

MINIMIZING WASTE IN CONSTRUCTION INDUSTRY BY VALUE STREAM MAPPING

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ABSTRACT

Delay in the construction industry due to various causes at site and at office work. Some natural and physical error disturbs or extends the scheduled time of the project. The aim of the study is identification of the wastage of working time in construction industry and minimize the wastage of this valuable time by adopting the lean construction tool value stream mapping. A value stream mapping is lean construction technique formerly used in manufacturing industry for minimization of waste to achieve the efficient results. For carrying this study a questionnaire survey is done depending on the different 24 variable which are responsible for waste production in the construction industry. By analyzing the data with the help of tool value stream mapping the activities which are value added and which are non value added are found. A value stream mapping is the tool used for the minimization of wastage of working time in construction industry.

KEYWORDS: *Construction waste, value stream mapping, lean construction tool, value added, value added etc.*

I. INTRODUCTION

India is developing country, infrastructural development is very important priority in national development but this development is unable to satisfy the customer demand due to various reasons.[1] Dissatisfaction of customer due to low quality of material, low production efficiency, wastage of material and time, accidents at site. Analysis of this condition it is suggested that well resource handling and elimination of wastage at construction at site helps to fulfill the customer demand.[2] The main element of wastage is delay in approval, poor supervision and irregular cash flow. The lean construction tool value stream mapping is mitigate these three elements [3] In construction industry many activities actually it does not add the value of the projects and these activities play the role of only time consuming that is called as non value added activities Construction waste is three types i) Labor ii) Material iii) machinery. Construction projects are often failed due to lack of identification of waste like waiting time, idle time, unnecessary travelling time, repair, rework, unskilled worker, lack of coordination within stakeholder of site, equipment failure, lack of supervision etc.[1] Low productivity in construction industry is due to lack of commitment between contractor and project manager so it is impossible to maintain the quality of work[4] Waste is the product that has no value from customer point of view. It is unwanted material. Construction waste is two types i) Physical waste ii) non physical waste. 17% of construction activities are non value added [5] Construction waste management is very necessary for improving the productivity at site, resource allocation at site and minimizing the waste [6] The working time is wasted in construction industry is wasted due to waiting, poor quality of material, and other shortcoming [7] The elimination of waste is main focus of lean technique *koskela* (2000). The aim of the paper is to minimize the construction waste which is non value adding activities in project. The data required for these study is collected from the

various contractor and construction firms in Pune city by questionnaire survey and interview. Suggestion for improvement in production is given by analyzing the data adopting the lean construction tool value stream mapping.

II. LITERATURE REVIEW

A) WASTAGE IN CONSTRUCTION INDUSTRY

From starting of the construction project, the project manager has to face many problems that negatively affect the construction process and produce a lot of wastage (Surpell et al., 1995). Construction industry includes mainly seven types of wastage: i) Transportation ii) Inventory iii) Motion iv) Waiting v) overproduction vi) over processing vii) Defects/Rework. This wastage occurs due to human error, mechanical error, or some natural error. There is too much difference between waste production in manufacturing industry and construction industry.

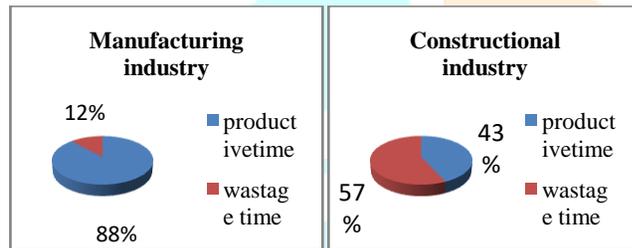


Figure 1. % of wastage and productive time in construction and manufacturing industry [8]

