International Journal of Technical Innovation in Modern Engineering & Science (IJTIMES)
Impact Factor: 5.22 (SJIF-2017), e-ISSN: 2455-2585
Volume 5, Issue 04, April-2019

Implementing Last Planner System for Improving Project Performance

Naveed A Hafiz Shirgar[1], Neetu B. Yadav[2]

[1]*M.E. Student & S.N.P.I.T. & R.C., Umrakh,*
[2]*Assistant Professor & S.N.P.I.T. & R.C., Umrakh,*

Abstract— Lean construction is very popular in manufacturing industries to improve productivity and smooth workflow. Implementation of Lean Construction (LC) tool Last Planner System (LPS) attempts to increase productivity at construction site. To achieve research objective a commercial building project site was analyzed implementing Last Planner System (LPS). With an attempt to increase project reliability and performance collected data analyzed using Lookahead plan and Weekly work plan. Identification of reason for variance and improvement in average Percent Plan complete (PPC) reveals that improving planning and well management practices can reduce variance and ensure positive impact on project performance.

Keywords— Commercial building construction, Last Planner System, Lean Construction, Percent Plan Complete, Weekly Work Plan.

I. INTRODUCTION

A Lean construction is a "way to design production systems to minimize waste of materials, time, and effort in order to generate the maximum possible amount of value," here waste is different from pure construction waste. Designing a production system to achieve the stated ends is only possible through the collaboration of all project participants (Owner, Architect/Engineer, contractors, Facility Managers, End-user) at every stages of the project. Lean concept is very popular in manufacturing industries to improve productivity by smooth work flow and minimize the waste.
Ballard (2000) and Howell (1999) developed the LC tool Last Planner System (LPS) as a construction planning and control system with an attempt to increase the reliability of the schedule, which could lead to increased productivity at the construction site. People, information, equipment, materials, prior work, safe space and safe working environment are the seven flows required to come together at the workplace to enable construction transformation to flow. The Last Planner System (LPS) manages all seven flows by building relationships, creating conversations, and by securing commitments to action at the right level at right time throughout the process (Mossman 2008).

II. LITERATURE REVIEW

Lianying Zhang et. al (2017), they conducted a research to identify critical factors of workflow reliability and explore interrelationship among them. The author identified critical factors using SPSS which are: (1) labor resource (2) managerial level (3) support of each part in project (4) visualization of work flow (5) rework and weather. They suggest that this study would help project manager to find out causes of unreliable work flow to take effective measures to reduce variability. There was need to develop more precise model to clarify better interrelationships among the critical factors.
Katarzyna Cwik and Jerzy Roslon (2017), investigated that last planner system abandons the concept of traditional approach in building project and proposed a new concept which is lean construction. LPS serves as better than the traditional project.
Farook R. Hamzeh et. al (2015), in their investigated task made ready in lookahead planning impact for reliable workflow and project duration. Lookahead planning involved transforming work that 'should be done' into work that 'can be done'. Task made ready and task anticipated are used to remove constraints in lookahead planning and PPC is considered in weekly work plan to check reliability. It was identified that more task made ready could result in reducing project duration because it removes constraints during lookahead process which indicate that task made ready is more reliable compared to PPC for project duration.
Marion M. Russell et. al (2014), did literature review on time buffer and last planner system. Through literature review author identified that buffer is criticized as a waste by some lean researchers and could have negative effect on project performance. The author conducted two different case studies: a. mechanical contractor case study which employed traditional planning method and b. general contractor case study which employed LPS in planning.LPS indicated that project was reliable and executed within duration as PPC increased with targeted productivity introducing adequate buffer.

III. LPS ESSENTIALS

Last Planner System employs hierarchy of schedule and planning as below:

1) *The Master Schedule:* The master schedule is the overall project schedule and contains major milestones only.
2) *The Phase schedule:* Phase schedule delineates the schedule and handoffs of phases on a project performed by various participants involved in each phase, starting backward from the planned phase completion date.

