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Study of Lean construction tools for Workflow Improvement -A Review

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Abstract - *In this study, a technology called Value Stream Mapping (VSM) is used to find and get rid of these unproductive operations, optimising the workflow in the process. Value Stream Mapping is regarded as a potent lean method for removing waste and making any organization's value stream lean and responsive. It is used to chart the flow of labour, resources, and information necessary to organise the tasks carried out by all project participants in order to deliver the finished product to the clients. The mapping of the present and future states is a component of VSM. The inefficiencies in the process and the inefficient, non-value-adding actions are revealed by mapping the existing state.*

Key Words: Value Stream Mapping, Workflow, Mapping

1. INTRODUCTION

A literature review is a crucial component of every endeavor. It must be done in order to comprehend different project facets and will aid in the project's successful conclusion. This chapter considers and reviews research that has been done in the fields of Lean construction, workflow in construction, and value stream mapping.

Research on a Lean Implementation Success Model for the Construction Industry was conducted by Sevilay Demirkesen et al. in 2020. This study's main goal is to put out a thorough success model for Lean implementation in the construction sector. A list of success criteria is defined within this framework, and these criteria are categorized into seven groups: financial, managerial, technological, workforce, cultural, governmental, and communication. When the relevance weights of these attributes have been determined by the five-person expert team, an analytical network process (ANP) model is then created to identify the connections between the success-related attributes. Eight seasoned civil engineers completed a two-part questionnaire to provide the information needed for the ANP model. The key success criteria for Lean implementation were determined to be market share, access to Lean tools and practices, and lean training. The study is anticipated to assist Lean practitioners and engineering managers in overcoming implementation process problems and advise them on success criteria to take into account and tasks to be prioritized when implementing Lean in their firms.

Framework for the selection of lean construction tools based on lean aims and functionality was the subject of research by Mughees Aslam et al. in 2020. Lean construction is regarded as a viable project management methodology to handle challenges in the construction sector and resolve some productivity and waste issues. Various lean tools have been developed to make the adoption of Lean Construction easier. Currently, the first choice of lean tools is mostly made based on objectives, with little thought given to how well it conforms to the building technique. This study intends to clarify constructors' first selection phase decision-making processes by shedding light on their mental models. Each Lean tool's goals and capabilities are listed in the study. The findings show that many tools have objectives that are practically identical but have distinct functionality. As a result, the selection criteria must take into account the functionalities of the lean tools. For the successful implementation of LC, the features of lean tools must be compatible with the relevant building processes. In the study, a framework for choosing the best lean tools was put forth. The main benefit of this study is that it will help constructors make better decisions when choosing the tool that would function best with their construction.

Research on multi-objective optimization of batch and pull production for lean-based repeated scheduling was conducted by Dina A. Saad et al. in 2021. According to the study, repetitive scheduling using traditional approaches has a number of issues because of imposed resource continuity assumptions that add time and money. As a result of the unit's downtime in between tasks, it also results in a higher inventory of units with work in progress. In order to decrease Work in Progress, time, and cost, this research established a new batch- and pull-based repetitive scheduling technique that is lean-driven. It contains a built-in multi-objective optimization algorithm to choose the right number of crews and batches to use in order to cut down on time and expenses while taking resource and unit idleness

into account. To compare the effectiveness of the new technique to the ones already in use, a real-world case study was performed. The outcomes proved the superiority of the Pull-Batch-based Repetitive scheduling technique and the capacity of the optimization model to provide ideal schedules.

Analysis of the Work Flow in a Complex Project was the subject of research by Adam Frandson et al. (2012). The investigation was carried out at a sizable Southern California hospital with 360 beds and 730,000+ square feet. The findings are presented in the publication. The study's primary goals were to look into the trades' work processes on the project site and to pinpoint any issues that might be impeding the smooth operation of the dry wall, electrical, and mechanical crafts operating in various rooms. A variety of techniques were used to gather the data, including interviews, document analysis, value stream mapping, document analysis, and direct observation of the work and trade meetings. The project's section on creating repeated units is the subject of this essay. The delay in finishing the units was largely attributable to waiting and idle periods brought on by issues with the information flow, particularly with regard to how employees commit to carrying out these duties.

Research on Lean Construction - Application of Value Stream Mapping on Infra Structure Project was conducted by Khaja Layeequddin et al. (2017). This study indicates that value stream mapping may be used to move information within infrastructure projects and process it there as well. Currently, casting one slab takes roughly 40 days. The value stream map reveals that non-value-added work like waiting and backlogs makes up 7 days of this time. Value-added and non-value-added operations on the value stream map can both be detected using Lean technologies. The process could be enhanced after improvements are made, as shown by the future state map. The difficulty lies in structuring the data in the VSM to eliminate or minimize the non-value-added steps. Contrary to production systems, information flows sometimes employ ad hoc scheduling and might be loosely structured, making it challenging to identify and map their value streams. However, businesses can utilize the value stream mapping tool in the same manner they do in manufacturing for office processes.

