

Standardized Operation Map for Communication in Construction Practices

แผนผังปฏิบัติงานที่เป็นมาตรฐานสำหรับการสื่อสารในการปฏิบัติงานก่อสร้าง

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Abstract

Many problems in the construction industry are caused from under-standard operation planning and lack of good communication, which cause unsuccessful results in achieving the objectives of time, cost, and quality. This research aims to create a Standardized Operation Map of GUYMAST TrueGif tower installation process, by using Value Stream Mapping Management (VSM) as a planning tool with the purpose of reducing wastes, eliminating non-value adding activities in the process, and determining a better working method. The creation of a standardized map was based on Lean concepts. Using the Standardized Operation Map as an operation guideline, it can help to reduce the duration of the original operation time by about 540 minutes per station by changing the working and installation methods. Furthermore, it helps facilitate employees to have a better understanding of overall performance of each activity and helps reduce the causes of inappropriate communication. Thus, this enables a continuous work flow of the process and reduces delays such that the production cost of the project is decreased which provides benefits to customers and the company alike.

Keywords: standard operation map, communication, construction

บทคัดย่อ

ปัญหาความล่าช้าในงานอุตสาหกรรมก่อสร้างส่วนใหญ่เนื่องจากการแผนการปฏิบัติงานและการสื่อสารที่ต่ำกว่ามาตรฐาน ส่งผลให้การปฏิบัติงานจริงไม่บรรลุตามวัตถุประสงค์ด้านเวลา ต้นทุน และคุณภาพ งานวิจัยนี้มีวัตถุประสงค์เพื่อสร้างแผนผังปฏิบัติงานที่เป็นมาตรฐาน กระบวนการติดตั้งเสา GUYMAST TrueGif จากการนำวิธีการจัดการผังสายธารคุณค่า (Value Stream Management--VSM) มาใช้เป็นเครื่องมือในการวางแผนงาน มุ่งลดสิ่งที่ไม่สร้างคุณค่า ขจัดความสูญเปล่าในกระบวนการ กำหนดวิธีปฏิบัติงานใหม่ที่ดีขึ้น เอกสารแผนงานมาตรฐานจะสร้างตามแนวคิดแบบลีน การนำแผนผังปฏิบัติงานที่เป็นมาตรฐานมาใช้เป็นแนวทางการปฏิบัติ สามารถลดระยะเวลาจากวิธีเดิมลงได้ 540 นาทีต่อสถานี โดยการปรับเปลี่ยนวิธีการปฏิบัติงาน และการยกติดตั้ง อีกทั้งยังช่วยให้พนักงานเข้าใจภาพรวมการปฏิบัติงานในแต่ละกิจกรรมได้ง่ายขึ้น ลดสาเหตุของการสื่อสารที่ไม่เหมาะสม ทำให้การไหลของงานต่อเนื่อง ช่วยลดปัญหาความล่าช้า ส่งผลให้ต้นทุนของโครงการก่อสร้างลดลง ซึ่งเป็นประโยชน์ต่อผู้บริโภคและบริษัท

คำสำคัญ: แผนผังปฏิบัติงานที่เป็นมาตรฐาน, การสื่อสาร, งานก่อสร้าง

Introduction

The construction industry has increasingly grown and expanded which is an important part that help create value to the nation. As a result, the organizations in this field are interested in the continuous study and development of the construction process. However, the construction project usually found delays in the work (Frimponga, et al., 2003; Reichelt & Lyneis, 1999; Doloi, et al., 2012) that affects the cost. (Reichelt & Lyneis, 1999; Aibinu & Jagboro, 2002). The main reason is probably because the operation plan is not standardized and lacks a good communication. (Frimponga, et al., 2003; Doloi, et al., 2012). As a result, the actual operation did not achieve its goals (Odeh & Battaineh, 2002; Doloi, et al., 2012). Therefore, in order to manage the construction project, there must be a good planning tools with an efficiency comparable to the standard that can contribute to the success of the project (Frimponga, et al., 2003).

The operation plan is the key element in the Project Life Cycle (Project Management Institute, 2008). Which related to labor resources, machines, money, materials and method of operation in the project (Giridhar & Ramesh, 1998). So if there is a support tool for planning the operation, and it should be able to manage resources and communication properly. Such support tool will result in a successful project in terms of time, costs, and quality (Ogunlana & Promkuntong, 1996; Dvira, et al., 2003), will help enhance competitive advantage in construction industry.

