

Value Stream Mapping- Literature Review and Implementation in Construction Manufacturing Industry

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Abstract-

In the recent days, value stream mapping is considered as one of the main tools in the lean construction. In which it identifies and reduces the errors, losses, waiting time, and improves the values adding time, leading to enhanced product quality through empowering production unit in terms of production risk and cost reduction in the long term. The low productivity in the construction projects is the long-term issues. One of the ways to increase the productivity is to reduce the Non-Value-Activities in the construction project. This research work illustrates the literature review on the value stream mapping application in various field of construction. In this the paper gives the comparative study on material with the current state and future state map by using value stream mapping through referring locally available construction project to reduce the NVAA in the construction project.

Keywords- *lean tools, waiting time, errors, NVAA, vsm.*

I. INTRODUCTION

Value stream mapping (VSM) is defined as a lean tool that employs a flowchart documenting every step in the process. Many lean practitioners see VSM as a fundamental tool to identify waste, reduce process cycle times, and implement process improvement. All of these could result in finding efficiencies and break down the work structure. Add that process data to the data boxes of value stream map. Value stream mapping (VSM), one of the methods of Lean Techniques, is the most suitable method that can be used in the first step. VSM is a paper and pencil-based method that focuses on the current state of a process, makes all value and non-value-added activities visible, and proposes a lean future state.

Much like Lean manufacturing, Lean construction seeks to create production systems that minimize waste of time, materials and efforts in an attempt to produce the most value for the customer. Practitioners believe that the only way to achieve such a lofty goal is to include all stakeholders and participants including architects, engineers, contractors, facility managers, and the customer early in the project. This is different than the traditional project management approach in which the participants react to designs rather than influencing them. Emphasis is placed on three areas that will be familiar to those who have studied Lean in other contexts.

II. SPECIFIC OBJECTIVE

- To examine how the product cycle time is reduced using lean tool(VSM).
- To compare the efficiency of the current state map and future state map by case study.
- To prepare the comparative study on PPPB’s using value stream mapping by plotting a flowchart.
- To obtain a proper methodology through various case studies and literature reviews.

III. SCOPE OF STUDY

In this study, the application of value stream mapping has been done as a case study in order to reduce the wasting time in the production processes of the paver blocks. This can be done through mapping the current state and future state of the production process of the paver blocks. Through this study we can map any production process or any manufacturing materials in the future to reduce the errors, losses, waiting time and improves value adding time, leading to enhanced product quality through empowering production unit in terms of production risk and cost reduction in the long term.

IV. METHODOLOGY

By referring various literature review this methodology has been derived in order to reduce the errors, losses, waiting time and improves value adding time, leading to enhanced product quality through empowering production unit in terms of production risk and cost reduction in the long term.

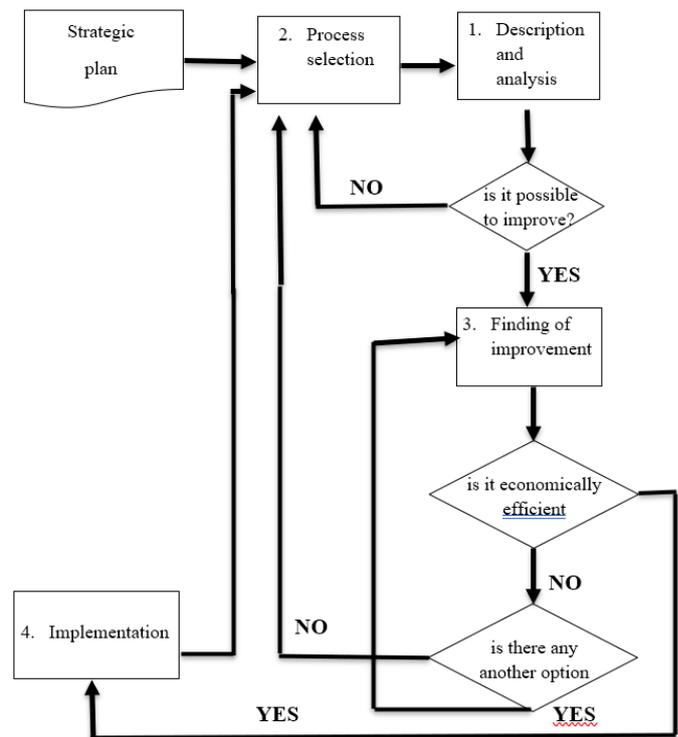


Fig:1. Methodology for value stream mapping (General)

