Implementation of Value Stream Mapping In Construction

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Abstract- *Construction industry in India has great scope. India being a developing country there are various opportunities in all fields residential, industrial, infrastructure. But most of the projects in India face problems of completing the project on time within required quality and without any major accidents.Value stream mapping, tool of lean management that has proven to be successful in production/manufacturing industry. Here an effort is made to implement the same in construction industry to reduce the cycle time primarily enhance the planning increase quality and safety. After deep analysis of the process map of a residential project in Hinjewadi, process wastages are identified. And the results of the implemented remedies are stated.*

Keywords- Value stream, Process wastages, Time and cost escalation, Lean management, Value to customer. Eliminate Wastes.

I. INTRODUCTION

The construction industry is the second largest industry in India after agriculture. It is highly diversified and involved in all spheres of construction like: Infrastructure: Highways, Airports, Seaports; Commercial: Offices, Malls; Residential: Apartments, Houses; Industrial: Refineries, Mills. Most of the Indian contractors are not well equipped to handle the growing demand and hence the projects quite frequently run in to time and cost overruns, disputes and lower quality. Another major factor causing delays is the lack of proper "faith" between the contractor and the owner due to which the disputes often end up as litigations and the work stalled (World Bank Report, 2008). The Indian construction industry is also facing a severe resource setback in terms of skilled and semi-skilled man power. Though the above mentioned problems need noteworthy thought and time, it is crucial that increased emphasis is given to new project management strategies so that the Indian growth story doesn't meet a hasty end. After some research the medium and big firms need to look to the developed nations and also China for new strategies and implement them here.

Construction projects are colossal in size and also take a lot of time and enormous cost for accomplishment. Most of the projects generate a part of cost requirement through loans and machinery required are rented ones. Thus the delay in completion time leads to escalation of the overall cost of project. This makes it vital to plan all the activities very profoundly and follow the schedule sternly. Even though the plan is and schedule is prepared very accurately, to achieve the schedule on actual site becomes very difficult because of the unforeseen uncertainties. Thus to retain the project on track becomes crucial. Lean management philosophies can ascertain to be helpful in various aspects.

The projects mostly are facing cost and time overruns the time overrun being more crucial. An analysis is made by applying lean construction for a residential project. Eliminate the potential wastes.

II. METHODOLOGY

To achieve the cycle time and overcome the barriers, first step is to create the actual process map of the project that contains each and every minute detail about the flow process and study it thoroughly. Comparing the planned and actual schedules gives the clear idea about the activities causing delay. The value stream map helps identify the critical wastages in the process. The reasons for the wastages is collected by a questionnaire survey on site. The people included in for the survey were of different levels from the site engineers, junior engineers who are actually involved in the process to the higher level management like project manager, assistant project manager, etc. The questionnaire survey gave a list of factors causing wastage and delay. The reasons are ranked by RII method of rankingand analyzed to find out the tactic to mitigate it. The remedial tactics are selected with help interview people on site. After identifying the process wastages. The root cause for all the wastages is pin pointed. Knowing the culprit the process can be improved and enhances the current scenario.

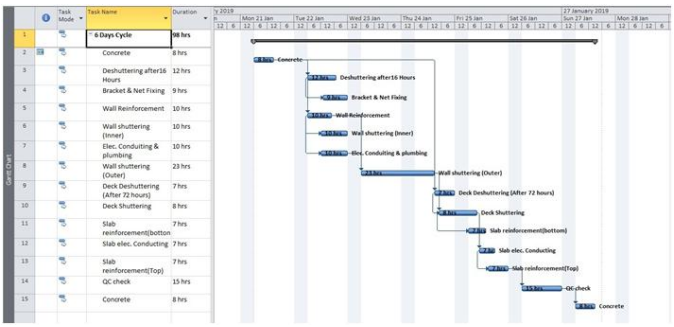


Fig. 1 Planned slab cycle

III. LITERATURE REVIEW

Lean methodology is not particularly a new. Ever since the successful implementation by the Toyota. It has been used by many manufacturing industries. The researchers led a comprehensive survey to identify barriers in implementing Lean principles in local construction industries and came to conclusion that there are several factors contributing as barriers. According to the research, lack of exposure on the need for lean Construction, uncertainty in the supply chain, tendency to apply traditional management, culture & human attitudinal issues (mindset issues), lack of commitment from top management, non-participative management style for workforce, attitude and ability to work in group, difficulties in understanding the concept of lean construction, fragmentation and subcontracting, lack of client and supplier involvement and lack of proper training are main factors contributing. [5][Desai A. 2014] Lean construction at a project site will involve people from various companies, we also need to consider how the external project based organization would engage in the translation and transformation process of the Lean construction concept. [3][Bygballe L. 2014]