The appreciable effect of production in manufacturing industry is possible due to lean thinking in manufacturing industry. Lean production philosophy provides continuous improvement. The main reason of construction project failure is lack of waste detection in construction processes. In manufacturing industry all processes are controlled, everything is taking place according to schedule. So, there is very less waste production but in construction industry this schedule is unable to follow. Due to this reason construction industry invests too much time in wasteful working and very less in productive [9]. Skillful labor, strict supervision, dynamic and qualified workforce helps to reduce the waste and improve the production [10]. The activity which does not add value in the project from the customer's point of view [11]. Construction waste is produced due to human error, mechanical error, and low quality of material. The construction waste is not properly addressed due to improper tools for measuring waste (Lee, et al., 1999). The quality of material is the main issue in construction industry; low quality or poor quality of material is responsible for waste production. To minimize the waste, the quality of material should be good. The supplier-buyer bond should be tight and supply chain management should be lean. The supplier-buyer relationship is tight; the material purchased is good quality and supply is just in time and at a reliable price. This results in great reduction of waste, reduction in waiting time, idle time, rework, and repair [12]. Skilled and trained labor always helps to minimize the waste [13]. Many practitioners and designers say that waste is produced during the planning, estimating, and design phase [14]. This waste has an adverse effect on the environment, society, and economy of the project. Waste actually does not add value to the project, so always try to minimize it [15]. Material procurement management automatically affects the mitigation of waste in construction industry [16].

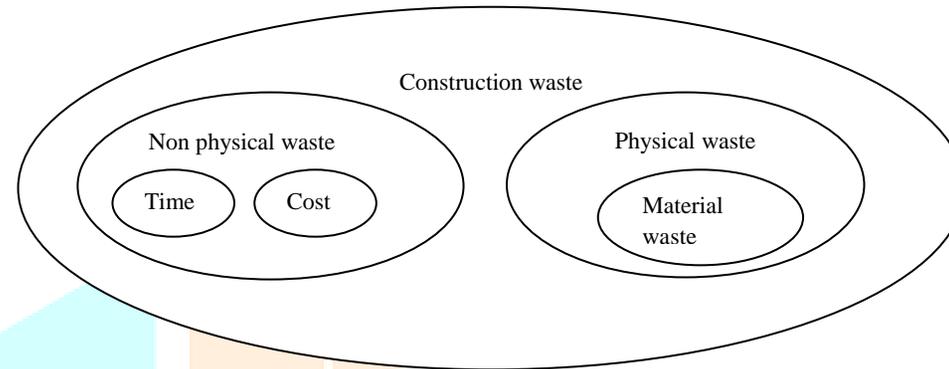


Figure2. Types of construction waste[17]

Constructional waste is divided in two types i) Physical waste ii) Non physical waste. Physical waste is material waste and non physical waste is time and cost overrun. Physical waste occurs during building renovation, demolition, and construction. Physical waste is generally solid waste. This waste is further deposited as a landfill [18]. Non physical waste is not directly related to the material it is time and cost overrun[19]

