International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 10 Issue: 03 | Mar 2023 www.irjet.net p-ISSN: 2395-0072

STUDY AND IMPLEMENTATION OF LAST PLANNER SYSTEM (LPS) IN CONSTRUCTION PROJECTS

Shamal S. Chavan[1], Prof. A.V. Hankare[2]

[1]PG Student (M. Tech Construction and Management)
[2]Assistant Professor (Civil Engineering Department)
[1-2] Tatyasaheb Kore Institute of Engineering and Technology, Warananagar, Maharashtra (India)

Abstract - *Lean construction is a relatively new construction management philosophy which has evolved from Lean manufacturing principles. Lean construction along with its various tools like the Pull Approach, Just in Time, Continuous Improvement, Last Planner System, etc. has gathered a lot of impetus in the developed nations. The challenge now lies in implementing it in the developing countries. The Last Planner System (LPS) is well-documented in the literature, and has sometimes been used to represent lean construction or lean project management. LPS aims to achieve reliable workflow by encouraging foremen to have a sense of ownership of the project programme and to build-in their commitment into it. Lean Construction method is considered the core principle behind the Identification and Elimination of various wastes in construction*.

Key Words: **Lean construction, Lean Principles, Last Planner, Labour activities, Target works**

1.INTRODUCTION

As such when we talk of construction, the immediate characteristics that go in our mind are uniqueness, complicacy and end result inclination. In order to execute an activity, the first and foremost step is the thought of answering how, when and most importantly "by whom". Though modern constructions have started to improve the construction practice and procedures by means of mechanization, a large part of any activity is dependent on the construction workers, whom we will here in after refer to as 'Labours' throughout this paper. Lack of skilled labour and low productivity may seem to be the immediate cause of wastage of labour resource. This is significant mainly in the finishing activities of any building project, since the appearance and a feeling of good aesthetic is mind oriented which can be well organized only with the help of labours. As its name indicates, in LPS the decision making is given to the 'last planner' or foreman, so that he can add in details and commit to what can actually be achieved in the coming week (Ballard, 2000).

1.1 Last Planner System

Lean Construction Institute created the Last Planner System in 1992. LPS is a production system, according to the Lean Construction Institute This was developed to provide a predictable workflow and to serve as a quick learning tool for construction performance, projections, documentation, and project handover. LPS is a bottom-up method to project management, as opposed to the top-down strategy used in standard project management. Control is delegated to lower-rank workers who actually operate on the site, rather than senior management, in LPS.

Work is broken down into smaller packages and activities in conventional management, and precise time durations were assigned to the completion of the tasks using the critical path technique. The CPM technique incorporates float for non-critical tasks, allowing these activities to be delayed without affecting the overall project duration. However, the biggest shortcoming of CPM is that it ignores the time necessary for information and material flow. However, given the dynamic nature of the construction sector, the display of information and material flow becomes critical. The LPS can be used to aid with this representation.

Last Planner is in charge of the connections, talks, and commitments that make a programme possible & in a variety of one-off production settings software, production planning choices must be made jointly at the lowest possible level One-of-a-kind production includes planning, shipbuilding, yacht fit-out, and construction. LPS also works on new product development and design with modifications.

Last Planner is a 25-year-old short-term project planning system that was initially used in engineering construction. It continues to make major advances in the safety of projects and programmes. Predictability, productivity, delivery speeds, profit, and project team members emotions of well-being LPS provides a practical solution to manage project-based production cooperatively, allowing issues to be discovered and managed before they become major problems On-site issues are reduced, increasing the likelihood that work will flow smoothly and projects will be finished on schedule. It serves as a critical link

between the logistics and construction teams. As a result, an increasing number of businesses are incorporating it into their usual project delivery strategy.

Last Planner, for example, encourages detailed communication between trade foremen and site management in the building industry and before the situation becomes serious These discussions boost the likelihood of work flowing and emphasize the importance of personal ties and peer pressure in the process.

1.2 Purpose of study

The construction business is one of today's emerging industries that has a significant influence on any country's economy. The building industry contributes significantly to the economy's competitiveness and growth. A modern, efficient infrastructure is a key driver of productivity, and the construction industry has a major role in delivering the built infrastructure in an innovative and cost-effective way.

The four M's are material, money, manpower, and machinery, with time being the essence of the building business. In construction, good project management requires a zealous pursuit of the most effective use of personnel, materials, and equipment. We must investigate the viability of the Last Planner System in the Indian construction sector in order to improve construction management performance.

It is widely acknowledged that construction management has a number of practical issues that need to be addressed or better understood. The person or group in charge of production unit management, or the accomplishment of individual assignments at the operational level, is known as the "last planner" (Ballard, 1994). It was created to improve the efficiency of planning and control by making programs more predictable, increasing the likelihood of completing projects on schedule. This method claims to make the job easier to complete Make assignments available, promote short-term planning, and reduce waste and non-value-adding activity to make programs more predictable. Furthermore, it allows for the collaborative administration of the full network of connections and interactions required for effective programme coordination, production planning, and project delivery. As a result, the technique's efficacy must be tested in the local building sector.