Research on the Workflow Model for Systems and Interior Finishing Works in Building Construction was conducted by Irina Brodetskaia et al. in 2011. The inadequacy of standard critical path modelling to capture characteristics of these activities, such as uncertainty, instability, non-linear and interrupted value-adding processes, and re-entrant flow, has hampered modelling the flow of systems and interior finishing works in building construction. A unique workflow model that explicitly predicts the movements of products and crews at a fine-grained level is proposed, drawing on real data gathered during a work study of a significant residential project. The overall model consists of a trade workflow model with a module for each type of work-package and a model at the project level with integrated trade modules. The model was put to the test by simulating a construction project with seven work packages that was carried out in a 20-story residential tower with 120 custom flats. The crew movements through the test building were modelled to replicate the same behavioral traits seen in building sites. The model makes it possible to evaluate the effect of management policies on the production flow at various levels of specificity. It can be used as a research tool and in the creation of construction management software in the future.

The development of a lean model for house construction using value stream mapping was the subject of research by Haitao Yu et al. (2009). Many home builders are looking for a more efficient manufacturing model that will shorten the overall lead time, enhance quality, and increase process reliability due to lengthy delivery times and significant waste in the construction process. Housing construction offers the most accurate comparison to manufacturing, but the high amount of variability prohibits a direct transfer of the lean mindset and procedures. In this study, a systematic strategy based on the value stream mapping technique is built in partnership with a nearby home builder in order to assess the current procedure and create a lean production model. The model has four primary characteristics, including synchronized first-in, first-out lane-based flow, production levelling at pacemaker, task rearrangement, and increased operational reliability. A simulation template is created to help with the creation of intermediate implementation models and to verify the model. In this paper, specific adjustments for the lean production model are recommended, along with data gathering and value stream selection.

A study on "Learning to perceive" the Effects of Improved Workflow in Civil Engineering Projects was conducted by Peter Simonsson et al. in 2012. This study demonstrates how allowing the site management to monitor and observe the workflow on the construction site can enhance the performance of civil engineering projects. The on-site management is able to comprehend the possible impact of enhancing the current workflow by "learning to perceive" workflow. It is rarely sufficient to change long-standing habits by just recognizing potential waste and schematically modelling the usual flow of work. As is the case when employing the Value Stream Mapping (VSM) method, the emphasis should be switched to the entire process rather than sub-optimizing the system by resource or sub-process usage. As a result, there is enormous potential to combine reactive production techniques with VSM visualization and analysis to enhance workflow. The on-site management must learn to appreciate the advantages of a perfect workflow utilizing proactive measures like buildability, though, in order to effectively improve the performance of construction.

Research on the classification of bricklaying activities in work sampling categories using accelerometers was conducted by Koshy Varghese et al. in 2012. Work sampling has gained recognition as an effective technique for evaluating worker productivity on construction sites. It aids in problem-solving and provides guidance for productivity-improving activities. However, in a work sampling assignment, watching and categorizing job activities is a time-consuming and challenging activity. Video-based systems have been looked into as a substitute for human observation, however the hostile environment of a construction site has a significant impact on how well they identify worker activities. According to preliminary investigations, accelerometer data can be used to classify worker activities because it contains rich information about the movement characteristics of workers. The findings demonstrate that the accelerometer-based classifier classified bricklaying activities into groups of effective, contributing, and ineffective categories with an overall accuracy of 81.37 percent.

Value stream mapping: a case study in structural masonry was the subject of a 2017 study by Luane A. P. Melo et al. Value Stream Mapping (VSM) is a crucial tool for a methodical Lean implementation. This article presents an exploratory case study that tries to suggest improvements for this process because there haven't been many studies that address the application of VSM for improvements linked to the execution of structural masonry. The execution of structural masonry is the activity that has the biggest impact on the budget and schedule in a residential project where data was gathered. Lean Thinking was used to enlarge on and analyze the VSM of the existing state based on field observations, interviews, and examination of administrative paperwork. Future VSM improvements will primarily target the reduction of transport and surplus (inventory) wastes. Cycle time is predicted to decrease by 45.5% but Value Aggregation Time (VAT) is predicted to grow by 32.45 to 60.55 percent. The VSM gave a systematic picture of the process' value chain, making it easier to identify wastes, trace their source, and suggest solutions.

8. CONCLUSION

A continuous workflow where the flow of processes, information, and resources is unhindered and under control throughout the whole production process must be the goal of the future state map. The accuracy of the future state map with improvements depends on how precisely the current state map is developed and analyzed.

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