As a result, Value Stream Mapping Management is then applied to the construction process to be used as a planning tool. This tool is used to display an operation map, visualize the story board of the overall process, and enhances the understanding of operations. It also helps to find and focus on reducing non-value activities that cause waste in the process, enables the continuous work

flow of the process, and reduces lead time of operations. In addition, it displays the detailed information as the operation map of future state which helps provide a better process plan (Arbulu & Tommelein, 2002; Simonsson, et al., 2012; Oberhausen & Plapper, 2015). The plan must be prepared according to the standard and properly communicated to the workers so that they can follow the plan correctly, cause to the standard operation according to Lean concepts (Productivity Press Development Team, 2002; Parry & Turner, 2007). In preparation, the Standardized Operation Map is adapted for using in construction operation. This is a key element to enhance the effectiveness of the plan and enable a good communication. Thus reducing the causes of unsuitable communication for workers involved in the operation (Assaf & Al-Hejji, 2006). In particular, the construction process that is performed in a repetitive manner. By properly planning the operation, it can result in an effective implementation in terms of time, cost, and quality (Oberhausen & Plapper, 2015), and help provide benefits to the current process and also become a new standard of future operations.

This research has an objective to use Value Stream Mapping Management to display the pictures of relation between sequence of operations for both value and non-value adding activities in the process. Operation map of the current state helps find out the non-value adding activities that cause wastes and the interruption of work flow, and also help in reducing waste in the process. The operation map of the future state can provide a better way for determining the new working method. The Standardized Operation Map is used to display the detailed document to promote an efficiency of the plans and communication, so that the operation meets the performance level according to Lean concept. As a result of using these tools, the actual operation can achieve its goal and reduce delays in construction process.

Value Stream Mapping Management (VSM) and Standardized Operation Map (SOM)

In 1991, James Womack et al. invented the system based on Lean concept using the basic principles of the Toyota Production System (TPS). This system reduces waste to a minimum in order to achieve continuous work flow in a process (Howell, 1999; Liker & Hoseus, 2008). VSM considered an important tool of Lean production for analyzing operations and planning the story board of operation, enables the capability to search for wastes in the process and helps reduce non-value adding activities. By using Value Stream Mapping Management and following the 8 steps below (Tapping, et al., 2002; Tapping, et al., 2006).

1. Commitment to Lean. It start from the management team (which consist of foreman, planner, project engineer, and Lean operator), who participate in the process since the beginning until the end and help motivate workers so that they are interested and support their own to pull out the resources that are required for training and improving Value Stream Mapping Management. The aim is to efficiently reduce and eliminate wastes with the support from the management team. Furthermore, there should be a communication between management team and workers at all levels of production line in the organization that indicate the importance of becoming Lean. Once everyone is understood, management team must be open-minded and let workers in the organization use their abilities to support the plan.

2. Selection of Value Stream. It is the selection of a group of operations (including both value adding and non-value adding activities) that are essential to the production process starting from raw materials, through

the production process, and until receiving payment. This selection is necessary for the operations that need to be updated, reduced costs, or used as a standard for comparing with other operations in the process. Within any organization that has multiple Value Streams, it is comparable to the rivers flowing into the ocean, and the production line of each product family can be viewed as a separated Value Stream. In addition, the Value Stream can be selected base on the plant requirement.

3. Learning about Lean. The Value Stream Mapping Management ensure that all employees including executives in the point of operation have the same understanding of Lean concepts and production tools. During Lean operation, it may be found that workers are being asked to learn more, and the management team must prepare various programs and resources that can be used to increase the understanding and skills of workers such as education within organizations, books, consultants, discussion, simulation of events, as well as comparison (Briosoa, 2015).

4. Plotting the operation map of the current state. This map reflects the Value Stream and the goal of the current state. It is the collection of process information and material flow in the actual operation site. The map of the current state begin from the delivery department, then pass through multiple processes, and gradually returns to the beginning of the Value Stream. This map allows observing and understanding the work flow of the entire Value Stream, not just a single separated operation. When workers agreed that the map is accurate and reflects the reality of the current operation. Then the team will plot the map of the current state and input information into the map using standard symbols. The standard symbols are shown in Table 1.