1.3 Objectives

1. To study concept of Last Planner System.

2. To identify the Work Packages i.e., activities deciding, material and labour required etc. that may be needed within the work period.

3. To consult with stake holders in order to complete the work within the time constraint.

4. To create weekly work activities that are going to be completed before delivery of the assigned work.

5. To apply weekly work planning on decided activities.

6. To check the labour productivity, time and cost minimization.

1.4 Methodology

1. Collection of information through literature review.

2. Learning the Lean construction.

3. To study LPS principles and examine the components of it.

4. To collect the necessary data from the case study taken from the Kolhapur region.

5. To make weekly constraint analysis of given case study based on data collected.

6. To analyse and apply impact of LPS.

2. LAST PLANNER SYSTEM & IMPLEMENTATION METHODOLOGY

2.1 Introduction

This strategy promises to make programmes more predictable by utilising short-term planning, reducing waste and non-value-added activity, and preparing assignments for work. It was created to improve the accuracy of planning and control by making programmes more predictable, thereby increasing the likelihood of completing the project on schedule. Abdullah O. Alsehaimi (Abdullah O. Alsehaimi) LPS is built on panoptic collaboration between diverse consultants, contractors, and subcontractors who commit to more detailed coordination of their efforts in order to determine the most practicable implementation techniques. In addition, the final and most detailed schedule plan is developed based on previous experiences with reference to what caused deviations between planned and actual execution. It detects all of the necessary tasks and

restrictions for a particular job and ensures that all of the prerequisites are fulfilled and any constraints are eliminated before the task begins.

The individual or group that makes assignments to lead employees is known as the "last planners" in LPS. (Ballard). Last planners are those who are involved in the actual execution of the job; they are also actively involved in designing the work schedule and ensuring that tasks are completed prior to the start of the activity. The final planner's responsibilities include ensuring that the workflow in the building process is efficient and that the job is completed at an ideal level.

As observed from the study last planner principles can be listed as-

- As you come closer to completing the task, you should plan with more depth.
- Prepare the plans in collaboration with those who will really be doing the task.
- As a group, analyse and remove the limits on the scheduled tasks. Commitments that can be relied upon should be made.
- Take notes on the work breakdowns that happened.

2.2 Components of Last Planner System

1. Master Planning
2. Phase Scheduling
3. Look-ahead Planning
4. Weekly Work Plan (WWP)
5. Percentage Plan Complete (PPC)

2.2.1 Master Planning

It represents the project's significant milestones. The project's overall timetable is contained in master planning. The milestone dates are calculated by working backwards from the project completion date to the project start date. It brings all of the important components together to examine their interdependencies and agree on the appropriate sequence of actions. The goal of this plan is to develop planning and execution methods, as well as to assess the viability of existing resources in completing the plan within the timeframe set, and to identify key milestones for customers and owners.

2.2.2 Phase Scheduling

Phase scheduling is a step in the LPS process that involves using a pull mechanism to create a timetable for each phase of the project. These phases are based on the master schedule's milestones and serve as the foundation for the schedule's appearance. Each step is planned backwards from the milestones, highlighting the criteria as well as conditions that must be met in order to go from one activity to the next. Phase scheduling also determines the level of collaboration needed to allow numerous tasks to run concurrently. At the conclusion of the procedure, durations for each activity are determined to check whether there is any float between the calculated start date as per the master schedule and the possible start date. If any float remains after the whole phase schedule has been prepared, it is either used to postpone the start of the phase by spending more time in earlier work or it is given to activities that are possibly changeable and involve greater uncertainty.

2.2.3 Look-ahead Planning

The most significant feature of the final planner method is look forward planning. The drafting of a look-ahead programme is usually done over a period of 4-6 weeks. These schedules give you a heads-up on actions that are due to be finished or begun within that time period. Look ahead planning's major goal is to identify and eliminate restrictions that must be addressed prior to the start of an activity. Contract design, material procurement, labour needs, and precursor work are all examples of constraints. Tasks are made work ready and can be put in workable backlogs after the indicated limitations are eliminated. Look ahead planning is important because it bridges the gap between long- and short-term planning. It's a planning loop that converts what should be done into what will be done. As a result, it gives operational information that are required for obligations

2.2.4 Weekly Work Plan (WWP)

In the last planner system, WWP is an element of short-term planning. It's a one-week operational assignment level timetable and collaborative management plan that's based on commitments. It contains all actions and activities that must be begun in that specific week and completed by the completion dates specified in the look ahead plan. Only work-ready quality assignments are included in WWP, which includes activities with all limitations eliminated, enough resource availability, necessary work accomplished, and so on. The goal of weekly meetings is to improve communication, discuss the progress of the previous plan, plan for the current week, and investigate task interdependency. For the project's effective advancement, there is a two-way transmission of information between top management and the final planners. This is the stage in which the last planners are held accountable for the promises they made during the subsequent schedule planning.