3) *Look-ahead planning:* It is considered an intermediate level of planning. It considers activities which must be executed within schedule to achieve milestone dates as per master schedule. Look-ahead window of 2 to 6 weeks is taken into account, the number of weeks for look-ahead planning is derived based on project characteristics, reliability of planning system, and lead time for acquiring information, labor, materials, equipments and information (Ballard, 2000).
4) *Weekly work plan (WWP):* The weekly work plan is a task level schedule weekly basis. This includes all activities or tasks that are required to be execute that week. It transforms what should be done into what can be done.WWP record the quantity and the reason for any variation of each task on the weekly work plan. The reliability of WWP is measured by Percent Plan Complete (PPC).
5) *Percentage Plan Complete (PPC):* Measures how well the planning system is working – calculated as the "number of tasks/activities completed on the day stated" divided by the "total number of promises/activities made/planned for the week". It measures the percentage of assignments that are 100% complete as planned.

IV. RESEARCH METHODOLOGY

The methodology used in carrying out this research employs a case study to evaluated project performance using lean tool Last Planner System (LPS). Commercial building project on site construction of R.C.C. work considered for this research. The data collection involves on site observation, interviews, participation and non participation and further LPS implemented in following stages are described as below:

1) *The first stage:* It was to provide the team with information about LC using the LPS and discussing the anticipated advantages of LC and LPS to implement this system. Then, the participants were observed during weeks in order to monitor the present planning rehearsal through asking them and taking notes.
2) *The second stage:* It was identified that Phase Pull Planning (PPP) as one of the key components of LPS was implemented during the early weeks of the beginning of project. Project parties such as, contractors, managers, field supervisors; client representatives, consultant engineers, and subcontractors participated to deliver certain objectives for accomplishment of the project through meeting which were held during early stage of project. In the case study project, lookahead plan was a unified four-week window constructed based on activities on site.
3) *The Third stage:* It contains weekly work plan to identify PPC reliability of project and further reasons behind uncompleted tasks investigated and noted for week after week. R.C.C work was observed for ten consecutive weeks.

V. LPS IMPLEMENTATION

A. *Case background*

The case study was carried out in an on-going construction project at Sahara Darwaja within Surat city. The Commercial Project name Surana 101 within Surat city, only R.C.C structure construction activities were considered, Table 1 shows characteristics of the project;

Table 1 Case Study Project characteristic

Characteristic	Case Study
Planning Method	Critical Path Method (non-LPS)
Duration of Project :	15 months
No. of Storey	15 Storey

Lookahead Plan prepared based on baseline schedule of current project. This is carried out to forecast the make ready needs of the project and helps in procurement of resources to avoid or reduce uncertainty of project which increase workflow and performance. Make ready needs included delivery of steel on, post tension steel work cables, required material procurement before following activities get started were identified.
Weekly Work Plan (WWP) constructed through observations and participation of engineers involved in construction project. WWP includes list of activities involved during each week, its completion, percent plan complete and reason for uncompleted task or reason for variance was noted.

B. *Findings*

The PPC charts and reasons for non-completion were used throughout the implementation process. These reasons for non-completion were: submittals, weather, labour, equipment, materials, rework and prerequisite. A weekly PPC's of 5 weeks was measured and is shown in Table 2 and Fig. 1 the average PPC is 41% which is a very low PPC. The reason for variance which leads to very low PPC is shown in Fig. 2.

Table 2 Comparison of 5 weeks of PPC (06/01/2019 - 03/02/2019)

Start date for week	No. of completed tasks	No. of uncompleted tasks	Total Task	PPC
06-01-19	3	2	5	60%
13-01-19	1	4	5	20%
20-01-19	2	3	5	40%
27-01-19	1	2	3	33%
03-02-19	2	2	4	50%
TOTAL	9	13	22	41%