V. LITERATURE REVIEW

1. Adefemi Aka and Fidelis Emuze (July 2020)-

This paper deals with the identification of the non-Value-Activities in the production process of the paver blocks using the method of taking survey, questionnaire and made a quantitative data that were verified with a survey research method. Typical forms of waste that were discovered in the study are excessive procurement of materials, unnecessary delay, not meeting up with the daily production schedule and over curing of concrete pavers. The initial results call for the adoption of lean practices that will reduce waste and improve production outputs in the factories. There is a major scope for the use of Kanban, JIT, and other lean tools in the case production settings.

2. Adefemi Aka, Abubakar Danladi Isah and Chukwudum J. Eze and Owolabi Timileyin (2019)-

The study provides knowledge on how lean thinking can be adopted to reduce wastes in BPP. Such knowledge may be beneficial to the present and prospective bricks producers. This implies that the proposed framework in the study allows producers of bricks to identify gaps in their implementation efforts, focus attention on areas that may require improvements, and access the benefits of lean approach in their factory products. The proposed framework may also be beneficial to the academics. In addition this paper first gain originality in the study context to propose for a lean framework that can be adopted to reduce wastes in BPP. Furthermore, the paper has not been previously published and all the information obtained from other sources are duly referenced.

3. Shuqiang Wang, Jia Tang, Yiquan Zou and Qihui Zhou (2019)-

The results of this study provide practitioners with a clear understanding of the optimization of the precast concrete component production and represent a method and basis for the process optimization of a factory production line; the approach is suitable for process optimization in other areas. This research represents an innovative application of lean production theory and value stream mapping in a complex production line of precast concrete components and thereby fills the gap between the theory and practice of the optimization of a precast concrete component production line.

4. Lisseth R. Espinoza, Rodrigo F. Herrera, and Xavier Brioso (2021)-

In this paper, the use of the value stream mapping of the basement construction has been done as a case study. This aims to map the process of the basement construction system in the execution of a building in lima-Peru city. The building in the case study has nine basements and 11- floor levels. Here an adaptation of an optimization cycle for construction projects was used. From that, mapping has been done with all relevant activities and proposing and implementing improvements in the construction system. As a result, three maps were obtained. The first one is a map of the current state (VSM 1). The second one is a map of the current state with improvements (VSM 2). Finally, a third map of the future state with improvements (VSM 3). This study demonstrated that it is possible to adapt the VSM in basement construction and the usefulness of this tool to evaluate and reduce waste within the workflow.

5. Prasanna Venkatesan Ramani, and Laxmana Kumara Lingan KSD (2019)-

The purpose of this paper is to discuss the effectiveness of Lean technique in managing construction projects. The modifications from Future State Map were carried out at the project and the results exhibited a substantial increase in productivity by reducing the project duration by 13 days which is about 30 per cent savings from the expected completion time after the implementation of Lean technique. Traditionally lean concept has been widely used in process-oriented manufacturing industry whereas it is

relatively new to the project-oriented construction industry. This current research has focused on applying lean tool to a real time construction project at the site level and measuring its outcome practically. The results of this study are real and affirm the effectiveness of applying lean concept to construction projects. It will be major paradigm shift in terms of managing construction projects.

6. Naga Vamsi Krishna Jasti and Aditya Sharma (2013)-

The study clearly shows that the VSM brings out the positive impact on process ratio, TAKT time, process inventory level, line speed, total lead and process time and reduced manpower. It is helping the company in satisfying their customers with respect to quality, cost, and delivery. The main limitation of the study is the confined focus on a single industry. The case should be extended to other industries in order to support the findings and for the purpose of the wider generalization. The results obtained from the study will help other industries and sectors to implement VSM in LM environment. The article deals with a real case study, which shows application of VSM for implementing lean principles.