Table 1

The standard symbols used for plotting a VSM

The meaning of symbols	Symbols	The meaning of symbols	Symbols
Customer or supplier		Data or feature	
Transported by truck		Production control department	
The flow of electronic information		Box of specific process	
The flow of information using human (Manual).		Performing a kaizen	
Worker's position		The flow of kaizen (Must flow from the point of performing kaizen).	
Push material		Box of shared process	
WIP work piece that is at a standstill		First-In , First-Out (FIFO)	

5. Determination of Lean measurement. The measurement must be considered from an environment that suit each organization by choosing the main measurements that are commonly used such as quantity of work/worker/hour, total cycle time, total lead time. After determining the measurements, they will be used for plotting a Value Stream Mapping.

6. Principles of Value Stream Mapping Management. Data and resources that flow to the points of operation of the future state will be managed by using 5S system: Screened area, Systematic area, Spotless area, Sanitary personnel, and Self-disciplined personnel. This is one of basic Lean manufacturing systems that can results in a better performance. The aim is to reduce 7 wastes as follows (Productivity Press Development Team, 2003). (1) Excessive production (over production), (2) Useless waiting, (3) Unnecessary transportation, (4) Unnecessary manufacturing process, (5) Storing too much inventory, (6) Motion or posture at work is inappropriate, (7) Defective product and spoilage. The purpose is to eliminate wastes so that the continuous work flow of the process can be achieved.

7. Creating the operation plan of future state.

The team will have to create a thorough operation plan in order to communicate and build a comprehensive understanding. All those involved in the operation should use the standard form to indicate the future states of Value Stream that are accepted by all stakeholders and can be brought into real practice, and also provide yield and quantity as scheduled. After that, requesting an approval from management team so that the operation plan can be brought into practice.

8. Implementing the operation plan. It may have an impact on all employees since most people may feel that the change is difficult. However, all employees must be ready for the change to occur. Managers need to visit the operation area regularly in order to encourage employees, arrange the meetings with employees so that they can understand the details of all operations from the beginning to the end, and negotiate with all employees who behave in a negative sense to make them understand that the improvements will help the organization sustain the future success, and they should be flexible and supportive. Although the operation may have some mistakes or unpredictable problems, but if workers being flexible and committed to learn, they will be able to implement and

solve the problems that cause the production stoppage, then resulting in the success of Lean manufacturing.

Create a plan to prepare a standard document used for communication. In order to let all employees know the standards and be able to follow correctly, it requires language, pictures, and symbols for communication, which allow for easier understanding. In addition, the standardized operation is not the operation that has a fixed standard, but it must be able to change according to the manufacturing requirement, working method design, and manufacturing management. Therefore, the Standardized Operation Map is the important component of the plan for managing the project and also used for communicating information so that workers can follow the same practices. The process of preparation is as follows (Productivity Press Development Team, 2002).

Step 1. Create the table to show production capacity and demonstrates the capacity of each current activity. Specify the number for each operation respectively. Enter the name of operation, the initial operation time, and the total operation time.

Step 2. Create the standardized map for linking the operations. Use data from the table to show productions, and visually display the link of operations. Then, display the relationship of operations in the form of time spent in the activities, the number of employees in each point of operation, definition of operations, and Bar Chart of operation time.

Step 3. Create table of working method. Describe

an activity in each point of operation and explain a clear working method to the existing workers and also the new workers so that they can quickly learn the working method.

Step 4. Create SCOM. Display production lines in each point of operation. Draw solid lines connecting each point of operation respectively according to the specified number. Draw dotted lines during the final stage and the first stage of the process. Display the production time and the sequence of operation. Insert quality checking points, security checking points, as well as the other information involved in the standard of that activity.

The Value Stream Mapping Management for Planning a Standardized Operation Map of GUYMAST TrueGif Tower Installation Process.

Step 1. Specify the date, the name of team leader and team members into the VSM of the current-state as shown in figure 2 by project engineer. Consult with a specialist in the field of Lean manufacturing and arrange a meeting to explain and review the importance of the VSM with the team and all those involved in the work.