There are various lean construction concepts that have been implemented & found to be successful. Heathrow Airport's Terminal 5 construction in 2001is a great example of a tool called last planner system. The lead time was reduced from 5 days to 4. This effectively made detailed engineering the first act of construction, rather than the last act of design, and enabled them to keep on schedule and to save almost 800,000 British pounds in on-site labour. The civil phase was completed on time and 10% under its 1.25 billion dollar budget [2] [Ballard G (2015)]

Last Planner System and other Lean Construction techniques in over one hundred Construction projects for five years in Chile were selected for study by author. Benefits of the concerned study was 7% to 48% performance improvement reported by 8 companies along with improved reliability of planning and PPC. The concluding remark by the author was that IT tools can support a more complete and standard implementation of LPS. [1] [Alarcon L.(2006)] there are many more tools of lean that are successful in other industries and not very much explored in construction industry. Poor productivity and inefficiencies in the production process are alarming issues in the construction industry that also erode the value proposition of projects. Value Stream Mapping (VSM) and Work Sampling (WS) are two important techniques in the „Lean" philosophy that aim at reducing and minimizing „waste" in the life cycle process of activities and thereby aide in maximizing productivity. [Pothen, L.S. and Ramalingam, S. (2018).]

IV. PROBLEM STATEMENT

Delay in completion of project on time is a commonly faced problem on almost all construction projects. All the material, machinery bought on credit and loans are time bound and exert pressure on the execution team. This leads to poor quality of construction and compromising safety to some extent.

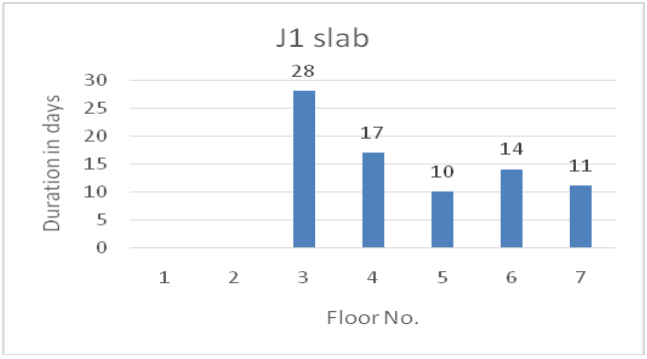


Figure no 2: Actual slab cycle

V. OBJECTIVES

Avoiding delay in completion of the project is the main objective. It is understood that the main reason for all the problems is time and schedule. Thus here the main objective is to reduce the actual cycle time ease out the pressure, so that the remaining hitches are also reduced. Quality is maintained as per the standards and all the work is done safely.

A. Creating a value stream map showing all the process and information flow.
B. Identifying the wastages and ranking them.
C. Structure a remedial action plan to improve the current situation.

VI. DATA MAPPING

The mapping is done based on the data of 6 RCC floors. From the concrete pour cards and log sheets the graph

in the problem statement is plotted. The log sheets have the data of all the sequential activates in a chronological order with their starting time. As per the planning schedule the slab cycle required is 6-7 days. From the problem statement data it is evident that the actual slab cycle is far from the planned cycle.

In order to understand the wastages of time the planned value map and the actual map is compared. And it was found that some activates are demanding quiet more time than it should be required.

Sr. No.	Activities consuming excess time.
1.	De-shuttering work
2.	Shuttering work
3.	Quality Check

To squeeze the cycle time, to know the actual reason was necessary thus major personal on site like project managers, project planners, tower in charges were interviewed. From the interviews some reasons for delay were repeatedly highlighted in almost all interviews, which gave us thecauses for delay.

After listing out the causes the severity or the criticality was found out based on the amount of rework required, its impact on goal achievement & effect on the budget. Likewise the probability of occurrence level is determined according to expert judgment. For this research, calculation is applied by multiplying occurrence of source of waste with severity of waste. Likelihood is divided into five scales: (1) rare, with less than 1% probability, (2) unlikely, 1-5 % probability, (3) possible, 15-50 % probability, (4) likely, 50-70% probability and, (5) almost certain, > 70% probability.Similarly, consequences is also divided into five scales: (1) insignificant, low impact, be able to ignore, (2) minor, low impact, be able to repair, (3) moderate, effect goal to achieved, (4) major, loss of production capability and, (5) catastrophic, big impact, loss of profit.