7. Deepak Agarwal, and Amit Katiyar (2018)-

This paper illustrates the implementation of value stream mapping in an assembly line. This paper covers the review and classification of literature on VSM, as there is hardly any paper on literature review of VSM, so it will be very beneficiary for both academicians and industry people. Applications of VSM are also presented by a practical implementation on an assembly process and reduction in cycle time, processing time, and work in process inventory and manpower requirement at individual stations in an assembly process of automobile industry located in Gurgaon (India). This Paper is a case study explaining about the successful implementation of lean manufacturing tools and techniques in the development and implementation of an assembly processes at the case industry plant.

8. Wenchi Shou, Jun Wang, Peng Wu, Xiangyu Wang & Heap-Yih Chong (2017)-

This paper illustrates the use of value stream mapping by a cross-sector review. The paper aims to determine the-state-of-the-art development of VSM in five sectors, including manufacturing, health care, construction, product development and service sectors. A total of 131 journal articles are reviewed and analysed from the period of 1999–12/2016. The analysis covers the complete implementation cycle of VSM, including metrics for current state map, improvement techniques for future state map, benefits, and achievements of VSM application, and critical success factors for VSM implementation.

9. Murat Gunduz, and Ayman Naser (2019)-

In this paper, the author illustrates the using value stream mapping as a lean tool for the construction project. This paper aims to propose improvements in the construction industry process using Value Stream Mapping. Therefore, the research methodology adopted was the illustrative case study. The results suggest that the construction of underground pipelines process lead time could be potentially reduced by 30.7 % and cost reduction of 20.8 % between current and future states. Some adaptations have been applied in construction industry by using a Value Stream Mapping as a lean construction tool.

10. Aneetha Vilventhan, VG Ram and S Sugumaran (2019)-

In this paper, the author illustrates a case study using value stream mapping for identification and assessment of material waste in construction. This article aims to estimate and assess the causes of waste generation in a high-rise building construction through a case study in Chennai city (India) using value stream mapping, a key lean construction tool. Onsite monitoring and measurement were performed to quantify the amount of waste generated. A strategic framework has been proposed to improve

construction and demolition waste minimisation depicting the synergy of combining lean construction principles with construction and demolition waste management strategies. The proposed framework helps in the systematic identification, assessment, and minimisation of on-site construction waste generation.

11. Haitao Yu, Tarry Tweed, Mohamed Al-Hussein, and Reza Nasser (2014)-

In this paper, the author describes the implementation of value stream mapping in the development of lean model for house construction. This paper presents data collection and value stream selection, current practice analysis, and specific changes proposed for the lean production model. Lean construction has recently attracted considerable attention in the home building industry. The model has four main features: synchronized first-in, first-out lane-based flow, production levelling at pacemaker, work restructuring, and improved operation reliability. A simulation template is built to verify the model and to assist in the development of interim implementation models.

12. Yang-Hua Lian, Hendrik Van Landeghem (2002)-

This paper deals with the application of simulation and value stream mapping in the lean construction. In this paper, he investigates some relevant lean manufacturing literature where lean principles and tools are presented or utilized. Two simulation models are built for two respective scenarios, push, and pull (kanban) systems. Model templates are explained and the key measurements such as lead times, throughput rates, value-added ratios are compared as well as evaluated. The effects of lean are clearly demonstrated by the simulation. Physical factory layout redesigns or changes of the supply chain infrastructure involve high costs. Through simulation and value stream mapping, managers can see the impacts before the implementation and transform the organization into a lean one at minimal cost.

13. Yaxu Lia and José L Fernández Solís (2019)-

In this paper, the author extended his view on the application of value stream mapping in the construction industry. For the past couple of years, various sectors of the service industry have started adopting lean methods. Similarly, value stream mapping has been used in manufacturing projects to describe and reduce waste. Although VSM is being used successfully in manufacturing, its implementation in the construction industry is not as successful as it is in manufacturing. This paper presents a structured literature review to summarize the current state of VSM in the construction industry.