Step 2. Select the targeted Value Stream of the GUYMAST TrueGif tower installation process that has an operation in a repetitive manner, high-value in contract, and long construction period which affect the entire project duration. The team considered that if it has been studied in advance and properly planned, the operation will be faster and easier, take less time, and has minimum cost.

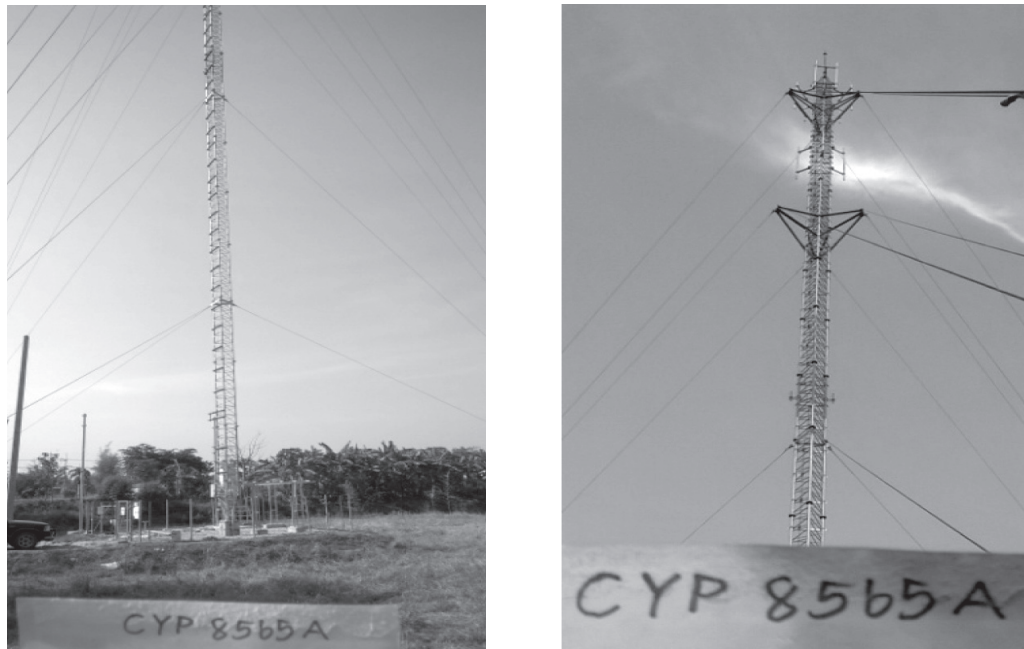


Figure 1 GUYMAST TrueGif tower, lower (left) and upper (right) sections.

Step 3. Review on how to apply Lean concept successfully. The team jointly discuss in order to learn about Lean concept and observe GUYMAST TrueGif tower installation process. It is found that the targeted Value Stream being implemented is a non-systematic operation, the work of each employee do not meet the standard, the process of operation is inappropriate, and the continuous workflow has limitations. After reaching the conclusion, the next step is to plot the map of the current state.

Step 4. Plot the current-state VSM of GUYMAST

TrueGif tower installation process.

From figure 2, the map of the current process allows to see the whole operations starting from sorting steel parts until finishing the installation and closing the job. This can be explained from the figure that the activity for sorting, preparing equipment, and lifting, installing, and assembling take approximately 180 minutes, 180 minutes, and 600 minutes respectively. The problems was found in the process that the workers lift, install, and assemble steel parts piece by piece, and cause waste due to an inappropriate production process.

Start Date 28/02/2016	Team Leader : Kanpasit Kodnanta, Main Team: Mr. Kanjanaphat Phatcharapiboonchai , Mr. Sitthisak Phuysopha	
Construction and Installation Process of GUYMAST TrueGif tower	Current State: non-systematic operation, the operation do not meet the standard, Inappropriate operation, continuous workflow has limitations	Measurement: lead time of 2 days : The total production cycle time of 960 minutes

