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Lean Construction - A Tool for Improving Workflow in the Construction Projects

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Abstract

With the support of the construction industry in India, the vast development in the infrastructure is clearly noticed. Pressures have been increased for achieving the completion of work activities on time. The sustainability of workflow in the construction field is very tedious to accomplish. To surge the pliability of resources accordingly with the indefinite that is protruding in the construction industry, the incorporation of lean construction is becoming a mandatory tool for its continual improvement. The association between the planning and execution team helps in improving the workflow. The parallel tracking and monitoring of the work process are made to identify the constraints and the reasons for the lag in planned activities. This will automatically emphasize the accountability of the work between the front-line management and the top-level management. This study highly recommends the lean tool to bring out the developmental changes in the construction projects for achieving the substantial flow of work.

Keywords: *Sustainability of workflow, Parallel tracking and monitoring, Accountability*

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1. Introduction

Construction projects comprise long and complicated processes, and different groups of members were involved in them. They'll be environed with heavy pressure to face upright within the competitive market with no flaws. For such conditions, conventional methods haven't got an impression on achieving the grandeur flow of labour. Lean construction has its foci on waste reduction and managing workflows; helps in distinguishing the work from conventional construction management. To bring out the involvement among the individuals who were involved

within the development activity both vertically likewise as horizontally in an organogram, the Lean tool called Last Planner System is mandatory.

2. Aim

The study was made to research the lean tools that help in bringing out the sustainable workflow in the construction of an industrial project located in Erode, Tamilnadu. Pull scheduling rather than push scheduling completely grabs the interest of each participant towards the work that automatically upsurges the productivity. The segregation within the work plan increases micro-level monitoring of activity.

3. Last Planner System – Methodology

The pre-eminent planning cannot be made effective with the absence of proper inputs and feedback from the participants. This can help to spot corrective alternatives for the issues that are arising. All the issues can't be resolved at a time by one responsible person. So, factually the involvement of the complete team would invoke an answer thereto. The changes within the system of labour should be in such a way that's capable of influencing the people to figure more and to be continuously insisted by themselves about their working targets. The unpredictable nature of construction will be controlled with the assistance of the collaborative involvement of all the working teams. The avoidance of non-value added tasks, optimal usage of resources, and improved flow of labour will be achieved with this lean tool.

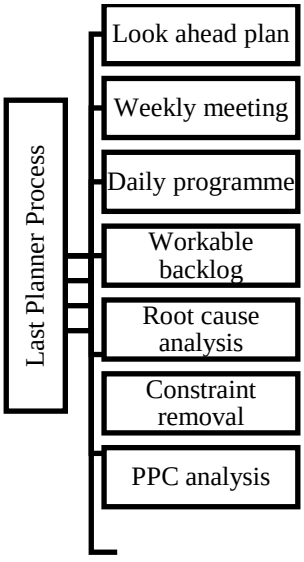


FIG. 1. LAST PLANNER SYSTEM

4. Literature Review

The construction industry has adapted lean techniques to eliminate wastage of materials, reduce the ideal time and increase profit. The literature study was conducted to assess the effectiveness of some lean construction techniques including the last planner, increased visualization, daily huddle meetings, first-run studies, the 5s process, and fail-safe for quality. The effectiveness of the lean construction tools was evaluated through performance criteria. It was found that more effective outcomes were achieved than expected. Among the techniques, 5s process and

fail-safe for quality did not meet the expectations. The literature study concludes that training and behavioral changes are required for the effective implementation of lean concepts.

5. Process Flow of Last Planner System

To grab attention towards the work process, a schedule consisting of a superior level of details is required. This involves pre-planning and improves the extent of PPC. PPC (Planned percentage completion) are often measured by the subsequent formula,

PPC = [Number of tasks completed / Total number of tasks] * 100

The removal of constraints was emphasized after conducting the weekly meetings. Considering the availability of resources, the constraints were planned and mitigated from the lag. They were made with the assistance of an early look-ahead plan and periodical weekly meetings. The daily hurdles were discussed with the battlefront management where it provides them the job satisfaction as being a part of the work improvement cycle. To make the process a streamlined flow, the root-cause analysis was made.

6. Findings and Managerial implications

To achieve the sustainable flow of work, PPC should be maintained to a level of cent percentage. The aim is to eradicate the undulations in the planned work process by ensuring the timely availability of resources at the project site.

