

# Improvement of Project Performance by Constraint Analysis and Root Cause Analysis of Last Planner System

T. Anand, P. Sachin Prabhu, H.A. Nishaant

**Abstract:** An effective planning is required to overcome cost over-run and time over-run problems in construction which could be achieved with the help of lean concept. The aim of lean is to maximize the value, in other words minimizing the wastes. Last Planner System(LPS) is one such lean concept developed in order to improve the project performance by reducing the inefficiencies faced in construction project. The objective of this paper to present the results obtained from implementing the Last Planner System in the construction of an apartment project. A list of constraints have been found out during constraint analysis and various remedial measures have been suggested for look ahead planning. Based on number of occurrences of constraints, root cause analysis was done to determine the causes for variation in Percentage of Plan Completed(PPC). The effectiveness and reliability of the project was found to be increased about 75% after implementation of Last Planner System(LPS). A list of success factors and barriers for improvement of project performance have also been listed.

**Keywords:** Last Planner System, Look ahead planning, Constraint analysis, Root cause analysis, Percentage of plan completed.

## I. INTRODUCTION

In general, conventional planning system is adopted in construction where lot of inefficiencies have been found. In order to overcome these huddles, lean concept have been introduced with the basic objective of maximizing the value and minimizing the wastes. Lean construction has different tools such as Value Stream Mapping(VSM), Increase visualization, Just In Time(JIT), 5 why's, 5S's, First run studies, Daily huddle meetings and Last Planner System This paper describes about implementation of Last Planner System in an apartment project on Coimbatore district executed by one of the leading contractor.

## II. METHODOLOGY

Last planner system is also known as collaborative planning system.

The term last planner means a person who controls or manages the lowest people in the hierarchy such as foremen, supervisors, managers. All those people must be considered during initial planning process. The Last Planner System starts with preparation of master schedule which sequences all the activities with duration. It is followed by phase planning which divides the master plan into various phases of detailed work plan that can be considered as targets by the project team. In the look ahead planning phase, management focuses on what is supposed to happen at sometime in the future and to take preventive actions to finish that future work without any delay. Generally look ahead schedule is prepared 4 to 6 weeks before start of work. Weekly work plans are derived from look ahead schedule. The activities entering the weekly work plan must be free from constraints. The Percentage of Plan Completed(PPC) is the process of determining the percentage of promises actually delivered on time. PPC can be calculated as the number of activities that are completed as planned divided by the total number of planned activities and it is expressed in percentage. Finally root cause analysis will be done to find the causes for the variation in PPC.

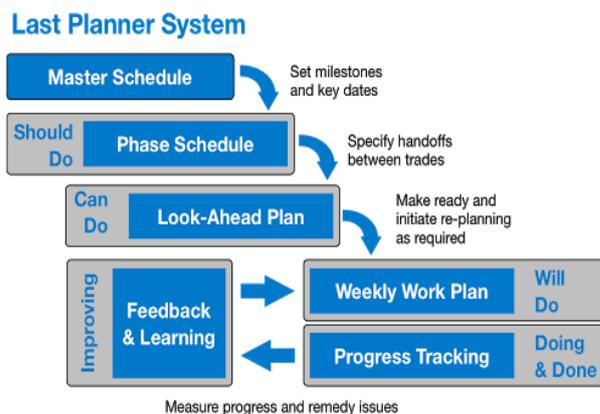


Figure 1: Planning stages in the Last Planner System

## III. DETAILS OF THE SITE SELECTED FOR LAST PLANNER SYSTEM IMPLEMENTATION

Project Particulars	Details
Name of project	Triloke
Location	Coimbatore
Site area	6000 sq.ft
Project value	Rs.1,50,00,000/-
Contract period	9 months

Table 1: Details of site selected for implementation

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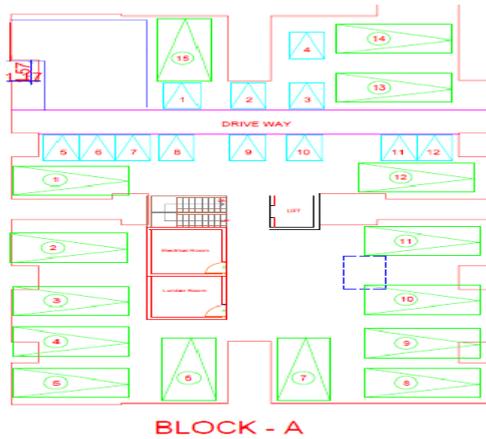


Figure 2: Plan view of site

IV. CONSTRAINT ANALYSIS

Before implementation of LPS, it has been found from site investigation that project is running 2 months delay with actual schedule. Hence a constraint analysis was carried out before implementation of lean system during which a list of constraints have been found out. Remedial measures have been suggested for identified constraints.