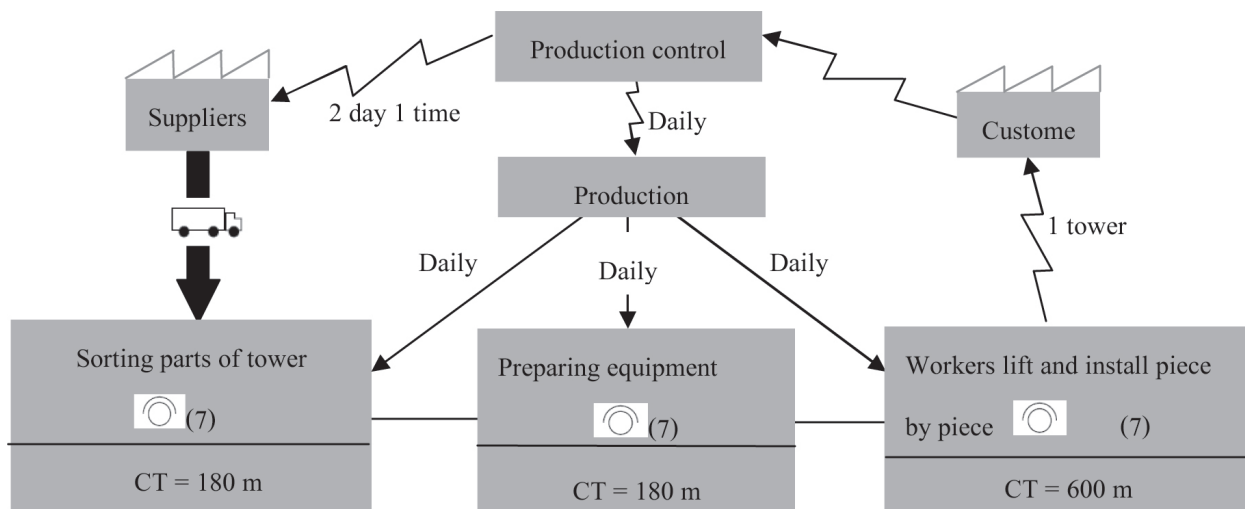


Figure 2 The VSM of the current-state of GUYMAST TrueGif tower installation process.

Step 5. The team prepared a list of measurements of the current state that require lead time of 2 days for implementation. For production cycle time of sorting parts, preparing equipment, and lifting, installing, assembling parts piece by piece, these 3 activities take approximately 960 minutes in the VSM of the current state as shown in figure 2

Step 6. Plot VSM of the future state of GUYMAST TrueGif tower installation process by analyzing the current state. Search and reduce wastes in the process, determine new working methods, and then go to the actual work site for the next station. Test the new operation plan in the new GUYMAST TrueGift tower installation process and collect the information of the process by using standard symbols, and record the actual operation time into the map as shown in figure 3.

From figure 3, the team considers using 5S system as an infrastructure for the future-state VSM

before eliminating the improvement barriers. The purpose is to manage the standards of the work site, teach the basic principles for improving the operation, let the workers take care the work site by themselves, and prepare the work site before eliminating all wastes. Then the sequence of operations is modified by combining the operations of sorting and assembling parts of structure, and implementing them on the ground. The structure can be separated into two sections: a lower section with the length of 31 meters, an upper section with the length of 23 meters. The total length of both sections is 54 meters. By combining the operations, the process will be more convenient to implement and easier than the original working method that assembles parts at the high level, and the quality of work can also be thoroughly checked. Furthermore, the equipment at each position of 24 cable slings, plate screws, piers, slings, and turnbuckles will be prepared and all activities will be performed in the same operating area. Totally, it takes around 420 minutes. Then

using mobile crane to lift the lower structure and install on the piers of the station. After that, the upper structure will be mounted on the lower structure, and assembled together according to the plan by using workers. This activity takes around 60 minutes. And totally, it takes

around 480 minutes which help reduce the operation time of its current state by 480 minutes. As a result, the GUYMAST TrueGif tower installation process of the next station can be started quicker.