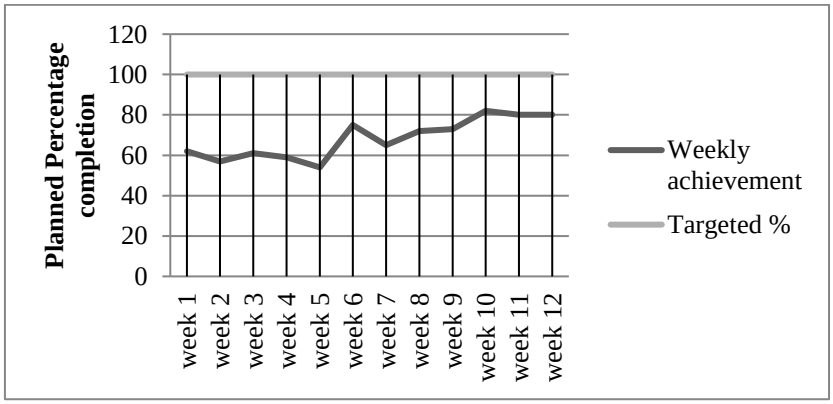


FIG.2. PPC

The master schedule for column construction reveals that there were deviations in the planned period and actual execution. If these periods can be further added to the future works while considering the monthly look-ahead plan, the delays can be minimized. Since the in-charge persons were asked to give their convenient date for executing the particular work activity, the pressure will be created for them to complete the work on time with the available resources. This creates the accountability for timely completion of work. A sustainable workflow can be achieved only when corrective measures were taken.

6.1 Look Ahead Plan

Based on the convenience and requirement, the breakup plan can be made by looking ahead of the schedule. In this project, a 4-week look-ahead plan was taken up. On the first week of every month, the fore coming week will be taken up as the first week and add another week from the following month will be added to it. This keeps on adding up until the end of the scope.

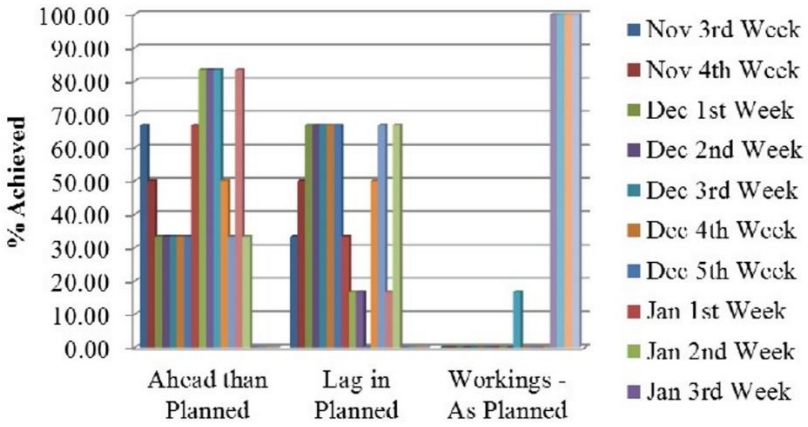


FIG.3. PLANNING EFFICIENCY

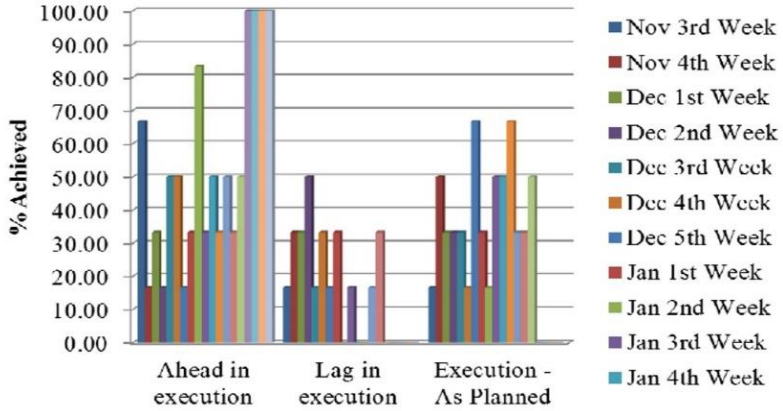


FIG.4. EXECUTION EFFICIENCY

Thus the above two graphical figure represents the planning efficiency and execution efficiency of the work. Planning efficiency is the data that shows the comparison between the total quantity planned by the planning department (based on remaining or pending quantity) and the total quantity that was planned by the in-charge person. Execution efficiency is the data that compares the total planned for the particular week to the total achieved in the concerned week.