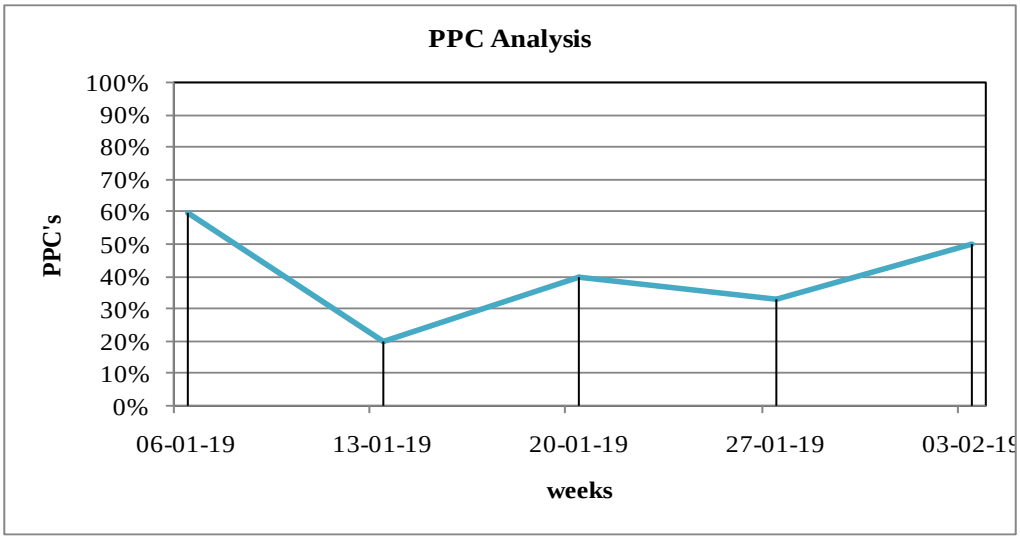

Figure 1Weekly PPC's for 5 weeks (06/01/2019 - 03/02/2019)

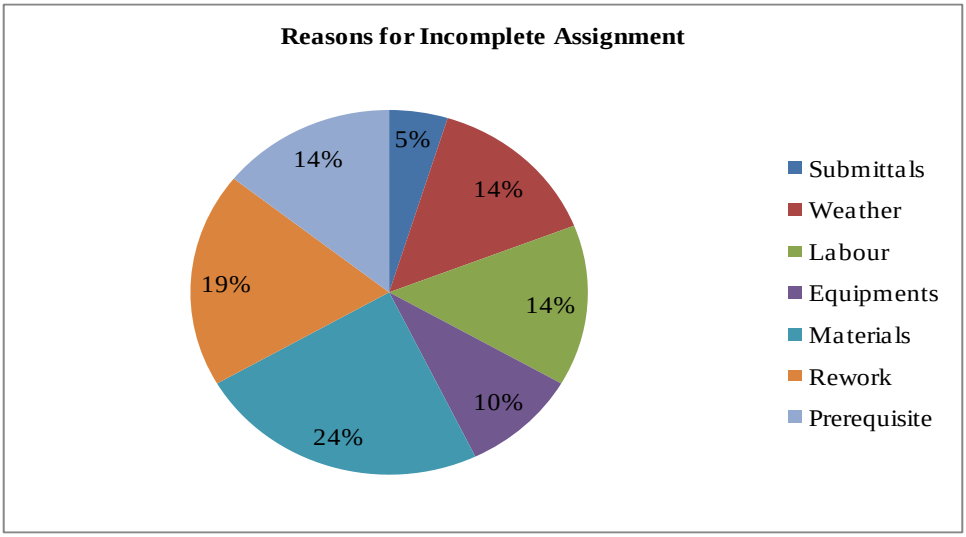

Figure 2 Reasons for Variance (06/01/2019 - 03/02/2019)

Table 3 Comparison of 5 weeks of PPC (10/02/2019 - 10/03/2019)

Start date for week	No. of completed tasks	No. of uncompleted tasks	Total Task	PPC
10-02-19	3	3	6	50%
17-02-19	3	3	6	50%
24-02-19	4	1	5	80%
03-03-19	2	1	3	67%
10-03-19	3	2	5	60%
TOTAL	15	10	25	60%