Start Date 5/03/2016	Team Leader : Kanpasit Kodnanta, Main Team: Mr. Kanjanaphat Phatcharapiboonchai , Mr. Sitthisak Phuysopha	
Construction and Installation Process of GUYMAST TrueGif tower	Future State: Using 5S system to change the sequence of operation.	Measurement: lead time of 1 day : The total production cycle time of 480 minutes

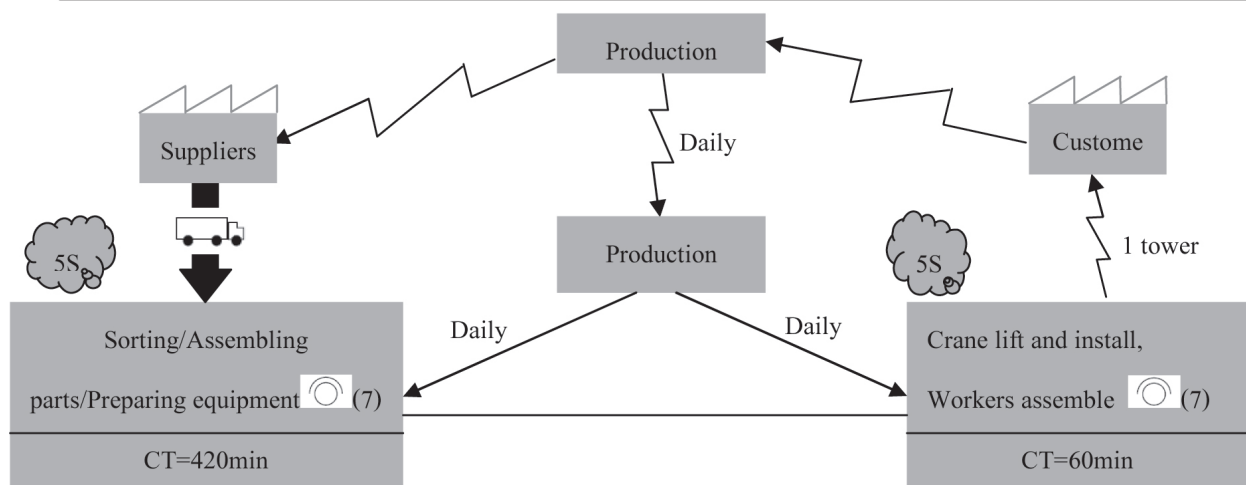


Figure 3 The VSM of the future state of GUYMAST TrueGif tower installation process.

Step 7. Create the new operation plan from the future state. In this study, we have developed a standard plan for communicating with those involved in the process so that they can follow correctly. The preparation of SCOM will start from displaying the capacity as shown in table 1.

From table 1, it shows the capacity of each GUYMAST TrueGif tower installation process by using solid lines. The activity in operation No.1 take approximately 420 minutes, and the activity in operation No.2 take approximately 60 minutes. And totally, it takes around 480 minutes/tower. The standardized map for linking the operations is shown in Table 2.

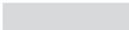
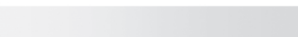
Table 1

Capacity of GUYMAST TrueGif tower installation process.

Operation No.	Description of operation	Initial operation time (minutes)	Time graph using solid lines
1.	Sorting parts/Assembling parts/Preparing equipment	420	 420 minutes
2.	Crane lifts and installs 2 sections of the structure, and assembled together by workers	60	 60 minutes
Total		480 minutes/tower	

Table 2

Map for linking operations of GUYMAST TrueGif tower installation process.

Process : GUYMAST TrueGif Tower Installation Process	Required Capacity: 1 tower		Recorded by: Project engineer				
Name of Project : Site id CYP 8565A	Total Cycle Time: 480minutes.		Operation : 				
Description of operation	Number of Workers	Operation time (minutes)	Cycle time for operation (minutes)				
			100	200	300	400	500
1. Sorting/Assembling parts/Preparing equipment	7	420					
2. Crane lifts and installs 2 sections of the structure, and assembled together by workers	7	60					

From table 2, the data from the table is used to create the map for linking operations of GUYMAST TrueGif tower installation process, and the operation time is displayed by the Bar Chart. This chart links the activities

of operation No.1 and No.2 and show the relationship of the operations in the form of time spent on each activity and number of workers in each of operation. The detailed working methods of operations are shown in Table 3.

