IJRAR.ORG E-ISSN: 2348-1269, P-ISSN: 2349-5138

INTERNATIONAL JOURNAL OF RESEARCH AND ANALYTICAL REVIEWS (IJRAR) | IJRAR.ORG

An International Open Access, Peer-reviewed, Refereed Journal

ANALYZING THE CHALLENGES FOR THE ADOPTION OF LAST PLANNER SYSTEM (LPS) IN CONSTRUCTION PROJECTS

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Abstract: One of the greatest industries in the global economy is construction. Delays and other time-related uncertainties are a common difficulty for contemporary construction projects in India. The Last Planner System (LPS) is a technique for short-term project planning that establishes a set of commitments that synchronizes the actions of all stakeholders, resulting in predictable, uninterrupted workflow. The Last Planner System's objective is to pull the tasks through team planning. LPS has shown significant growth in developed countries. Implementing it in developing nations is now the difficulty. The research focuses on identifying the challenges for the adoption of LPS in construction projects through literature surveys with a perspective of reaping enough data needed for the preparation of a questionnaire. Relative Important Index (RII) was used to do the Statistical analysis of data and ranks were given. Further analysis discovered that the most important challenge was 'Lack of understanding of new system'. The findings of this study may aid researchers, professionals, and businesses in the Indian construction sector in focusing their attention more quickly on the crucial challenges for a successful rollout of the Last Planner System.

Index Terms **- Last Planner System, Cronbach's Alpha, Relative Important Index, IBM SPSS 22, Indian Construction Industry**

I. INTRODUCTION

Investigations conducted in the 1990s in the United States showed that 50% of projects were unable to complete work in the given week, even with well-managed locations and knowledgeable engineers and managers. To address the issues with production flows, Ballard and Howell (1997) developed the Last Planner System as a planning and controlling system [1]. It was created by builders for builders so that schedules would be more reliable and predictable. The Lean Construction Institute defines last planner as the collaborative, commitment-based planning system that integrates should-can-will-did planning as follows: pull planning, make-ready look-ahead planning with constraint analysis, weekly work planning based on reliable promises, and learning based on analysis of PPC and reasons for variance. However, the introduction and use of this system, according to LPS users and mentors, has a number of issues. The research focuses on identifying the challenges for the adoption of Last Planner System in the construction projects.

II. AIM, OBJECTIVES & SCOPE

The aim, objectives, scope of the study and scope of research are described below:

2.1 Aim

The main ai of the research was to analyse various challenges for the adoption of Last Planner System in construction projects.

2.2 Objectives

The main objectives were to identify the challenges for the adoption of Last Planner System in construction projects through literature survey; to prepare questionnaire survey based on identified challenges and to rank them based on RII method.

2.3 Scope of the project

The main scope of the project is to create an awareness about the challenges faced during the implementation of Last Planner System in Indian construction projects.

2.4 Scope of the study

The questionnaire survey is limited to 155 respondents only and the study is limited only to 21 Indian States and 1 Union Territory.

III. RESEARCH METHODOLOGY

The methodology used are as follows:

3.1 Literature Survey

The use of LPS for various construction projects is the subject of a sizable body of literature. A large portion of this material takes the form of case studies from the academic and professional worlds. Case studies detail the application of LPS for various project settings (building construction, major civil construction, etc.), geographical locations, and project phases (definition, design, pre-design, and construction). Benefits of adopting LPS include smooth work flow [6], predictable work plans [2], lower costs [11], quicker project completion [7], increased productivity [5], and improved collaboration with field personnel and subcontractors [23]. The following issues were also mentioned by participants in test case projects when applying LPS: Resistance to change [9], Lack of Effective LPS Training Programme [17], Negative attitude towards new systems [21], Lack of understanding of new system[18], Lack of leadership[3], Lack of stakeholder support [4], Lengthy approval procedure from client and top management [8], Poor use of information generated during implementation of LPS [10], Contracting and legal issues or structure [13], Partial or late implementation of LPS [14], Bad team work or lack of collaboration [4], Bad work ethics and cultural issues [25]. It is equally important to recognize that addressing these problems head-on will probably increase both the rate of LPS acceptance inside firms and the productivity advantage of LPS on any given project. The Last planner notion plays a crucial role in replacing idealistic planning with realistic planning by measuring employee performance in terms of their capacity to consistently deliver on promises. The Last planner aims to extract the tasks through team planning that optimizes the project's resources through reverse phase scheduling. LPS has shown significant growth in developed countries. The current challenge is putting it into practice in emerging nations like India.