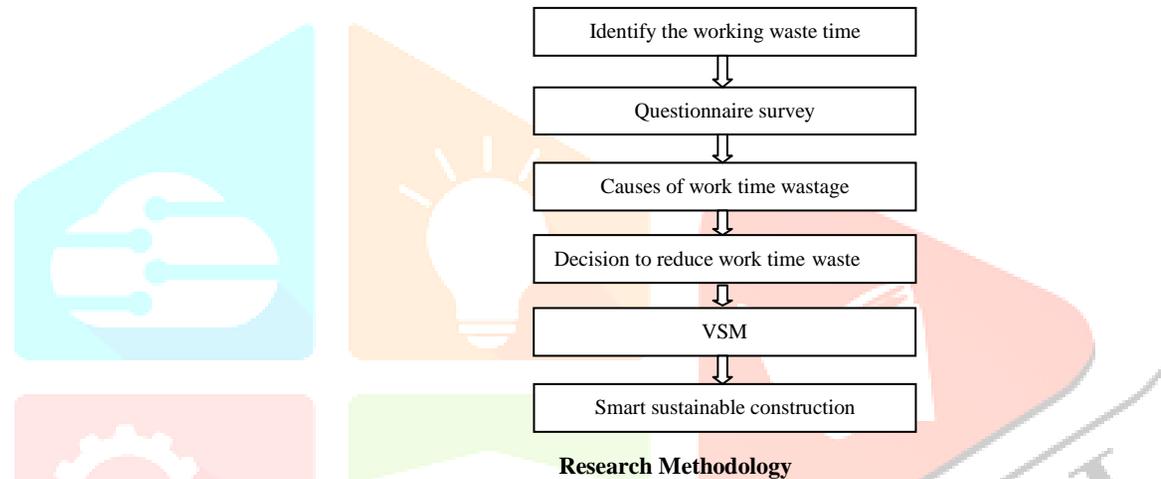
B. VALUE STREAM MAPPING

Value stream mapping concept is developed in second half of twenty century by 'Toyota' company one of the important lean management tool. It is become very popular to identify the waste and mitigate the waste[20]. Value stream mapping is the tool that identify and focused on the waste sources like waiting time, idle time, inventory, loss of information. This tool identifies the opportunities for the improvement of this waste. (Rother and Shook, 1999) Value stream mapping is the process of developing the plan from the current state map and analyzing the current state map to achieve the objective of the project. the final plan is future state map. It is alternative method of control (Friere and Alcon, 2002) It is graphic representation of symbol and activity. It is a simple paper and pencil strategy to obtain the objective of the project. For drawing the current state it is important to analyze each activity not a current state. (Rother and Shook, 1999). The main purpose if the study is to create the road map and finding which activity is important from the customer point of view[21]. It mainly focus on continuous flow of material and information eliminating waste and deficiencies in the process[22]. Value stream mapping is system of better improvement.[23]. Value stream mapping is tool that identifies which activities which are value adding, which are non value adding and improve the current state so that waste is minimized and future state map is drawn. It is system of representation of symbol.

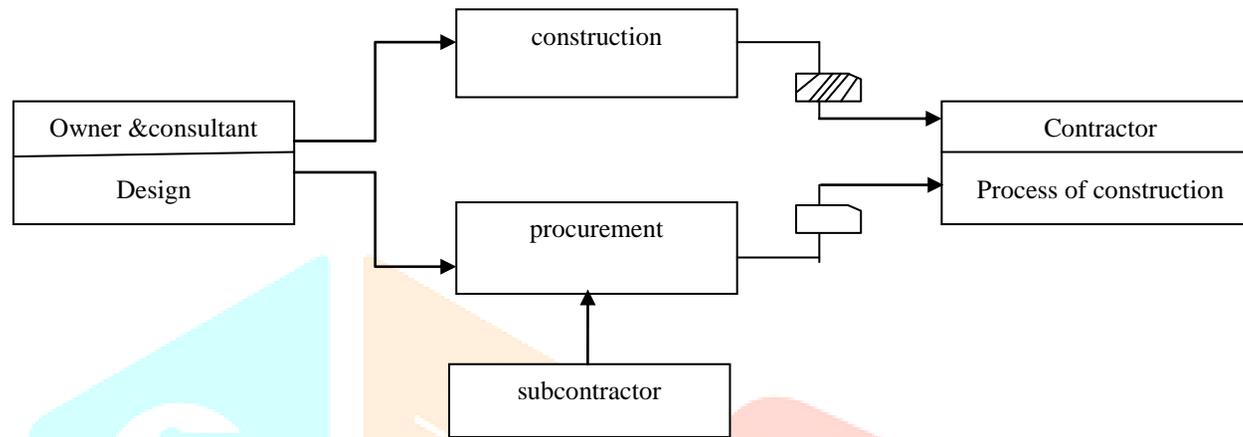
III. RESEARCH METHOD

The research method for this study is questionnaire survey in Pune city from different contractor and constructional firms. Survey is conducted with 24 different variable that are responsible for this waste production in construction industry. The question sheet of 24 main variable is send to the various 10

construction firm . The collected data is analyzed and categorized in the three different groups i) Low ii) Medium iii) more . The variables which are responsible for great waste production. A special remedy should be chosen to mitigate these variable. The medium and low affect in waste production should be taken in to consideration. Every stakeholder in the firm are involved in the process .The value stream mapping of the activities is done for work time wastage identification in construction management. The data collected from various contractor, site engineers, worker and supplier is analyzed and work time waste is identified and suitable strategy is used for minimizing the wastage of working time and causes of wastage are found to obtain the more efficient results. Information management system and parties involved in it identify the waste in structured process of construction.



For conducting the research firstly waste in construction industry is find out by various methods like site visit, interviews with the worker , site engineer , owner , contractor , supplier. A questionnaire survey is conducted in Pune city at various site. Causes of waste production in working time is find out. The causes are natural , human error , or mechanical problems. The causes are bad weather, poor quality of material , instrumental error, idle time, waiting time, waiting for material , waiting for the instruction, low co- operation between stakeholder etc. decision is taken to reduce the working wastage time by applying value stream mapping . a value stream mapping is connecting bridge between current state and future state which is ideal. A value stream mapping is simple paper and pencil sketch conducted at site . It is a simple drawing simply understand by skilled unskilled person . This is possible by involving every person at site and behind the site by conducting common meeting and common problems.



