Pakistan Journal of Life and Social Sciences
www.pjlss.edu.pk

https://doi.org/10.57239/PJLSS-2024-22.2.00237

RESEARCH ARTICLE

Case Study of Value Stream Mapping for Inspection Process in Oil and Gas Industry

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ARTICLE INFO

Received: May 22, 2024

Accepted: Jun 24, 2024

Keywords

Value Stream Mapping

Inspection

Lean

Oil and Gas

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ABSTRACT

This research emphasizes the importance of inspection and also inspection test plan (ITP). Then, in an organization responsible for ensuring that the materials or product they receive meet the project's standard, specification, and demand, it is necessary to study the inspection process remotely whether there is space to im-prove by checking the non-value-added or waste. The focus of this research is the inspection process in the company from oil and gas industry. This research aims to develop Value Stream Mapping based on particular steps of witness inspection. Also, to identify waste and non-value-added based on VSM. The method used to collect data is through interviews with several workers from the company who are directly involved in the process. The data was analysed using the value stream mapping (VSM) technique to see the processing steps with information flow. At the end of this research, researcher can build future value stream mapping (VSM) with a shorter time and identify waste and non-value-added based on the entire process.

INTRODUCTION

Nowadays, pandemic COVID-19 affected many employment sectors, including inspection activity at oil and gas industry. It is because workers can't go to the site because of enforcement of the MCO by the government. Also, the number of employees is limited to come to work physically due to MCO restriction and without the employer's permission. However, because the number of employees is limited, inspection cannot be conducted as usual according to the Inspection Test Plan (ITP) requirements that have been set, especially those related to witness point or hold point. The term "Quality Inspection Plan" refers to an Inspection Test Plan (ITP). It was stated that ITP highlighted the critical control points for each phase, such as scheduled inspection or verification activities, in order to ensure the smooth progress of the project. In addition, prior to the start of work, the ITP that was provided to clients will be reviewed and approved [1]. Customers must ensure that the materials or product they receive meet the project's standard, specification, and demand. The results of the entire material test used on site will be completed either on site or in the laboratory and kept in the ITP. This testing is linked to ensuring that the quality meets the specifications. As a result, inspectors are required to be there and observe the testing process. So that, this study about the process

inspection by remotely whether there is space to do improvement by checking the non-value added or waste.

Moreover, a remote inspection is a method of investigating the product defect and tracking the surrounding environment by using video cameras located on-site. These cameras may relay data to monitors either wirelessly or through cables connected to the computer. Field operators will not need to be on-site all of the time to monitor manufacturing conditions and adjust inspection machine parameters in the coming internet of things age by using network connectivity, field operators can keep an eye on it from afar [2].From workers qualification to on-site management and control, it realized extensive visual management and control [3]. So that, this study about the process inspection by remotely whether there is space to do improvement by checking the non-value added or waste.

Therefore, Value Stream Mapping (VSM), 5S, and just in time (JIT) are examples of lean techniques and tools that can be used to identify customer values and reduce non-value-added activities [4]. In prefabricated construction, [5] used VSM, a lean technique for systematically describing and investigating production processes and further help in the identification of wastes that can be removed from the process.

RESEARCH METHODOLOGY

In this chapter, the researcher will use qualitative method in which the interview will be used an embedded single-case design and multiple unit. The context of the case study referred to the improvement activities in single cases namely Company X. This study conducted the case study at one of the local companies in Malaysia. The company was established in 1982 and is a global leader in subsea, onshore, offshore, and surface technologies. Thus, the entity as a unit of a case study that involved in this study was a more group improvement team itemized by the company.

Research Instrument. As for this research, the interview is made to know more about the whole process Interview with the workers from oil and gas industry to find out more about the procedure or process of inspection by using remote inspection. Next, the interview indicates how many workers that involved in each process. Other than that, the interview is conducted to learn more about the details in term of process time, waiting time and change over time. Aside from that, the interview is being performed to learn more about the operation's specific. This form of interview aims is to learn more about the process. The process employees are questioned about their background, the process flow that they have used in the past, and their thoughts in this form of an interview.

Value Stream Mapping. In this study, there are four steps for implementing Visual Stream Mapping. The strategies for achieve the implementation steps are the data detail of product, processes and other information obtained from the worker from oil and gas industry. Next, time studies to find the duration and data collected from observation.

The current information was collected directly from oil and gas industry by interview with the worker that involved in the process. Customer demand, general process flow, raw material supply, and so on are examples of such data. Then, time studies were carried out to determine the exact cycle time and changeover time for each processing step. Individual processes were given the observed value of time in time studies [18]. Information about the amount of inventory and work in progress between processes, as well as cycle time, changeover time, and the number of operators participating in each processing step, were all determined [18]. A current map of the material and information flow will be created. The average cycle time was compared to the takt time. The areas in need of improvement will be identified.