6.2 Day-Wise Planning

Higher the PPC; Higher will be the reliability of workflow and vice-versa. Thus it helps in targeting the activity that is lagging to extend its task performance by analyzing the constraints. This results in the improvement of the system. The main objective for this finding is to create "imagine at the forefront" and thus the failure in accessing

the planned process can be able to be measured to ascertain the non-conformities that are being generated during the execution.

TABLE 1. SAMPLE PPC OBSERVATION AND CALCULATION

S.No	Activity	UoM	07.12.2020			Root Cause
			Planned	*Achieved*	*Work Status*	
1	Column Shuttering	Sqm	62	48	N	Insufficient material
2	Column Concrete	Cum	8.3	8.3	Y	
2	Slab Shuttering	Sqm	276	276	Y	
4	Slab Reinforcement	MT	16	16	Y	
5	Slab Concrete	Cum	312	312	Y	
Total Achieved					4	
No of Activities					5	
Daily PPC %					80 %	

The above table shows the model format for finding out the PPC value for every day in a week. The activities will be planned with the help of the in-charge persons. The ratio of planned vs achieved can be entered into the respective columns. The output is derived by putting Yes (if executed) and No (if not executed). The ratio of total achieved to the total number of activities will be yielding a percentage. Calculating the average value of all days will give the percentage value for the particular week.

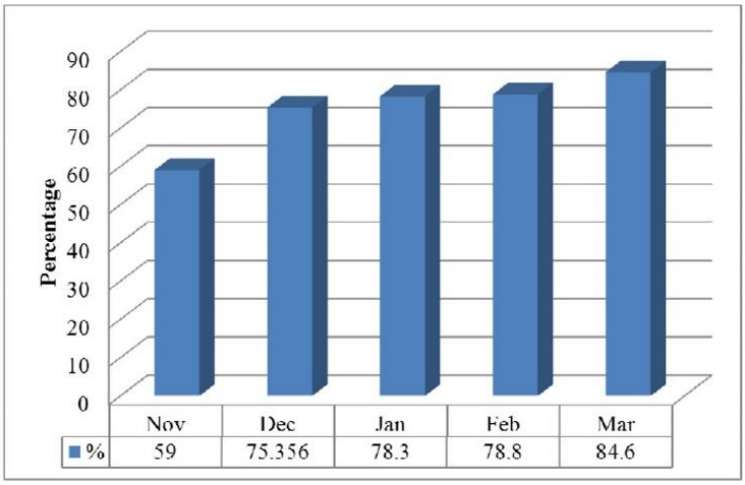
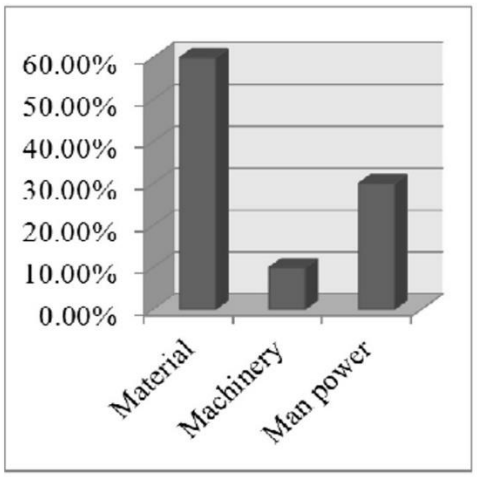


FIG.5. ACHIEVED PPC

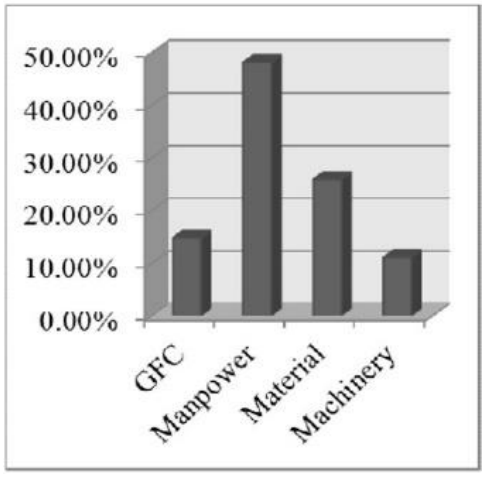
The above graph represents the gradual increase in the PPC showing that there is increased coordination among the planning and execution team. The percentage increase indicates the improved reliability and increases in the progress of the workflow.