3.2 Questionnaire Survey

The designed questionnaire was prepared based on the literature review and expert opinions. The questionnaires consisted of two main sections: (1) respondent profile (2) respondent's perception survey. The first section includes the questions on respondent's profile. The questionnaire survey focused on Indian construction industry and the respondents participated in the survey were from 21 Indian states, namely Madhya Pradesh, Kerala, Maharashtra, Uttar Pradesh, Tamil Nadu, Jammu and Kashmir, West Bengal, Karnataka, Telangana, Andhra Pradesh, Gujarat, Rajasthan, Jharkhand, Himachal Pradesh, Goa, Bihar, Uttarakhand, Chhattisgarh, Haryana, Punjab, Sikkim and 1 Union territory-Delhi.

The questionnaire was distributed among clients, contractors, consultants, managers and engineers across India. 47.7% of the respondents of the questionnaire were Managers or engineers, 18.1% of them were consultants, 16.8% of the respondents belongs to contractors, 10.3% of them were other construction professionals and 7.1% of the respondents were clients. The graphical representation of the respondent's job profile is shown in Fig.1.

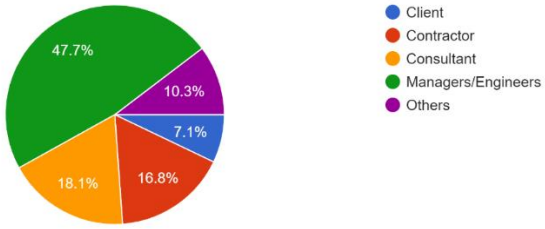

Fig.1 Respondent's job profile

The second section includes the questions on respondent's perception about various challenges that an LPS implementer or user may face. The Questionnaire contained 12 questions in section two. Each of question on the questionnaire was a 5-point Likert scale question from "strongly disagree" to "strongly agree". According to the researcher's observation and reviewed literature, the challenges fall under two categories, implementation phase and continual use phase. Also, the challenges are faced at organizational and project levels. The graphical representation of resistance to change is shown in Fig.2, in which 22.3% of the respondents strongly agrees it as an important challenge and 35.5% of them agrees with it while 13.2% of the respondents disagrees with it and 27.3% of them has a neutral opinion.

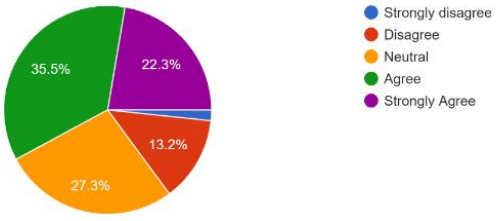

Fig.2 Graphical representation of resistance to change

The graphical representation of lack of effective LPS training programme is shown in Fig.3, in which 23.1% of the respondents strongly agrees it as an important challenge and 48.8% of them agrees with it while 8.3% of the respondents disagrees with it and 17.4% of them has a neutral opinion.

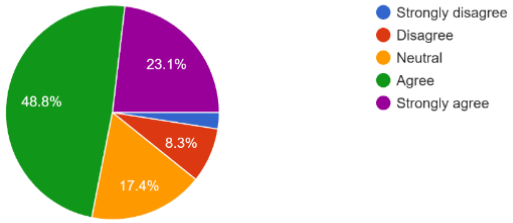

Fig.3 Graphical representation of lack of effective LPS training programme

The graphical representation of negative attitude towards new systems is shown in Fig.4, in which 24.8% of the respondents strongly agrees it as an important challenge and 33.9% of the respondants agrees with it while 14.9% of the respondents disagrees with it and 23.1% of them has a neutral opinion.

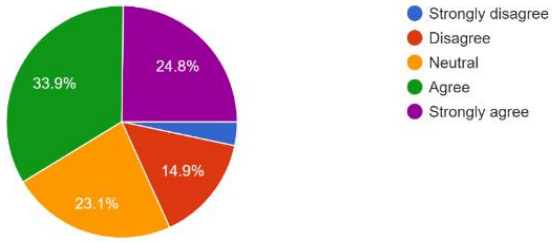

Fig.4 Graphical representation of negative attitude towards new systems

The graphical representation of lack of understanding of new system is shown in Fig.5, in which 51.2% of the respondents agrees it as an important challenge and 26.4% of them strongly agrees with it, while 14% of the respondents has a neutral opinion.