RESULT AND DISCUSSION

After the interview established the framework for the process. The procedure is for inspection process by using remote inspection for witness point. The flowchart is designed to make it easier to

determine between value added and non-value-added processes, as well as to collect data for each process length.

Flowchart. Flowchart is a one of 7 basic quality tools are used when trying to determine where the bottlenecks or breakdowns are in work processes. Flow- charting the steps of a process provides a picture of what the process looks like and can shed light on issues within each of the inspection process that will investigate. Flowcharts are also will used to show the current process for inspection of witness point to show a new workflow process.

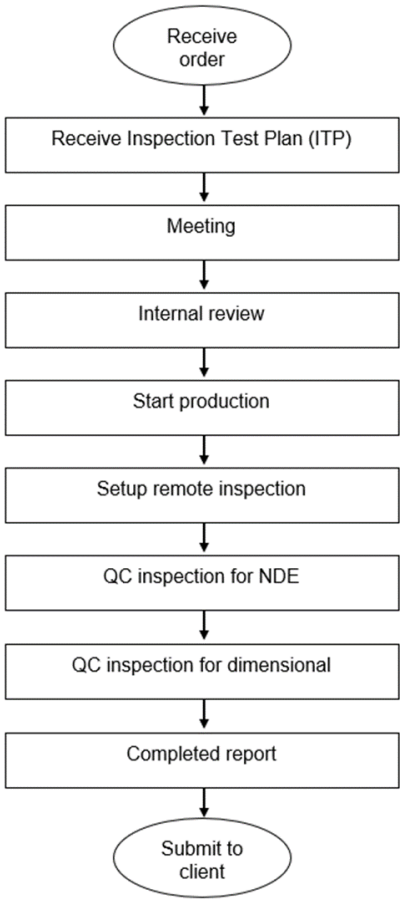

Figure 1: Flowchart the whole process

Check sheet. Check sheet is used to record the time taken for each main process in inspection activity. The time taken is in hours.

Table 1: Detail the whole process

No.	Process	Number of workers	Process time (hours)	Waiting time (hours)	Total process time (hours)
1.	Receive order	-	-	-	-
2.	Receive ITP	1	0.1	0	0.1

3.	Meeting for all department	10	2	0.25	2.25
4.	Internal review	5	480	0	480
5.	Start production	2	26	2	28
6.	Setup remote inspection	2	1	0.5	1.5
7.	QC inspection for NDE	2	3	2	5
8.	QC inspection for dimensional	2	4	1	5
9.	Completed report	1	0.5	0.1	0.6
10.	Submit to client	-	-	-	-
				Total	522.45

Current State Mapping. The researcher created a Current State Value Stream Mapping based on the NDE process at oil and gas industry. There is an additional method in the data below. All the information about the process sequence, waiting time, process time, and the number of employees assigned to the project contributes to the current process mapping, which makes it easier for the researcher to imagine and come up with improvement ideas.

Result for NDE process at oil and gas industry

PLT = 522.45

VA/T = 516.60

PCE = 98.88%

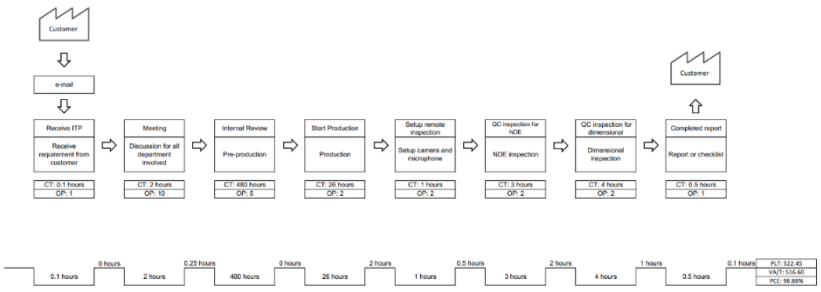

Figure 2: Current State Mapping

Bottleneck (Internal Review). Based on the data collected that is the entire inspection process, internal review takes the longest time compared to other processes. Internal review is a bottleneck for this process. Therefore, the process that is deeply involved in the internal review that causes it to take a long time is as shown in the figure 3 below.