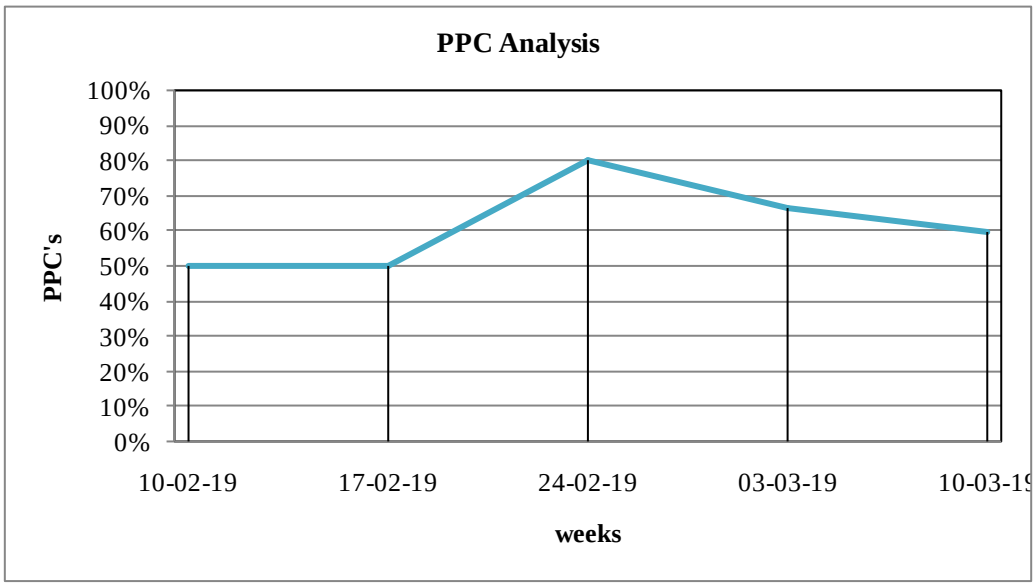

Figure 3 Weekly PPC's for 5 weeks (10/02/2019 - 10/03/2019)

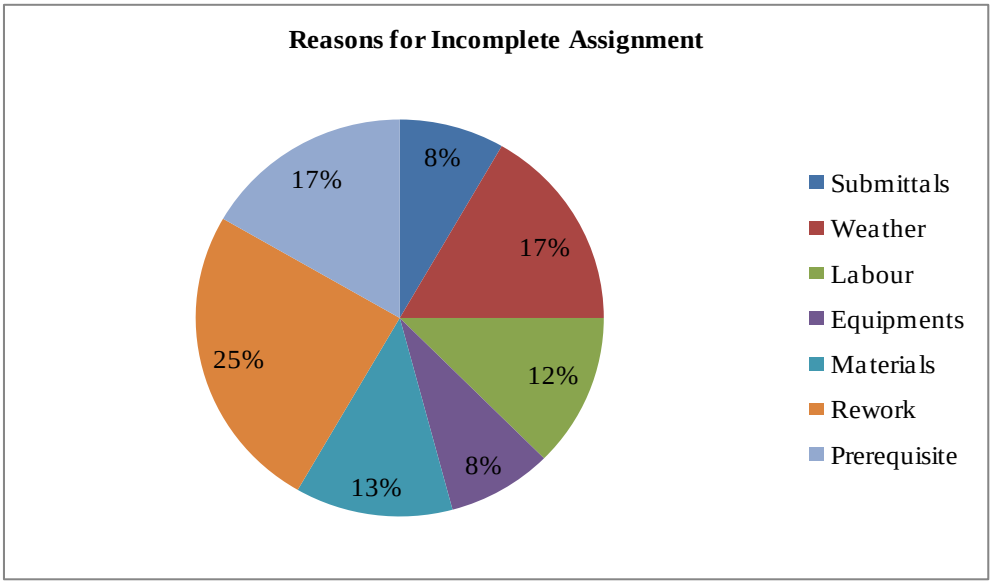

Figure 4 Reasons for Variance (10/02/2019 - 10/03/2019)

During first 5 weeks PPC and reason for variance indicates very low productivity of current projects performance. This helped project participants to learn and hence improvements recorded in following weeks. Table 3 and Fig. 3 indicates the PPC's collected till week 10th March, 2019 where average PPC is 60% further Fig. 4 indicates reason for variance following these five weeks. This was higher than average PPC (41%) recorded in first five weeks of observations. The improvement in average PPC indicates that project team was ready to keep their commitment and improve the project performance.