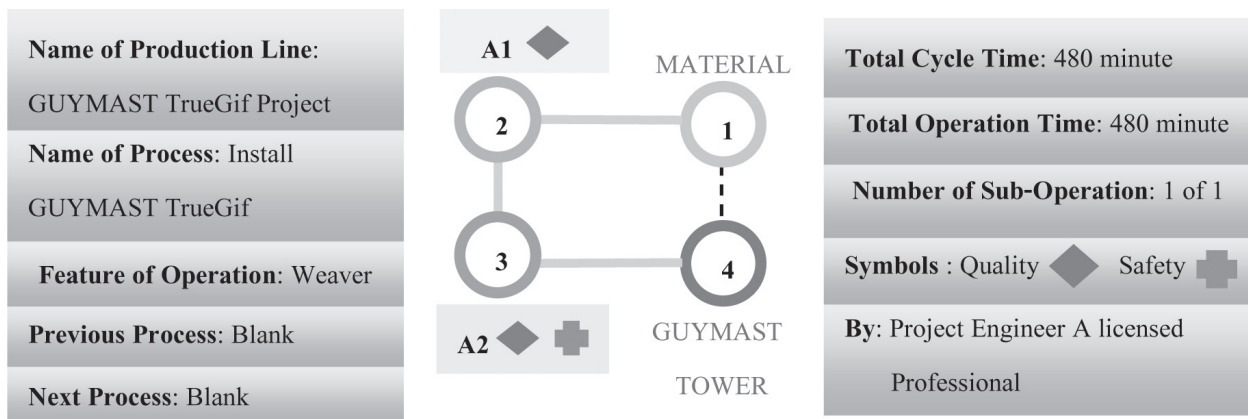
Table 3

The Standardized Working Methods of GUYMAST TrueGif tower installation process.

Process: GUYMAST TrueGif Tower Installation Process				Required Capacity: 1 tower	Recorded by: Project engineer Duty #: 1 of 1
Name of Project : Site id SKN – 8541 – A : SITE NAME : GRF/Ban Huai Hip				Total Cycle Time : 480 (minutes)	Department: Structure installation
Operation No.	Description of operation	Quality (Checking)	Important factor for operation	Total operation time (minutes)	
1. Sorting parts /Assembling parts/ Preparing equipment	Checking part number of steel structure according to the construction plan. Specifying the position to assemble parts/ fasten screws at the ground level. The structure can be separated into 2 sections: the lower section with the length of 31 meters, the upper section with the length of 23 meters. The total length of both sections is 54 meters. /The equipment at each position of 24 cable slings, plate screws, piers, slings, and turnbuckles will be prepared.	Workers must check the parts of steel structure according to the standard, and thoroughly check the part number with the plan so that they can be assembled to the correct position. / Checking screws used for assembly whether they match the specification. / Checking a sling and sling swivel according to the standard.	1. The materials meet the standard for construction and installation. 2. The worker must carefully check materials and operations. 3. Act only upon permission of the supervisor.	420	
2. The structure is lifted and installed by the crane, and assembled together by workers.	Mobile crane is used to lift the lower structure, and installed on the piers of the station. After that, the upper structure will be mounted on the lower structure, and both sections of structure will be assembled together and fastened by the screws. From the equipment being prepared, attach the slings to the structure from the top level to the bottom level according to the plan, and use turnbuckles to adjust the tension of the slings by workers.	Check whether two sections of structure are well attached to each other, not deformed, and well-aligned according to the degree set in the plan/Check the sizes of screws and turnbuckles according to the standards.	1. The materials meet the standard for construction and installation. 2. The worker must carefully check materials and operations. 3. Act only upon permission of the supervisor.	60	
				Total 480	

Table 4*SCOM of GUYMAST TrueGif Tower Installation Process.*

Process: GUYMAST TrueGif tower installation	Required Capacity: 1 set		Recorded by: Project engineer Duty #: 1 of 1				
Name of Project: GRF/Ban Huai Hip	Total Cycle Time: 480 (Minutes)		Operation				
Description of operation	Number of Workers	Operation time (minutes)	Cycle time for operation (minutes)				
			100	200	300	400	500
A1. Sorting /Assembling parts/Preparing equipment	7	420					
A2. Crane lift and install, and assembled together by workers	7	60					



From table 3, activities of operation No.1 and No.2 give a clear explanation of working method so that workers can quickly follow. Then the SCOM of the GUYMAST TrueGif tower installation process is created as shown in table 4.

From table 4, it shows the production line of the process. The solid line shows the link between each point of operation respectively from 1-4 and a dash line shows the link between the first and the last operations of the process. From point 1 to 2, it is the interval of activity for transportation. From point 2 to 3, it is the interval of activity for sorting/assembling parts/preparing equipment. And, from point 3 to 4, it is the interval of activity for using crane to lift and install the structures and assembled together by workers. At point 2, it is the

point for quality checking. At point 3, it is the point for both quality and security checking. After combining all data, it can be displayed as the SCOM.