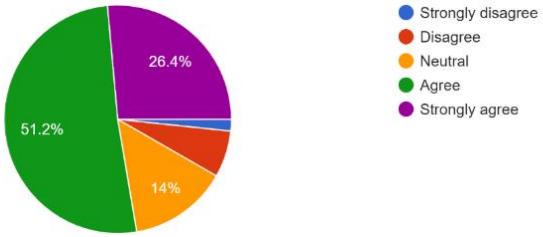

Fig.5 Graphical representation of lack of understanding of new system

The graphical representation of lack of leadership or non-supporting organizational climate is shown in Fig.6, in which 15.7 % of the respondents strongly agrees it as an important challenge and 29.8 % of them agrees with it, while 20.7 % of the respondents disagrees with it and 28.1% of the respondents has a neutral opinion.

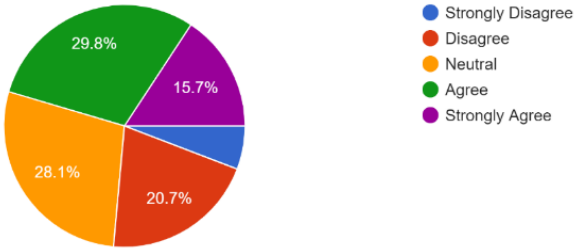

Fig.6 Graphical representation of lack of leadership or non-supporting organizational climate

The graphical representation of lack of stakeholder support is shown in Fig.7, in which 9.9% of the respondents strongly agrees it as an important challenge and 28.9 % of them agrees with it, while 26.4 % of the respondents disagrees with it and 29.8 % of the respondents has a neutral opinion.

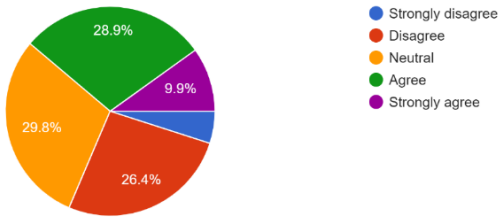

Fig.7 Graphical representation of lack of stakeholder support

The graphical representation of lengthy approval procedure from client and top management is shown in Fig.8, in which 19 % of the respondents strongly agrees it as an important challenge and 34.7 % of them agrees with it, while 23.1 % of the respondents disagrees with it and 19.8 % of the respondents has a neutral opinion.

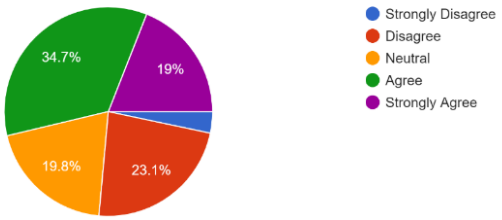

Fig.8 Graphical representation of lengthy approval procedure from client and top management

The graphical representation of poor information generated during implementation of LPS is shown in Fig.9, in which 14.9 % of the respondents strongly agrees it as an important challenge and 47.1 % of them agrees with it, while 14 % of the respondents disagrees with it and 22.3 % of the respondents has a neutral opinion.

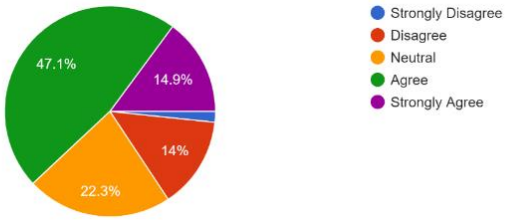

Fig.9 Graphical representation of poor information generated during implementation of LPS

The graphical representation of contracting and legal issues is shown in Fig.10, in which 9.9% of the respondents strongly agrees it as an important challenge and 27.3 % of them agrees with it, while 16.5 % of the respondents disagrees with it and 11.6% of them strongly disagrees it. But 34.7 % of the respondents has a neutral opinion.

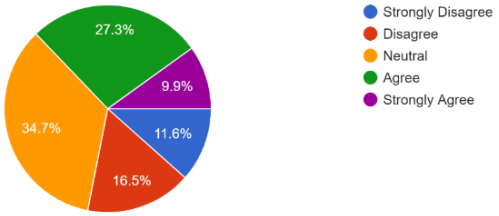

Fig.10 Graphical representation of contracting and legal issues

The graphical representation of partial or late implementation of LPS is shown in Fig.11, in which 10.7 % of the respondents strongly agrees it as an important challenge and 33.9 % of them agrees with it, while 14.9 % of the respondents disagrees with it and 15.7 % of them strongly disagrees it. But 24.8 % of the respondents has a neutral opinion.