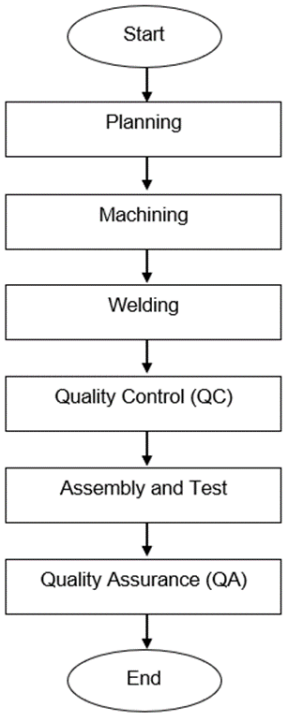

Figure 3: Flowchart for Internal Review process

Activity for each process (Internal Review). Table 2 shows the process and activities involved in internal review process.

Table 2: Process and activities

No.	Process	Activities
1.	Planning	– Prepare raw material – Paperwork – Order – Material received
2.	Machining	– Review drawing – Create CNC program – Check tooling

3.	Welding	– Review drawing – Check WPS – Check tooling
4.	Quality Control (QC)	– Inspection – Review requirement – Check inspection test plan
5.	Assembly and test	– Check tooling
6.	Quality Assurance (QA)	– Final review – Production meeting – Check all requirement

Value Stream Mapping (Internal Review).

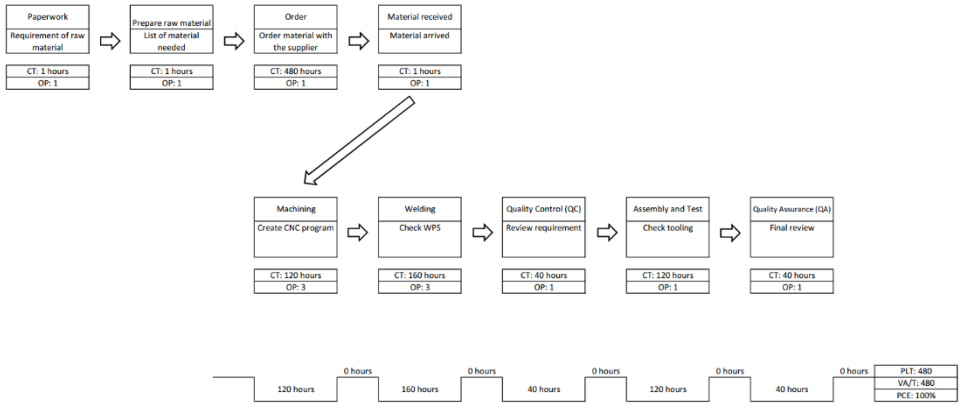

Figure 4: Value Stream Mapping (Internal review)

Check sheet (Internal Review). Table 3 shows the detail for the Internal Review process.

Table 3: Detail for the Internal Review process

No.	Process	Number of workers	Process time (hours)	Waiting time (hours)	Total process time (hours)
1.	Planning	-	-	-	-
2.	Machining	3	120	0	120
3.	Welding	3	160	0	160

4.	Quality Control (QC)	1	40	0	40
5.	Assembly and test	1	120	0	120
6.	Quality Assurance (QA)	1	40	0	40
				Total	480

Problem identification. The cause and effect diagram below are causes of long process time.

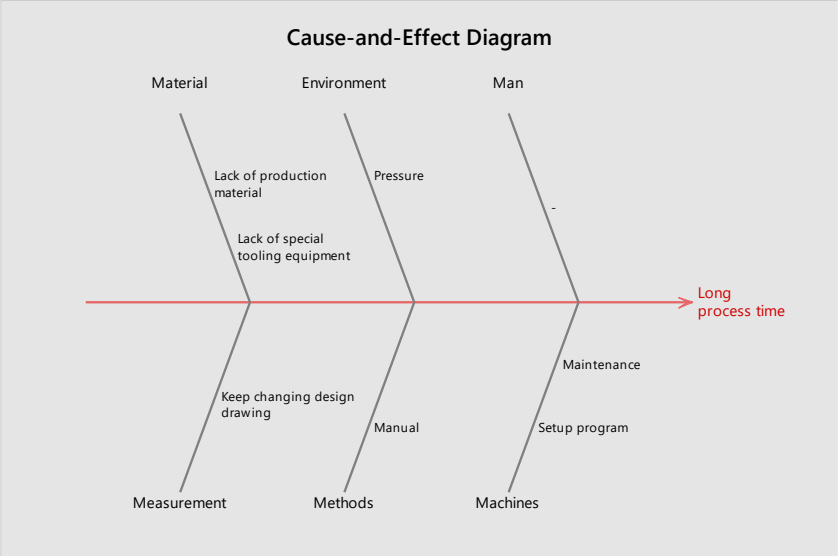

Figure 5: Cause and effect diagram

The cause and effect diagram, each of the categories has their own causes. However, based on the research that are concentrating in material and measurement.