Step 8. Implementing phase. Before using the SCOM, the team must explain the importance and benefits to the management team in order to get an approval and support beforehand, since the resources or budget to implement the new operation plan may be required. Once approved, the new operation plan will be explained and communicated to all workers, after that the plan will be brought into real practices in the next station. Initially, there may be a few trouble for complying with the new operation plan, therefore in the initial phase, the operation plan is then performed under a close supervision so that the workers are given the opportunity to learn and

practice new ways of working until becoming skillful and capable of applying the standardized operation plan to the real practice.

By applying the Standardized Construction Operation Plan to the GUYMAST TrueGif tower installation process, it is found that the Standardized Construction Operation Plan can help workers understand the overall operation of each activity easier, reduce causes of inappropriate communication, allow a continuous work flow, and also reduce operation time and cost of production.

Conclusion

VSM is an important tool for analyzing operations and planning the story board of operation. Workers, tools, and measurements are combined together to create the map that is easy to understand and observe. This map enables the capability to search for wastes in the process and helps reduce non-value adding activities. The aim is to determine the standardized new working method that enable a continuous work flow and improve the performance. The SCOM should receive an agreement from workers and used for linking workers, materials, and machines, in order to maintain the quality, efficiency, and safety of the process. It can be used as an operation guideline so that workers can follow the operation correctly, and the quality of operation is increased due to the lower operating time. In addition, it can also reduce delays in construction projects, and reduce the cost of production, which give benefits to consumers and the company.

Discussion

The results of this study are consistent with the delays in construction processes. These delays are caused by inappropriate operation plans, non-standardized operations, and lack of good communication. As a result,

they create wastes in the process. In order to solve this problem, the VSM is applied as a tool to systematically find and reduce wastes in activities and maintain value adding activities in the process. By developing the future state map and creating the SCOM, it can enhance the effectiveness of the plan and reduce inappropriate communications between those involved in the work. Good communications and good plans can result in the success of construction project in both operation time, cost, and quality (Ogunlana & Promkuntong, 1996; Dvira, 2003). and sustainably enhance competitive advantage in construction industry.

In order to apply Value Stream Mapping Management into real practice, it requires the cooperation of all parties, including senior manager, foreman, manager, team leader and workers, because they all need to work together to find the most effective working method. Every aspect of the Value Stream Mapping Management needs a good cooperation. In particular, the current state map and the future state design. The management team need to understand the Value Stream Mapping Management, be confident in that process before applying to the organization, and get involved from the start until completing all the operations. If the management team have never been involved in the activities to improve the plan, it will be difficult to find wastes. Supervisor or team leader must understand how to use Value Stream Management for planning, reporting, and also applying to other works. The most important part is the communication to colleagues/workers so that they know and understand the standardized plan, and can follow it in the same way. The new established standard should be documented, communicated, and evaluated on a regular basis.

However, there are many projects fail from the beginning because manager is not responsible, and assign the work to the team instead. Some organizations avoid assigning workers to join the team. The main reason is

the cost issue. The cost of a team member can be considered as an investment. These costs will be paid and pay backed within a few weeks, when the team begin to be experienced. The organizations that allow workers to be part of the improvement, and allow workers to participate in the planning process and the overall process design of the future state, will be able to elevate the organization to the global enterprise class quicker than the organizations that do not provide such opportunity.

When comparing this study with the previous studies, there are some works that use Value Stream Mapping Management to create the work plan in the organization for eliminating non-value adding activities

and wastes, and improving efficiency of the supply chain such case study on pipe support used in power plants, (Arbulu & Tommelein, 2002). and civil engineering that repeatedly leads to the same practice (Simonsson, et al., 2012). and including the application of Lean Manufacturing Principles to Construction (Salem & Zimmer, 2005). It is found that each activity can reduce the operating time and cost, and the result is consistent with this research that uses Value Stream Mapping Management to determine the standardized working method for GUYMAST TrueGif tower installation process. In addition, the process can also provide better productivity and achieve intended cost of operation.



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