2.2.5 Percentage Plan Complete (PPC)

In the last planner system, PPC is the learning phase. PPC is used to determine the WWP's dependability. PPC is computed by dividing the total number of tasks accomplished by the total number of tasks planned for a specific time period (1 week). PPC measurement is the first step toward better planning since it identifies the reasons for activity non-completion and identifies the core causes. Following that, steps are done to prevent these reasons of non-compliance from occurring again. This assessment serves as a foundation for long-term progress through the decrease of difficulties. This PPC approach is used to keep track of a project's progress.

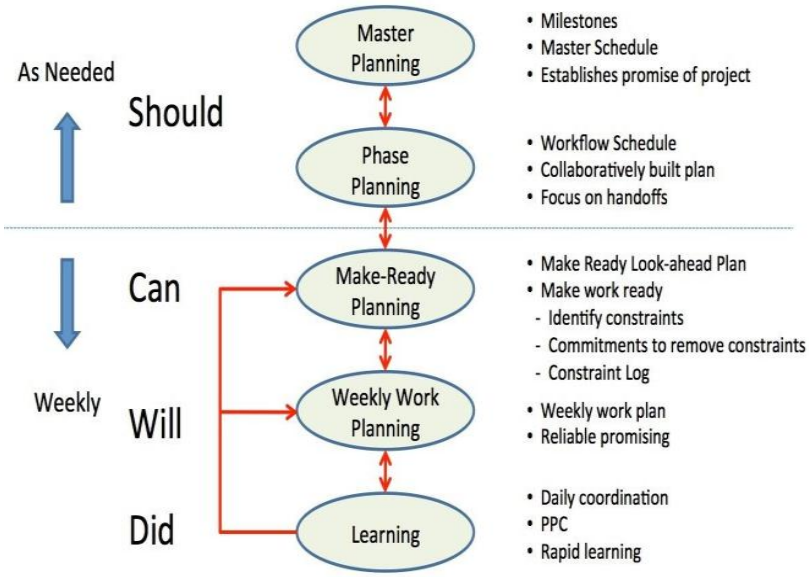

Fig -1: Last Planner System process

2.3 Last Planner System tools

The author has particularly noted that the tools described below, including as tables and charts, would be essential for effective implementation of LPS theory on building projects in order to get the best potential outcomes. As previously said, LPS is a component of short-term planning, and it is separated into five elements. WWP and PPC are the real operational assignment level portions in the implementation process, out of these five sections. In WWP, restrictions are analysed, and last planners make commitments for the future week. The following tools must be used in practise for accurate WWP analysis.

2.3.1 Weekly Constraints analysis board

Table-1: Weekly Constraints analysis board

Constraints	CNC (Causes of non-compliance)	CA (Corrective actions taken)
Constraints found in WWP	Non-compliance is caused by external circumstances or persons.	Corrective actions performed to alleviate or eliminate restrictions

This constraints analysis board illustrates the restrictions that are seen as roadblocks to completing specific tasks. Because this board contains a list of recognised restrictions, it aids the project manager in categorising them as actions or no actions. As a result, project managers may focus their attention on tasks that can be implemented. In addition, the CNC column explicitly defines the individual or external circumstances responsible for the failure to complete the obligation, as well as the corrective action taken to eliminate the same restrictions. With this tool, the project manager may readily determine whether or not the remedial action conducted was justified.

Constraints may be classified into several categories to simplify the analysis process even further, as indicated in table:

Table-2: Constraint categories

Constraint category	Example
Directives	Design documents, specifications, and work assignments, among other things.
Work that is required in advance	Work that must be completed before moving on to the next activity.
Resources	Labor, equipment, and supplies, to name a few.

2.3.2 Pareto chart of causes of variation

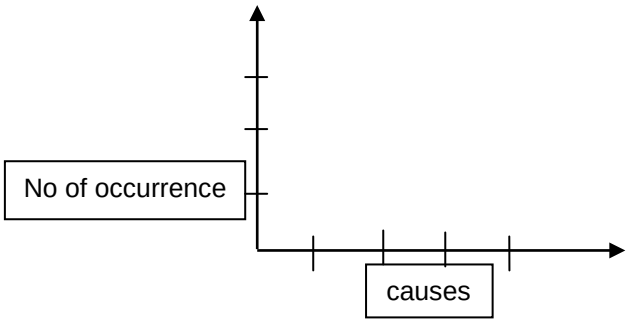

Chart-1: Pareto chart

This graph depicts the hierarchical order of causes observed in building projects based on the number of occurrences, starting with the reason that has occurred the most times in a certain period and progressing to the cause that has occurred the fewest times. This assists the project manager in identifying the factors that recur and obstruct the project's development. With the aid of this graphic, one may quickly identify the most influential reasons and concentrate their efforts on removing them.