Table 4: Common problem

Cause	Root cause	Effect
Material	Lack of production material	Insufficient material needs to be purchased. If the material is not enough, production cannot run. So that, it is a waste of time to order and takes a few days for the order to arrive.
	Lack of special	Special tooling equipment required is difficult to obtain from suppliers. This is because the size

	tooling equipment	of the material is too long or the size is too large, it usually takes months to get the right raw material.
Measurement	Keep changing design drawing	The design drawing does not conform to the design or dimensions of the machine. This causes the production department to not be able to do. Therefore, the design drawing needs to be changed according to the suitability of the machine. This is a waste of time because have to create a new design.

Value Added and Non-Value Added. Table 4 shows most of the non-value added but it is operational value added are from the meeting for all department, setup remote inspection, QC inspection for NDE and inspection for dimensional. From this activity three category of waste can be consider.

Next, non-value added but it is operational is a waste under Muda (waste) because over processing which is the activities that consumes resources without creating value for the customer. All the activities that do not add value to the product, but are currently necessary. For example, this process required by customer specification, industry standard and work method.

Table 5: Value added and Non-Value added for the process

Process	Value Added	Non-value added
Receive order	V/A	
Receive ITP	V/A	
Meeting for all department		NVA but it is operational V/A
Internal review	V/A	
Start production	V/A	
Setup remote inspection		NVA but it is operational V/A
QC inspection for NDE		NVA but it is operational V/A
QC inspection for dimensional		NVA but it is operational V/A
Completed report	V/A	
Submit to client	V/A	

Kanban. According to root cause, to improve lack of production material is by apply Kanban. In the manufacturing or distribution process, Kanban is an inventory scheduling technique that allows organization to stock just the components and artwork that are required. Kanban is a strategy used in lean manufacturing systems to keep inventory level as low as feasible. The worker needs to monitor their material inventory, and when it runs low, orders the next batch.

Automated inspection system. Automated inspection system is a system that facilitate process inspection. In addition, workers do not need to setup remote inspection all the time. Also, inspection process becomes faster and more accurate by using automated inspection system. Other than that, can reduce employee utilization.

Future State Mapping. Figure 6 shows future value stream mapping which is future improvement for this process.

PLT: 519.95

VA/T: 514.10

PCE: 98.87%

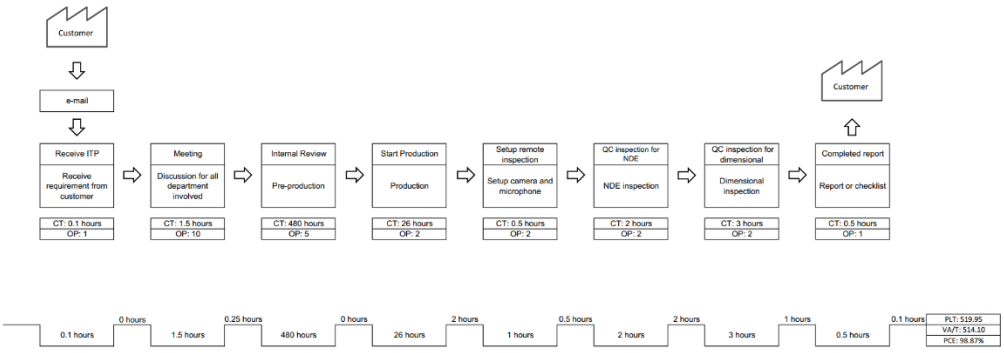

Figure 6: Future Value Stream Mapping

CONCLUSION

This research was conducted to look at waste and how to reduce it during the inspection process. Based on the root cause of a long process time, researcher is concentrating on material and measurement. For material, lack of production material can solve by collaborate with suppliers or apply kanban to make sure supply material is always available. In addition, the lack of special special tooling equipment which is difficult to obtain from suppliers can also be solved by go-to product standardization based on modules type. Next, the root cause for measurement is keep changing design drawings. This cause can be overcome by involving the production engineer in the design process.

Next, non-value added and non-value added but it is operational value added in the process is referred to as waste. Non-value added is major waste in the inspection process which is meeting for all department, setup remote inspection, inspection for NDE and dimensional. Based on the findings of the study, by reduce time of the process lead time may be minimized.

The process lead time for each process takes a long time to complete, according to current value stream mapping, internal review process is the bottleneck because has a longest time. However, all the activities in internal review process is a value added. As a result, future stream mapping is designed to reduce the amount of time it takes to complete the process. The process can be completed earlier by and the amount of time it takes.

ACKNOWLEDGMENT

Authors are grateful to corresponding authors Ts. Dr. Hj. Mohd Amran Mohd Daril for the guidance and support. This research was supported by University Kuala Lumpur – Malaysian Institute of Industrial Technology (UniKL MITEC) that provided the financial support for the publication purposes.

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