapping tool. Each activity in production process later be classified into group of operation, transportation, inspection, storage and delay. After being identified to specific group, further, they will be classified to activities.
with value added (value added), activities with non-value added (non-value added) or activities that considered important with have no value added (necessary non-value added).

Based on the result of calculation, it is obtained the percentage for each activity; operation is resulted with 55.23%, transportation is 27.6% and delay is 17.17%. While for the classification of value-added existence, it is confirmed that value added activities resulted with 50.66%, 34.88% for non-value added activities and 14.46% for necessary non-added value. The recapitulation of process activity mapping could be seen in Table 1.

Table 1. Recapitulation of process activity mapping

| Activity       | Quantity | Total Time [seconds] | Percentage |
|----------------|----------|----------------------|------------|
| Operation      | 17       | 3992                 | 55.23%     |
| Transportation | 11       | 1994                 | 27.6%      |
| Inspection     | 0        | 0                    | 0%         |
| Storage        | 0        | 0                    | 0%         |
| Delay          | 3        | 1241                 | 17.17%     |
| VA             | 14       | 3661                 | 50.66%     |
| NVA            | 14       | 2521                 | 34.88%     |
| NNVA           | 3        | 1045                 | 14.46%     |

3.3. The result of fishbone diagram identification

On the fishbone diagram, the causes of waste are clustered into 4 (four) categories; which are man, machine, method and environment. First cause of waste is man; the quantity of workers at the line 2 are considered as less-evenly in distribution. It means that there is a process that highly depended on human or machine. Frequent idle time or idle operators is emerged due to the unbalance production process. Besides, man factor is contributed to the waste due to the lack of understanding or skill in machine utilization and less expert in handling issues while working.

In the production process, issues happen frequently. For instance, the size of joint plate hole that matchless the mold. It is considered as significant obstacles since the workers will realize after joint plate have been installed at the iron reinforcement before being moved to concrete mold, and only several workers could handle this kind of problem. The second cause of waste is method; due to layout factor and inappropriate 5S system. Layout of line 2 in this production process is considered as narrow for handling the size of concrete products, at the same time 5S system run inappropriately by considering the simple things, such as unorganized tools.

The third cause of waste is machine; the lack of machine’s quantity and the existence of less upgraded machines. It could easily be notified from the spinning machines or the compression of the machine, if it is improved with one type of single spinning machine, it could boost the production up to 10-15 additional products, batching plant that still integrated with line 1 causes longer waiting process for casting station, so it needs vacuum machine to pull out products from mold for effectiveness and efficiency purposes. The fourth cause is environment factor; the rain that could affect condensation maintaining process or evaporation. It is caused by low temperature and humidity that influence time of evaporation, besides, heavy rain could infiltrate the steam vessel.
Figure 2. Fishbone diagram on waste of excessive transportation

3.4. Improvement recommendation
Based on the result of observation and interview with experts, it can be resumed that the waste in this production process could be identified as waste of excessive transportation. After the causes of waste are derived from fishbone diagram, hence improvement recommendations are suggested to reduce waste on the pile production process. Below is the improvement recommendation to mitigate the waste of excessive transportation.

3.5. The addition of tools/machines
The requirement of tools/machines is described as follows: the addition of crane and trolley to shorten the transportation time, hence the queueing for using tools could be removed from the process. The importance of disintegrating the batching plant with line 1 is to cut the waiting time on the casting process. The addition of spinning machine single type could improve the quantity of products up to 10-15 per day and reduce idle operators. The procurement of release and vacuum machine for work station 6 or mold opener could possibly reduce the process duration.

3.6. Training for workers
The training is designed to improve workers’ ability. Training is divided into two types, which are soft skill training and technical training. Soft skill training delivers the knowledge on working in team and the way to communicate, while the technical training focuses on the ability to solve the problems and ability to master the tools or machines. Training is carried out gradually by the company. Not only executing the training, but the controlling towards the improvement of workers’ ability and skills should be conducted as well by the company.

3.7. The implementation of optimal 5S
The implementation of 5S system at the production line, should be intensified. Such as the arrangement for placing tools/equipment to ease the searching whenever they needed. This could accelerate the workers in finding the right tools.

3.8. The arrangement of optimal layout
If the improvement of layout is possible, then the company needs the area expansion particularly for this production line. By considering bigger size of products require spacious room to store half-finished
products before being forwarded to the next process. It is designated to avoid excessive transportation in production process by utilizing space at the empty space.

4. Conclusions
Based on the results and discussion, it could be concluded that on the value stream mapping, it can be notified from the existing current state value stream mapping, cycle time for product is 5.847 seconds and the lead time of a process is 1.380 seconds. From the observation and interviews with the experts, indicated that the biggest waste is derived from the waste excessive transportation. It happens on the same workstation or among other workstations. The result of process activity mapping indicates that 27.6% of all activities are included in transportation activities.

The Mapping by employing fishbone diagram has resulted the causes of waste, which are: man; the quantity of workers at the line 2 are considered as less-evenly in distribution. It means that there is a process that highly depended on human or machine. Frequent idle time or idle operators is emerged due to the unbalance production process. Besides, man factor is contributed to the waste due to the lack of understanding or skill in machine utilization and less expert in handling issues while working. Method; due to layout factor and inappropriate 5S system. Layout of line 2 in this production process is considered as narrow for handling the size of concrete products, at the same time 5S system run inappropriately by considering the simple things, such as unorganized tools. Machine; the lack of machine’s quantity and the existence of less upgraded machines. It could easily be notified from the spinning machines or the compression of the machine, if it is improved with one type of single spinning machine, it could boost the production up to 10-15 additional products, batching plant that still integrated with line1 causes longer waiting process for casting station, so it needs vacuum machine to pull out products from mold for effectiveness and efficiency purposes. Environment; the rain that could affect condensation maintaining process or evaporation. It caused by low temperature and humidity that influence time of evaporation, besides, heavy rain could infiltrate the steam vessel.

The efforts or improvement are recommended as follows: The addition of tools/machine, the addition of specific tools/machines, such as vacuum machine, release machine to remove the screw, spinning machine to reduce duration of production. Besides, it needs additional lifting tools to anticipate limited numbers of crane. Training for workers; it is important to provide training to workers to enhance their skill and minimize human error while working. Optimal implementation of 5S (Seiri, Seiton, Seiso, Seiketsu, Shitsuke), as it need to be intensified for efficient and organized production process. Optimal layout; if the improvement of layout is possible, then the company needs the area expansion particularly for this production line. It is designated to avoid excessive transportation in production process by utilizing space at the empty space.

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