VI. CONCLUSIONS

In this research Lean construction tool LPS was implemented to improve the current project performance and workflow. LPS employed using lookahead plan and weekly work plan which was not practiced at current project. This helped the project team to investigate the project performance and workflow. The finding revealed the average PPC during first five weeks was very low which indicated the productivity of project. Further reason for variance identified aid the projects participants. This helped project participants to learn from failures and hence improvement recorded i.e. average PPC 60% indicates improvement in project performance. This ensures that improving planning and well management practices can prevent constraints and imprint positive impact on project performance.
Further this case project suggest implementation of LPS can improve process by encouraging collaboration among various project participations, weekly meetings, trust and reliability of the schedule.

REFERENCES

[1] Arif Marhani, Aini Jaapar, Nor Azmi Ahmad Bari, "Lean Construction: Towards enhancing sustainable construction in Malaysia" Procedia - Social and Behavioral Science, (2012), Vol. 68, 87-98.
[2] Ballard, G. "The Last Planner System of Production Control", PhD Thesis. University of Birmingham, Birmingham, UK, (2000).
[3] Ballard, Glenn, Howell, Gregory A., Tommelein, Iris D., Zabelle, Todd, "The Last Planner Production System Workbook", Lean Construction Institute, San Francisco, California, USA, (2007), 81pp.
[4] Dhyey K. Shah, Neeraj D. Sharma, Rushabh A. Shah, " Application of Lean Construction on Cement Concrete Road Project", International journal of advanced research in engineering, science & management ISSN: 2394-1766.
[5] Farook Hamzeh; Glenn Ballard; Iris D. Tommelein, "Rethinking Lookahead Planning to Optimize Construction Workflow" Lean Construction Journal, (2012).
[6] Farook R. Hamzeh, Emile Zankoul & Carel Rouhana, "How can 'tasks made ready' during lookahead planning impact reliable workflow and project duration?" Construction Management and Economics, (2015), Vol. 33, No. 4, 243–258.
[7] Gao Shang, Low Sui Pheng, "The Last Planner System in China's construction industry — A SWOT analysis on implementation", International Journal of Project Management, (2014).
[8] Glenn Ballard, Iris Tommelein, Lauri Koskela and Greg Howell, "Lean construction tools and techniques", Design and Construction: Building in Value, 1999, 227-255.
[9] Hamzeh, F.R., Ballard, G. and Tommelein, I.D. "Improving construction Workflow- The Connective Role of Lookahead Planning", Proceedings of the 16th Annual Conference of the International Group for Lean Construction, IGLC 16, (2008) July 16-18, Manchester, UK, 635-646.
[10] Howell, G. A., "What is lean construction", (1999) Proceedings IGLC.pp.1.
[11] Huseyin Erol, Irem Dikmen & M. Talat Birgonul, "Measuring the impact of lean construction practices on project duration and variability: A simulation-based study on residential building", Journal of Civil Engineering and Management, (2017), Vol. 23, No. 2, 241-251.
[12] Katarzyna Ćwik, Jerzy Rosłon, "Last planner system in construction", MATEC Web of Conferences, (2017), Vol. 117, 00032.
[13] Koskela, L.,"Application of the New Production Philosophy to Construction", Technical Report 72, CIFE, Stanford University, CA, (1992).
[14] Lianying Zhang, Xi Chen & Yongqing Suo, "Interrelationships among critical factors of work flow reliability in lean construction" Journal of Civil Engineering and Management, (2017), Vol. 23, No.5, 621–632.
[15] Marion M. Russell, Min Liu, Gregory Howell, M.ASCE and Simon M. Hsiang, "Case Studies of the Allocation and Reduction of Time Buffer through Use of the Last Planner System", American Society of Civil Engineers, (2014).