Sl.No	Causes for delay	Remedial measures
1	Late issue of drawings	Co-ordination with architect
2	RMC is not allowed	Maximum utilisation of mixer machines
3	Shortage of bulk material	Proper pre-planning required
4	Shortage of skilled labours	Negotiation with local workers
5	No commitment towards plan	Good team work should be developed

Table 2: Constraint analysis with remedial measures

V. LOOK AHEAD PLANNING PHASE

In this phase, look ahead schedule was prepared for a period of 8 weeks taking into considerations of all the constraints with 4 weeks as constraint window. The various activities covered under look ahead plan are listed in the following table:

Sl. No	Activities
1	Steel fabrication and erection for column
2	Column shuttering
3	Column concreting
4	Beam and slab shuttering
5	Steel fabrication and erection for beam and slab
6	Beam and slab concreting

Table 3: Table showing activities involved in look ahead planning phase

VI. PPC AFTER IMPLEMENTATION

Sl. No	No of activities planned	No of activities completed	PPC (%)
1	2	1	50
2	5	4	80
3	2	1	50
4	2	2	100
5	2	1	50
6	4	3	75
7	3	3	100
8	2	2	100
		Average	75.625

Table 4: PPC after implementation of LPS

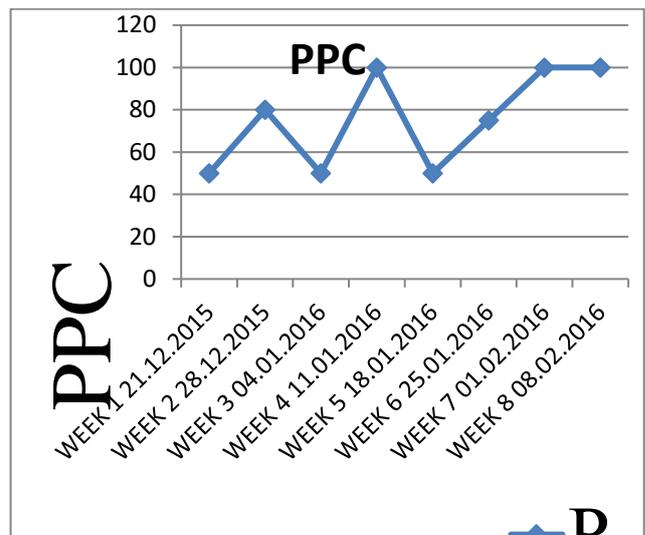


Figure 3: Line chart showing variation of PPC

VII. ROOT CAUSE ANALYSIS

Root cause analysis have been done in order to find out the causes for variation in PPC. Brief explanation of the various factors was given in the following section.

Constraints	No of occurrences	Percentage contribution
Labour	8	32
Materials	11	44
Pre-requisites	1	20
Equipment	5	4

Table 5: Table indicating percentage contribution of various constraints

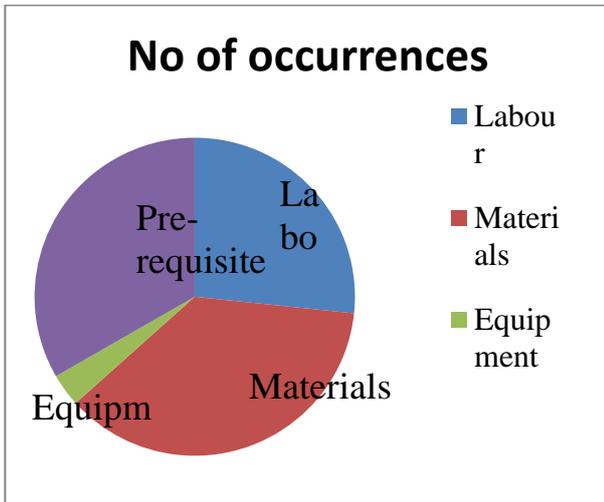


Figure 4: Pie chart showing percentage contribution of various constraints

**A. MATERIAL**

Contribution from material for poor PPC is about 44%. The major constraint from material side is due to late delivery of materials which affects project schedule to a great extent. The major cause for this constraint is due to no practice of scientific project management. An effective planning methodology to procure materials in advance should be made for smooth running of site.

**B. LABOUR**

Contribution from Labour for poor PPC accounts for about 32% due to low productivity. From analysis, it has been found that poor productivity is due to motivational problems of labour. Hence additional incentives must be given to labours in order to motivate and improve his productivity skills.

**C. PRE-REQUISITES**

Contribution from pre-requisites for poor PPC is about 20% due to unavailability of shuttering material. Because for beam and slab concreting, shuttering is the basic step which must be completed for reinforcement erection and concreting activities to take place. Hence proper pre planning is required for smooth flow of activities.

**D. EQUIPMENT**

Contribution from equipment for poor PPC is about 4%. The major constraint is due to machine repair. Hence proper inspection is required to maintain the service life of equipment for a prolonged time.

**VIII. SUCCESS FACTORS FOR LPS IMPLEMENTATION**

**A. Removing the constraints in the plan**

- a. Matching the resources and work load
- b. Planning at greater details
- c. Skill of the worker
- d. Interest of site engineer
- e. Co-ordination with client
- f. Effective communication

**IX. CONCLUSION**

- a. The effectiveness of the project was found to be increased about 75.6% after implementation of LPS.
- b. The reliability of plan is achieved to a great extent after implementation of LPS.

**LEARNINGS FROM IMPLEMENTATION**

- a. Planning at greater details is required to do a successful LPS.
- b. A suitable compensation mechanism for labours increases the productivity which in turn helps to finish the project as per actual schedule.

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