2.3.3 Commitment monitoring board

Table-3: Commitment monitoring board

	Commitments	Sections			
		RCC	Electrical	Plumbing	Etc…..
Consultant	Commitments given by consultant				
Contractor	Commitments given by contractor				

3. CASE STUDY (DATA COLLECTION & ANALYSIS)

3.1 Introduction

1.Site location- Shivaji Park, Kolhapur

2.Name- Elixa Park

3.Wing- D

4.Builder name- Mr. Ajaysinh V. Desai

The construction of a (G + 15) residential structure is the subject of this case study. Because the case study was just two and half months long, all four phases of the last planner system could not be implemented. Following a one-week trial period for weekly work planning, the creation of a look-ahead plan began. The initial master plan and phase schedule were created, however due to the short time frame of the case study, it was not able to use the pull approach to create the phase schedule. It was not possible to update the look-ahead plan on a weekly basis since it is a course of practise that takes a long time to master. This must be viewed as a flaw in the work.

On certain of the activities, the Last Planner System is used on the real building site. The building operations included RCC construction of three storeys and brickwork. Kolhapur was the location of the construction site.

The details of building are as under,

D Wing Residential Building G+15

Address = Kolhapur

Total Area = 631 sq.m

Built-up Area = 631 sq.m

Beam = 122m3/floor

Column = 20m3/floor

Slab = 80 m3/floor

- **Rates of Labour**

1 Carpenter= Rs 450/8 hr

1 Helper = Rs 350/8 hr

1 Skilled = Rs 350 /8 hr

1 Unskilled =Rs 300 /8 hr

1 Mason= Rs 500 /8 hr

1 Male mazdoor = Rs 350 /8 hr

1 Female mazdoor =Rs 300 hr

- **Rates of Material**

Aggregate = Rs. 1800 per brass

River Sand = Rs. 7000 per brass

Crushed Sand = Rs. 3700 per brass

Cement = Rs. 340 per bag

Bricks = Rs. 11 per piece

3.2 9 Weeks Look Ahead Plan

The table below depicts the 9-week look-ahead plan from the case study. It represents the constraints that have been observed as well as the people who are in charge of removing such constraints.

Table-4: 9 Weeks Look Ahead Plan

Assignment	Constraints	Person Responsible
1.RCC 1.1- COLUMN 1.1.1-Reinforcement 1.1.2-Shuttering 1.1.3-Casting 1.2- BEAM 1.2.1-Reinforcement 1.3-SLAB 1.3.1-Shuttering 1.3.2-Reinforcement 1.3.3-Casting	**1. Material (for 9 weeks 5th to 7th floor)** 1.1 RMC: 660 m3 1.2-Aggregate: 6 m3 1.3-River sand: 6 m3 1.4-Crushed Sand: 6 m3 1.5-Cement: 500 bags 1.6-Steel: 27000 kg (Approx..1.5 kg per sq ft) **2. Men** 2.1-Carpenter-7, helper-10, 2.2-Skilled worker-8, unskilled worker -10 2.3-Slab Casting gang 5 mason, for pump 8 male mazdoor **3. Cost** 3.1 RMC- ₹2970000/- 3.2-Aggregate- ₹26400/- 3.3-River Sand- ₹70400/- 3.4-Crushed Sand- ₹52800/- 3.5-Cement Bags- ₹123200/- 3.6. Steel- ₹460900/- 3.7. Construction Cost- ₹4888000/- (Approx.₹1900/-per sq meter)	Men and Material-Manager (Mr. Aniruddha Shinde) RCC- Supervisor (Mr. Sagar Patil)
2.Brick work 2.1 Prop Removal and site cleaning 2.2. Soaking and staking of bricks 2.3. Line out and brick work	**1. Material** 1.1- Bricks- 45000 nos. **2. Men** 2.1-Mason-8, male mazdoor-15. **3. Cost** 3.1- Bricks- ₹495000/- 3.2- Construction Cost- ₹288000/-	Men and Material-Manager (Mr. Aniruddha Shinde) RCC- Supervisor (Mr. Sagar Patil)

3.3 Weekly Work Planning (WWP)

This section provides details of weekly planning done throughout the period of case study. WWP in this case study considers detailed requirements of manpower, material and prerequisites needed for the fulfillment of upcoming week work.

WEEK 1-

Table-5: Week 1

Date	Activity	Material	Manpower	Prerequisite
15/03/21	5th floor column stater	Sand, aggregate, cement	Carpenter -3 Unskilled-6	Slab complete
16/03/21 17/03/21 18/03/21	Column & lift reinforcement	Steel	Skilled -5 Unskilled-10	Column starter complete
19/03/21 20/03/21	Column shuttering	Formwork & leveling instrument	Carpenter-4 Unskilled-8	Column reinforcement complete

WEEK 2-

Table-6: Week 2

Date	Activity	Material	Manpower	Prerequisite
22/03/21 23/03/21	Column casting	R.M.C used for casting so concrete pump required	Mason -2 Unskilled-4 Unskilled-4 (for pump)	Column shuttering complete
24/03/21 25/03/21 26/03/21 27/03/21	Slab & beam shuttering	Formwork & leveling instrument	Carpenter -7 Unskilled-14	Column casting complete