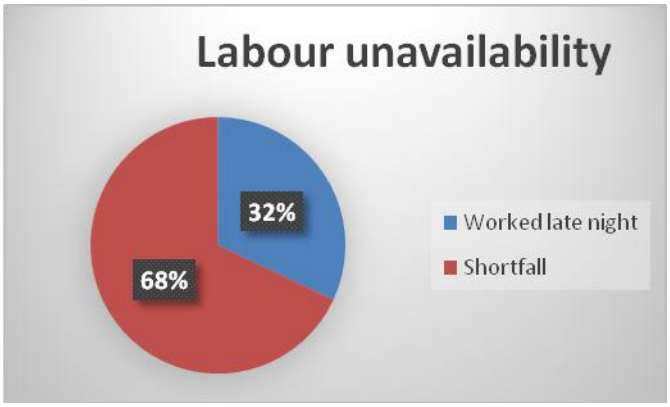
TABLE I. Causes and RPN

Causes	Severity	Likeliness	RPN
Labour unavailable	3	4	12
Improper processes	3	4	12
Idle labour	3	3	9
Material Unavailability	3	3	9
Change in Plan	4	2	8

From the above table 3 causes were identified as crucial as they were linked to the activities consuming most of the excess time and which have a scope of improvement as well.

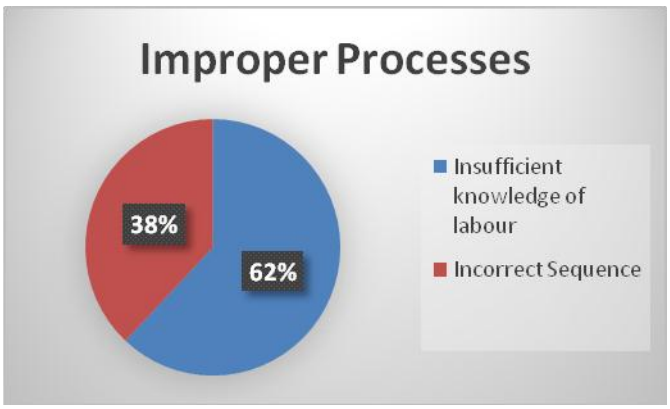
A. Labour unavailable- This is the most crucial cause that requires highest level of attention. Because with shortfall of labour no activity can be completed on targeted time. After in depth analysis it was found that

   a. There was a shortfall of labour than actually required according to the planned productivity.
   b. Labour are unavailable if worked late-night. \



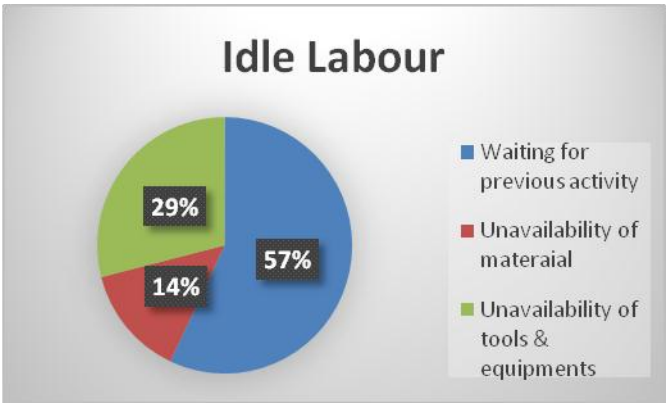
B. Improper processes-If the activities are not done as per proper methodology it requires excess time and the required quality of work is not achieved. And may also require rework or rectification. In depth analysis showed that

   a. The labour did not have knowledge of systematic method of work.
   b. The sequence of activities is not followed correctly.



C. Idle labour-Labour on site being idle is waste of both productive time and adds to unnecessary cost. The analysis showed that

a. Labour waiting for predecessor activity to get completed, no further activity available.
b. Labour waiting idle due to unavailability of material.
c. Labour waiting idle due to unavailability of tools and machineries.



VII. RESULT AND DISCUSSION

Based on the Risk Priority Number it is evident that it is necessary to pay attention at the labour availability and work processes. To improve this the additional labours were added on site. The next problem of late night work never existed as per the planned schedule. If all the activities were done as per the planned schedule the concreting would never be done at night. And the problem of labour not being available the next day would never arise.This was an attempt to reduce the shuttering time actually required

To improve the process and avoid unnecessary motion induction training was given to the labours about the correct work method. Also a meeting was held with the engineers and foremen showing them the impact of wrong sequence of activities and making them aware of the right sequence. The milestones were set for every activities after which the next activity could be started. This reduced the disorder occurring when multiple activities were overlapped and disturbed the sequence of activities.Proper sequencing would improve the quality of work and reduce the time required for quality checking.

It was difficult to avoid the idle labour waiting for previous activities to get over. So the labour had to be given some other work till they had a clearpath for work. Labour waiting for material happens rarely in case it happens it has a huge impact on the schedule. It was solved by keeping certain amount of buffer stock at the central store. Some of the equipment's like auto level, laser level, breaker, chipper etc.were used in common for some towers. The waiting for machine during the observation period occurred due to failure or breakdown. To avoid this the periodic maintenance cycle was reduced from 3 months to every month.

After implementing the preventive measures discussed above training the labours appropriately showed a noticeable difference in the slab cycleafter 7th floor. It is more than the planned schedule. But less than the duration required for previous slabs.

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