Value Stream Mapping

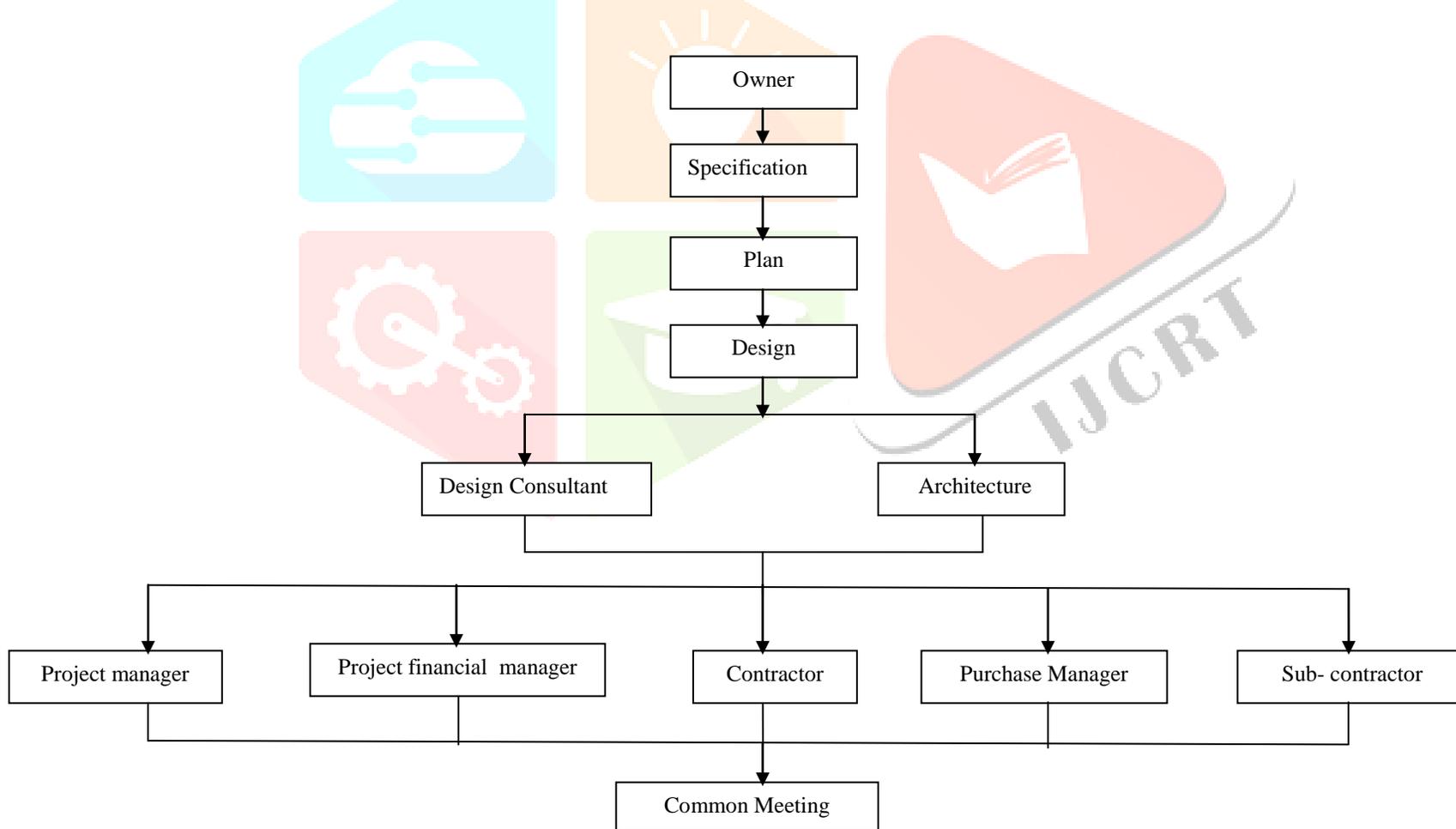
In above map subcontractor takes the material in the kanban production . in this process production of predefined no. of parts or material and signifies the supplying the material to another downstream process . The process of taking material is taking in withdrawal kanban i.e. a device or card that informs the material handler to transfer the material from supermarket to receiving process.