WEEK 3-

Table-7: Week 3

Date	Activity	Material	Manpower	Prerequisite
29/03/21 30/03/21	Slab & beam shuttering	Formwork & leveling instrument	Carpenter -7 Unskilled-14	Column casting complete
31/03/21 01/04/21 02/04/21 03/04/21	Slab & beam reinforcement	Steel	Skilled -5 Unskilled-10	Slab & beam shuttering complete

WEEK 4-

Table-8: Week 4

Date	Activity	Material	Manpower	Prerequisite
05/04/21	Slab & beam reinforcement	Steel	Skilled -5 Unskilled-10	Slab & beam shuttering complete
06/04/21	Slab casting	R.M.C used so concrete pump is required	Mason-3 Unskilled -8 Unskilled -4 (for pump)	Slab & beam reinforcement complete
07/04/21	Pond making Outside beam deshuttering	Sand, cement	Mason -2 Unskilled-4 Carpenter -4 Unskilled -4	Slab casting complete Slab casting complete
08/04/21	6th floor column starter	Sand, aggregate, cement	Carpenter -3 Unskilled-6	Slab casting complete
09/04/21 10/04/21	Column & lift reinforcement	Steel	Skilled -5 Unskilled-10	Column starter complete

WEEK 5-

Table-9: Week 5

Date	Activity	Material	Manpower	Prerequisite
12/04/21	Column & lift reinforcement	Steel	Skilled -5 Unskilled-10	Column starter complete
13/04/21	Holiday Gudipadwa	--	--	--
14/04/21 15/04/21	Column shuttering	Formwork & leveling instrument	Carpenter-4 Unskilled-8	Column reinforcement complete
16/04/21 17/04/21	Column casting	R.M.C used so concrete pump is required	Mason-2 Unskilled -4 Unskilled -4 (for pump)	Column shuttering complete

WEEK 6-

Table-10: Week 6

Date	Activity	Material	Manpower	Prerequisite
19/04/21 20/04/21 21/04/21 22/04/21 23/04/21	Slab & beam shuttering	Formwork & leveling instrument	Carpenter -8 Unskilled-16	Column casting complete
24/04/21	Slab & beam reinforcement	Steel	Skilled -5 Unskilled-10	Slab & beam shuttering complete

WEEK 7-

Table-11: Week 7

Date	Activity	Material	Manpower	Prerequisite
26/04/21 27/04/21 28/04/21 29/04/21	Slab & beam reinforcement	Steel	Skilled -5 Unskilled-10	Slab & beam shuttering complete
30/04/21	Slab casting	R.M.C used so concrete pump is required	Mason-3 Unskilled -8 Unskilled -4 (for pump)	Slab & beam reinforcement complete
01/05/21	Holiday Kamgar din	--	--	--
02/05/21	Pond making Outside beam deshuttering	Sand, cement --	Mason -2 Unskilled-4 Carpenter -4 Unskilled -4	Slab casting complete Slab casting complete

WEEK 8-

Table-12: Week 8

Date	Activity	Material	Manpower	Prerequisite
03/05/21 04/05/21	5th floor slab & beam deshuttering & cleaning of floor	--	Carpenter– 4 Unskilled- 8	Curing time complete
05/05/21 06/05/21	7th floor column starter	Sand, aggregate, cement	Carpenter– 3 Unskilled- 6	Slab complete
	5th floor brick work	Brick, sand, cement	Mason– 8 Unskilled-15	Deshuttering of slab complete
07/05/21 08/05/21	Column & lift reinforcement	Steel	Skilled -5 Unskilled-10	Column starter complete
	5th floor brick work	Brick, sand, cement	Mason– 8 Unskilled-15	Deshuttering of slab complete

WEEK 9 -

Table-13: Week 9

Date	Activity	Material	Manpower	Prerequisite
10/05/21	Column & lift reinforcement	Steel	Skilled -5 Unskilled-10	Column starter complete
	5th floor brick work	Brick, sand cement	Mason– 8 Unskilled-15	Deshuttering of slab completed
11/05/21 12/05/21	Column shuttering	Formwork & leveling instrument	Carpenter-4 Unskilled-8	Column reinforcement complete
	Lintel shuttering over brickwork	Formwork & leveling instrument	Carpenter-2 Unskilled-2	Brickwork up to lintel level completed

13/05/21	Column casting	R.M.C used so concrete pump is required	Mason-2 Unskilled -4 Unskilled -4 (for pump)	Column shuttering complete
	Lintel reinforcement	Steel	Skilled -2 Unskilled-2	Lintel shuttering completed
14/05/21	Column casting	R.M.C used so concrete pump is required	Mason-2 Unskilled -4 Unskilled -4 (for pump)	Column shuttering complete
	Lintel casting	Sand, aggregate, cement	Mason-1 Unskilled-6	Lintel reinforcement completed
15/05/21	Slab and beam shuttering	Formwork & leveling instrument	Carpenter -7 Unskilled-14	Column casting complete