6.3 Root-Cause Analysis and Action Plan

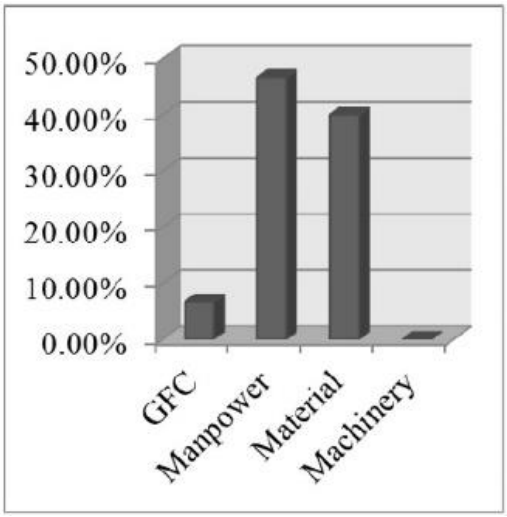
Constraint identification is the essential facet of constraint removal. Unless otherwise being noted, they may result in subsequent changes that induce variability in the work process. The reason behind the delay of work and the influence of each consequence was found and represented as follows,



NOV 2020



DEC 2020



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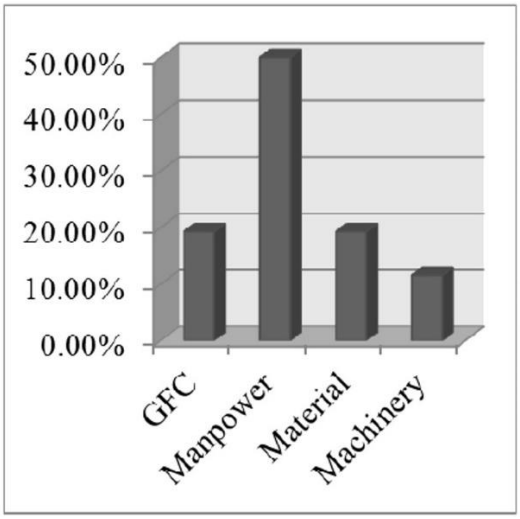

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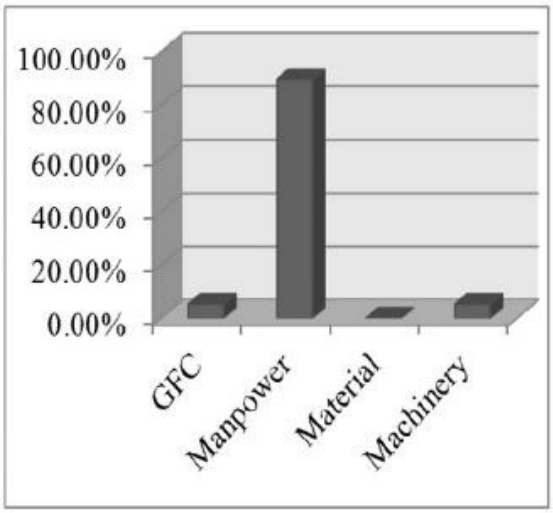

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FIG.6. ROOT-CAUSE ANALYSIS

The Constraints were identified by implementing the last planner system at the project site as follows,

- Delay in approval for column termination from PMC
- Lag of coordination between the execution teams.
- Insufficient shuttering materials.
- Delay in work due to rainfall.
- Inadequate workforces, materials and concrete placing equipments.

Action plans made for the removal of flaws during the execution are,

- Sent the mail to PMC for receiving first-floor roof Slab Details.
- Sent the mail to PMC for first-floor column termination level approval.
- Periodically the feedback was collected from execution teams to find out the issues and also to take the corrective measures.
- Workforces were increased for satisfying the requirements.
- Boom placer (1 no.) and front end loader (2 nos.) were purchased to satisfy the requirements.

7. Problems encountered

The various problems encountered during execution are as follows,

- Since the Last Planner System was a new concept for execution, understanding the process was tough.
- The documentation of planned Vs achieved was noted down in a notebook.
- The front-line supervisors did not submit the constraints faced in the site on time.
- The period of conducting the meeting became a boring one since it was made frequently on every Mid-week.

- The mismatch occurred in the calculation and execution of planned work.

8. Solutions

The solutions obtained for the concerned problems are,

- The periodical reviews in a week were reduced and it was changed as a personal meeting.
- Every person knows their target and coordination was improved among all levels of management.
- Delay of work and cost overrun was reduced.
- The daily hurdles should be analyzed and proper course correction has to be made.
- The meeting minutes were recorded and maintained properly for all meetings at a project site.

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