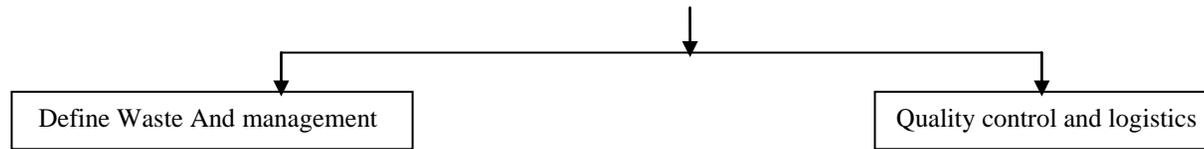
Table 1. Causes of waste production at site

1.Bad weather	9.Equipment is not proper working	17.project layout is not proper
2.Change in the schedule	10.Installation error of the instrument	18.fabrication site is too far
3.Shortage of material	11.Low quality product	19.Working method is not exact
4.Rework/Repair	12.Unskilled labor	20.Misinformation
5.Damage during erection	13.Lapse between top management to bottom	21.Equipment error
6.Project instruction are not clear	14.plan changing	22.poor supervision
7.Waiting for the material	15.material searching	23.site accident
8.Waiting for the information and instruction	16.Excess material inventory	24.Dispute among stakeholder

Based on the causes of waste production the data is collected from 10 different construction industries by questionnaire survey and interviews to the experienced contractor , site engineer, worker , material supplier . The collected data is analyzed and studied how this variable are responsible for the waste production in construction industry. These causes are classified in three different groups low, medium, and more effect in waste production. Value stream mapping is lean construction tool used for identification of the waste and problems that negatively affect in project. Due to this study it possible to improve in the reduction of construction waste. By analyzing it is possible to study the project policy assets , technology knowledge and human resource component . The main element in construction industry is customer demand i. e owner demand that starts from the design and plan of the

building responded by the consultant with drawing specification and estimation . after studying and execution of the plan and design of main structure the order of material from the suppliers per the requirement when needed. Contractor will store the material as per the requirement and safety stock. Analysis of the activities is done and it is tried to reduce the work time wastage considering the relation between practionaries activities at site . The value stream mapping is the schedule of activities related to each another process . Value stream mapping displays the schedule of information contains in it ; The parties involved in activity process are i) Owner ii) Project manager iii) planner consultant iv) project finance manager v) supervisory consultant vi) contractor vii) Quality controller and logistics and subcontractor . The function of construction waste management is to identify the waste in construction industry and cause of waste production. A value stream mapping is done to identify the causes of waste or activities that negatively affect the schedule and value of project. Value stream mapping is tool that helpful for identifying the non value added activities and value added activities so that it possible to reduce wastage in construction industry , working time wastage reduction, repair and rework reduction, improvement in low quality products , less inventory , reduction in damage during erection. Effect of environment , error in instrument and machinery, change of work schedule, unskilled labor, waiting of instruction ad material wrong information , and material does not match the specification.





Modified value stream mapping

From literature review it is stated that, some activities at site do not add the value i.e non value added waiting of material , waiting of instrument, overconsumption of resources , material damage due to mishandling or careless delivery. Identification of waste depends on environment, technology, human resources , and culture of the construction project. This study is based on the causes of work time wastage which are given in table no. 1. To minimize the waste a value stream map is drawn . In map owner is significant person as his demand is customer demand . According to specification given by the owner a plan is drawn and design of plan is prepared by co- operation of architecture and design consultant. After this sanctioned plan goes to the project manager he plans the activities with the collaboration of project financial manager as he is the key member of project , then purchase manager for timely and just in time supply of material with good quality. contractor and sub contractor plays role to finish project with customer demand and in predefined cost and time. To achieve the goal it daily common meetings are conducted at site to discuss the problems and feasible solution .Waste at site is find out which does not add the value to the project and qualitative and logistics control is applied .

IV. CONCLUSION

Value stream mapping is the tool used for identification of value added and non value added activities . identification of waste time and quick efforts taken to reduce the non physical waste time i.e .waiting error in construction project management to achieve the efficient results. Value stream mapping is useful tool for construction manager to identify the waste and make decision for reducing it. So it is possible to smart and sustainable construction management is possible.

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