WEEK 10 -

Table-14: Week 10

Date	Activity	Material	Manpower	Prerequisite
17/05/21	Slab and beam shuttering	Formwork & leveling instrument	Carpenter -7 Unskilled-14	Column casting complete
	5th floor brick work over lintel level	Brick, sand cement	Mason– 4 Unskilled-8	Lintel casting completed
18/05/21 19/05/21 20/05/21 21/05/21	Slab and beam shuttering	Formwork & leveling instrument	Carpenter -7 Unskilled-14	Column casting complete
	5th Inside plastering	Sand, cement	Mason – 5 Unskilled - 10	Brickwork completed
22/05/21	Slab & beam reinforcement	Steel	skilled -5 Unskilled-10	Slab & beam shuttering complete
	5th floor Inside plastering	Sand, cement	Mason – 5 Unskilled - 10	Brickwork completed

WEEK 11 –

Table-15: Week 11

Date	Activity	Material	Manpower	Prerequisite
14/05/21 25/05/21	Slab & beam reinforcement	Steel	Skilled-5 Unskilled-10	Slab & beam shuttering complete
	5th floor inside plastering	Sand, cement	Mason – 5 Unskilled – 10	Brickwork complete

26/05/21 27/05/21	Slab & beam reinforcement	Steel	Skilled -5 Unskilled-10	Slab & beam shuttering complete
28/05/21	Slab casting	R.M.C used so concrete pump is required	Mason-3 Unskilled -8 Unskilled -4 (for pump)	Slab & beam reinforcement complete
29/05/21	Pond making	Sand, cement	Mason-2 Unskilled-4	Slab casting complete
	Outside beam deshuttering	--	Carpenter -4 Unskilled -4	Slab casting complete

3.4 Percentage Plan Complete (PPC) Analysis

A nine-week look-ahead plan was created at the start of this case study. However, actual implementation demonstrates that the look-ahead anticipated at the start of the project took 11 weeks to complete. This table explains the 11-week PPC analysis from the case study. It shows how many activities from allocated activities were done per week and the primary reasons for delays.

WEEK	1	2	3	4	5	6	7	8	9	10	11
Percentage Plan Complete	66.67%	100%	100%	83.33%	100%	75%	100%	80%	90%	100%	75%
Activities completed	2	2	2	5	3	3	4	4	9	6	3
Activities assigned	3	2	2	6	3	4	4	5	10	6	4
Reasons of incompletion	Shifting of formwork	----------	----------	Column shuttering broked (Rework)	----------	Shuttering took more time than planned time	---------	Lift problem occurred so delay in transportation of brick	Lintel shuttering took more time than planned time	---------	Problem occurred in Steel bending machine