14. Manjunath M., Keerthesh Kumar K. S., Deepa Puthran (2014)-

In this paper, it illustrated a case study under value stream mapping as a lean manufacturing tool in construction industry. The main purpose of the paper is to know how value stream mapping (VSM) is a powerful tool in lean implementation and to tackle the improvement areas from the current state & to propose the future state which helps in reducing the lead time, manufacturing cost and delivery in time without compromising for the quality of the product. VSM helps firms to understand and to improve continuously to work towards becoming lean enterprise.

15. L. F. Romero, and A. Arce (2017)-

This paper, it illustrated the author perform a systematic review on the application of value stream mapping on a manufacturing sector. Value Stream Mapping is a critical tool when it comes to implement the lean approach and it has spanned to many sectors in industry. Although previous studies justify its use in manufacturing sector by identifying previous cases within the literature, none to the best of our knowledge has used our approach to explore the aspects covered in this review, yet the potential exists. Based on a systematic approach, we analyzed available literature published in refereed journals, providing

academics and researchers with valuable findings related to the evolution, application and performance of the Value Stream Mapping in context of the manufacturing sector.

16. Ana Julia Dal Forno, Fernando Augusto Pereira, Fernando Antonio Forcellini, Liane M. Kipper (2014)-

In this paper, it illustrated that the problems and challenges found in the literature from the past 15 years about application of Lean tools as value stream mapping. The purpose of this paper is to investigate the main difficulties and limitations encountered during the construction of current state maps, analysis of the associated causes, and pointing out of guidelines to facilitate the use of VSM to map processes. To do so, a search and evaluation of papers in journals, conferences, theses, and dissertations was conducted, and the articles were categorized according to the field of application (factory floor, supply chain, product development and services) and approach (theoretical or practical).

17. Amir Azizia, and Thulasi a/p Manoharan (2015)-

In this paper, the author extended on his view on a case study by designing a future state of value stream mapping to reduce lead time using SMED. Nowadays, it is targeted to improve the productivity performance by reducing the production lead time and production waste that are the most important goals for almost all manufacturing companies. The main objective of this study is to design an efficient Value Stream Mapping (VSM) to improve the productivity in Small Medium Enterprise (SME) by eliminating non-value-added activities. The methodology of the study is to firstly analyze the production waste in current state map, secondly to use the Kaizen activity with Single Minute Exchange of Die (SMED) to effectively support future state for process improvement of the action plan.

18. Wei Guo, Pingyu Jiang, Lei Xu and Guangzhou Peng (2019)-

In this paper, the author extended his view on a case study of air-conditioner assembly line by integrating of value stream mapping with DMAIC for concurrent lean-Kaizen. According to the concept and application scenarios of value stream mapping and DMAIC (Define, Measure, Analyze, Improve, and Control), we proposed an integrated VSM-DMAIC by adopting their advantages and avoiding their disadvantages. The VSM-DMAIC model is applied to tackle the production problems on production line.

VI. LITERATURE SUMMARY

From referring various literature review, I get that the application of value stream mapping plays a lead rule in construction industry. It compares the current state and future state map for any material or product manufacturing in which identifies and reduces errors, losses, waiting time and improves value adding time, leading to enhanced product quality through empowering production unit in terms of production risk and cost reduction in the long term.

VII. CONCLUSION

Many lean practitioners see VSM as a fundamental tool to identify waste, reduce process cycle times, and implement process improvement. All of these could result in finding efficiencies and break down the work structure. One of most important tools for lean production is value stream mapping (VSM), which identifies and reduces errors, losses, waiting time and improves value adding time, leading to enhanced product quality through empowering production unit in terms of production risk and cost

reduction in the long term. In this project the methodology of VSM and the production process of a product has been derived through referring various literature papers. The future work of this project may find a production product, through with a current state and future state map can be compared in order to reduce the wasting time and improve the value-added time for the selected product in future phase.

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