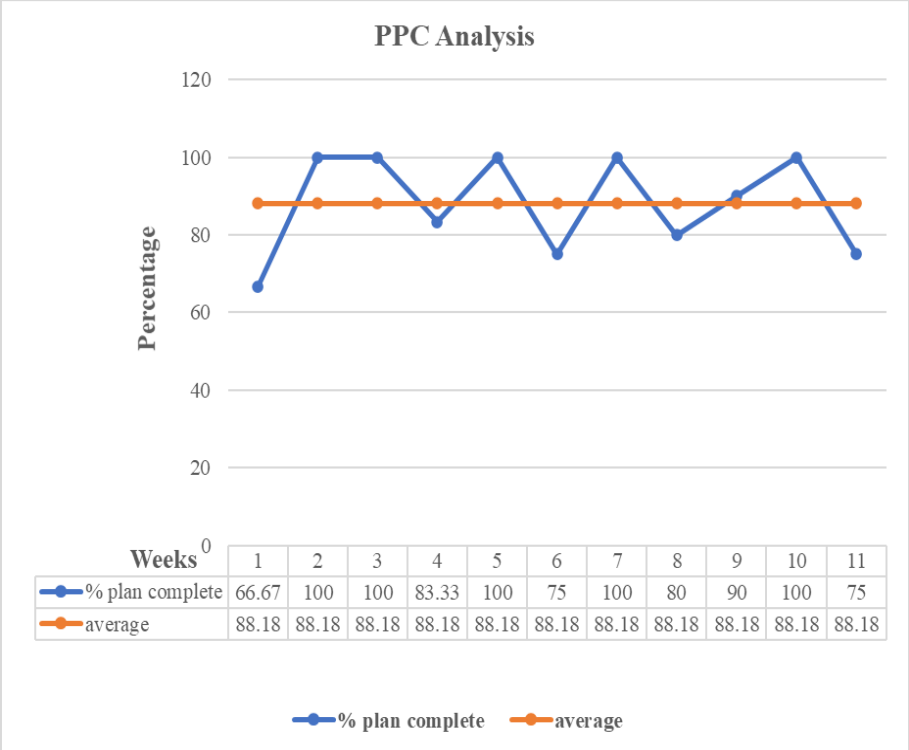

Chart-2: PPC Analysis chart

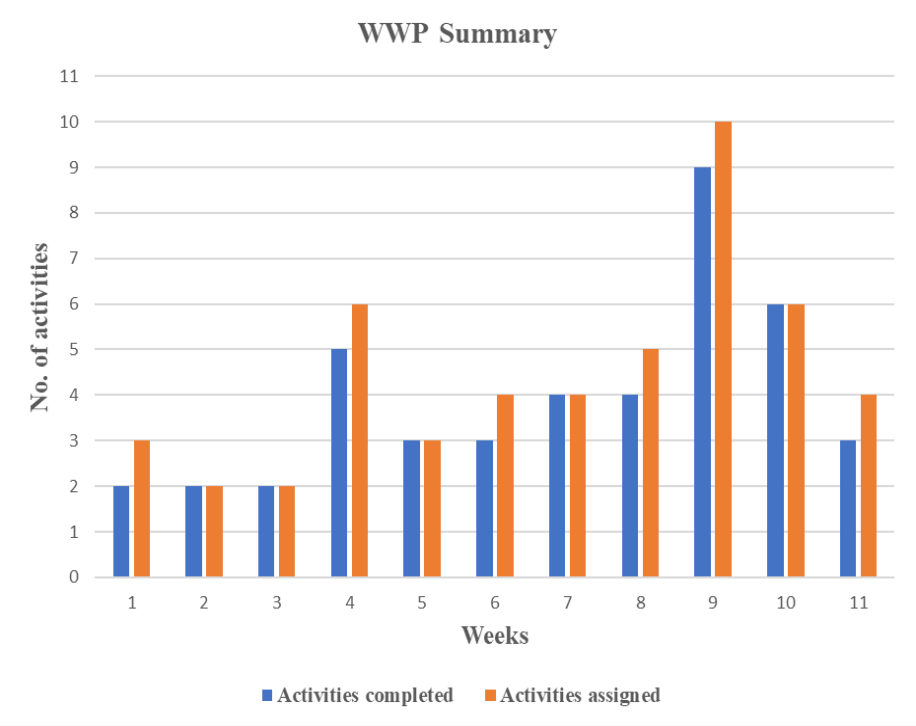

Chart-3: WWP summary chart

3.5 Overall Cost and Time Saving

After application of Last Planner System, reduction in cost is as follows-

1. Material

a) Steel = Rs. 189000/- (Fluctuation 7 per kg)

b) Cement = Rs. 20000/- /- (Fluctuation 20 per kg)

Initial Cost of Steel was Rs. 60 per kg and for cement bag was Rs. 340 per bag. But in view of manager, there was a possibility of price hike and it was observed as one of the constraint in look ahead plan and the prediction was true, price hike was by Rs. 7 per kg of steel and Rs.20 per bag of cement bag.

2. Men

a) Labour = Rs. 38500/-

b) Supervisor and manager = Rs. 42000/-

By the implementation of LPS, there was time reduction by 3 days for per floor construction which resulted in cost saving as mentioned above.

Overall Cost reduction using LPS-

= 189000 + 20000 + 38500 + 42000

=Rs.289500/-

3.6 Concluding remark

In order for last planners to achieve the appropriate degree of plan reliability, project coordinators must embrace the Last Planner system's objectives, particularly the look ahead phase, which is committed to getting tasks ready for assignment and balancing load and capacity. Last planners, for their part, must follow the Last Planner standards and, in some cases, use the LPS system's PPC learning tool consistently and effectively.

Comparison between without LPS and with LPS

Without LPS	With LPS
1) Time- 78 months Project starts- January 2017 Probably possession- June 2023 Without using LPS, the time period of construction was increased by 78 months. Time period increased by 216%	1) Time- 36 months Project starts- January 2017 Probably possession-December 2019 By using LPS, the time period will be decreased by 36 months.
2) Cost- At the beginning of project, the estimated cost of project was 78 Cr. But because of delay in construction, the cost of project increased by 112 Cr. Cost increases by 143.59%	2) Cost- At the beginning of project, the estimated cost of project was 78 Cr. but increased by 112 Cr. Hence, by using LPS the cost can be saved by 34 Cr.

4. CONCLUSION

4.1 Conclusion

LPS has proven to be a very effective technique in terms of planning, improved participant coordination, collaborative management, and information flow. The results of this literature review reveal that LPS training is necessary for complete implementation since the participant's work identity must be compatible with his previous intended work practise. According to the findings, LPS is unlikely to have a higher impact when used for a shorter amount of time; however, combining look-ahead schedules, WWP, and PPC assessments with the learning process would improve work flow over a longer period of time by creating an experience learning cycle.

Understanding the causes of variation observed in the LPS learning phase and taking appropriate action against these causes using risk assessment matrixes, excel spreadsheets, time buffers, information flow software's, social subcontracts, action research, and other tools will improve LPS effectiveness.

The adoption of LPS would diminish the power of autonomy by delegating choices to the engaged players in the process, hence top management plays a critical role in its successful implementation. This research aids in understanding the theory underlying the Last Planner System, as well as the main implementation aspects, roadblocks to complete adoption, and well-known advantages of the Last Planner System.

4.2 Barriers

Most common barriers observed from study are-

- Inadequacy in dependable commitments during LPS implementation.
- Stubborn attitude i.e., resistance to change.
- Partial implementation of LPS.
- Faulty presentation of PPC components.
- Lack of LPS implementation training or a hazy understanding of system components.
- Afraid of delegation of authority, upper management is unsupportive.
- Insufficient use of data gathered during installation.
- Lack of long-term vision, a hostile work climate, or a lack of teamwork.

REFERENCES

[1] Ahiakwo Ograbe, Oloke David et al.(2013), "A case study of Last Planner System implementation in Nigeria" , Proceedings IGLC-21, July 2013, Fortaleza, Brazil,pp.699-707

[2] Alarcón Luis F., Salvatierra José L.(2014) , "Using last planner indicators to identify early signs of project performance", Proceedings IGLC-22, June 2014 | Oslo, Norway, pp 547-558

[3] Aslesen, S. and Tommelein, I.D. (2016). "What "makes" the Last Planner? A Typology of Behavioral Patterns of Last Planners." In: Proc. 24th Ann. Conf. of the Int'l. Group for Lean Construction, Boston, MA, USA, sect.7 pp. 43-52

[4] Bhatla Ankit , Pradhan Bulu et al (2016), "Identifying Wastes in Construction Process an Implementing the Last Planner System in India", KICEM Journal of Construction Engineering and Project Management Online ISSN 2233-9582 , pp 11-19

[5] Brioso Xavier, Humero Antonio et al (2016), "Comparing Point-to-point Precedence Relations and Location-Based Management System in Last Planner System: A housing project of highly repetitive processes case study", Procedia Engineering 164,pp 12 – 19

[6] Daniel Emmanuel , Pasquire Christine (2015), Exploring the implementation of the last planner® system through iglc community: twenty one years of experience", 154 Proceedings IGLC-23, July 2015 |Perth, Australia,pp 153-162

[7] Dave Bhargav, Koskela Lauri(2015), "Exploring the recurrent problems in the last planner implementation on construction projects", Proceedings of the Indian Lean Construction Conference (ILCC 2015).pp 1-9

[8] Samad Ghali, Emdanat Samir(2017), "Last planner system – the need for new Metrics", Proceedings IGLC Heraklion, Greece , pp 637-644

[9] Hamzeh Farook , Zankoul Emile et al (2016), "Removing Constraints to Make Tasks Ready in Weekly Work Planning", Procedia Engineering 164 , pp 68 – 74

[10] Hussain Mannan, Asra Fatima et al (2015), "A systematic approach of construction management based on last planner system and its implemention in the construction industry", IJRET: International Journal of Research in Engineering and Technolog, 4(1), pp 2321-7308

[11] Kalsaas, B.T., Skaar, J. and Thorstensen, R.T., 2015. Pull vs. push in construction work informed by Last Planner. In: Proc. 23rd Ann. Conf. of the Int'l. Group for Lean Construction. Perth. Australia, pp.1-10

[12] Kemmer Sergio, Biotto Clarissa(2016), "Implementing last planner in the context of social housing retrofit", In: Proc. 24th Ann. Conf. of the Int'l. Group for Lean Construction, Boston, MA, USA, sect.6 pp. 83–92.

[13] Lagos Camilo, Herrera Rodrigo et al(2017), "Contributions of information technologies to last planner system implementation" , In: LC3 2017 Volume II – Proceedings of the 25th Annual Conference of the International Group for Lean Construction (IGLC), Walsh, K., Sacks, R., Brilakis, I. (eds.), Heraklion, Greece, pp. 87–94.

[14] Paz, A., and Oscar, V. (2016)."Last Planner System: Implementation, Evaluation and Comparison of Results in the Construction of a Social Housing Project in Chile." Proc. 24th Ann. Conf. of the Int'l. Group for Lean Construction, Boston, MA, USA, sect.6 pp. 153–162

[15] Pellicer Eugenio, Cerveró Fernando et al (2015), "The last planner system of construction planning and control as a teaching and learning tool", Proceedings of INTED2015 Conference 2nd-4th March 2015, Madrid, Spain , pp 4877-4884

[16] Vitaliy Priven, Rafael Sacks (2016), "Impacts of the Social Subcontract and Last Planner System Interventions on the Trade-Crew Workflows of Multistory Residential Construction Projects", J. Constr. Eng. Manage., 2016, 142(7): 04016013

[17] Olubukola Tokede(2016), "Last Planner System-from theory to Implementation",10th ICES 2016 const engg. , quality surveying and product management , pp 305-318

[18] Walia Banpreet Suri, N. et al (2017) ,"Implementation Of last planner system and challenges encountered in an indian residential construction project", International Research Journal of Engineering and Technology (IRJET) , 4(6), pp 2881-2888

[19] Zaeri F., Cox J. et al (2016), "Implementation of the LPS using an excel spreadsheet A case study from the New Zealand construction industry", Construction Innovation Vol. 17 No. 3, 2017 pp. 324-339