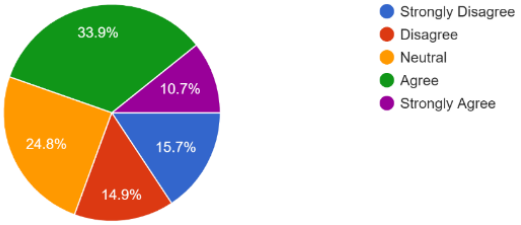

Fig.11 Graphical representation of partial or late implementation of LPS

The graphical representation of bad team work or lack of collaboration is shown in Fig.12, in which 9.9 % of the respondents strongly agrees it as an important challenge and 33.1 % of them agrees with it, while 26.4 % of the respondents disagrees with it and 9.9 % of them strongly disagrees it. But 18.2 % of the respondents has a neutral opinion.

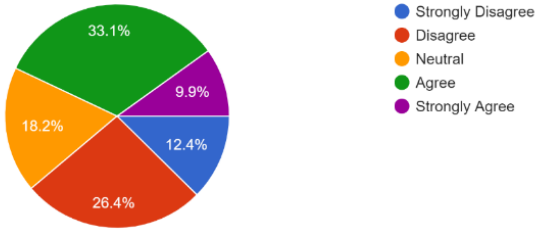

Fig.12 Graphical representation of bad team work or lack of collaboration

The graphical representation of bad work ethics and cultural issues is shown in Fig.13, in which 9.9 % of the respondents strongly agrees it as an important challenge and 26.4 % of them agrees with it, while 30.6 % of the respondents disagrees with it and 14 % of them strongly disagrees it. But 19 % of the respondents has a neutral opinion.

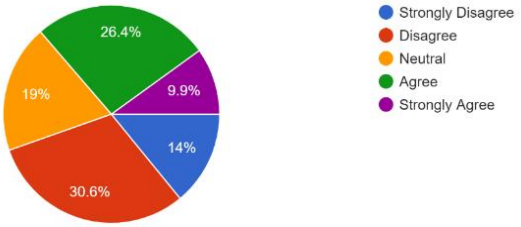

Fig.13 Graphical representation of bad work ethics and cultural issues

The data obtained from the questionnaire were subjected to reliability test to check the internal consistency of the questionnaire. To assess the internal consistency of the questionnaire, Cronbach's alpha Test for Reliability was used. Cronbach's alpha test was chosen to see if multiple-question Likert scale surveys are reliable. The questions generally measure the latent variables that are mostly hidden or are unobservable variables just like a person's conscientiousness, neurosis or openness. These are very difficult to measure in real life. The formula for measuring the Cronbach's alpha is as follows:

$$\alpha = \frac{N \cdot \bar{c}}{\bar{v} + (N-1) \cdot \bar{c}}$$

(Source: George & Mallery, 2003)

Where:

N = the number of items.
$\bar{c}$ = the average covariance between the item-pairs.
$\bar{v}$ = the average variance.

Table 1 The Cronbach's alpha and Interpretation
(Source: George & Mallery, 2015)

Sl. No	Cronbach's Alpha	Internal Reliability
1	$\alpha \geq 0.9$	Excellent
2	$\alpha \geq 0.8$	Good
3	$\alpha \geq 0.7$	Acceptable
4	$\alpha \geq 0.6$	Questionable
5	$\alpha \geq 0.5$	Poor
6	$\alpha < 0.5$	Unacceptable

Table 1 shows the rule for interpreting Cronbach's alpha for Likert scale questions. SPSS software was used to obtain the outcome of the internal consistency of the data. The range of Cronbach's alpha value is between 0 to 1, where 0 is the weakest value and 1 the strongest value. Alpha values within this range; $\alpha \geq 0.9$ excellent while $0.9 > \alpha \geq 0.8$ good. As well as $0.8 > \alpha \geq 0.7$ is acceptable but $0.7 > \alpha \geq 0.6$ is questionable. $0.6 > \alpha \geq 0.5$ is considered poor and $0.5 < \alpha$ as unacceptable.

Table 2. The Cronbach's Alpha Value Obtained

Reliability Statistics	
Cronbach's Alpha Value	0.807

Table 2 shows the obtained Cronbach's Alpha value of the questionnaire survey. In the survey, it was discovered that the alpha value was 0.807 which was good and the data is found to be trustworthy.

3.3 Analysis Using RII Method

The required information obtained from the questionnaire survey is accessed and ranked by using the Relative importance index which is a quantitative method. RII analysis allows to identify most of the important challenges based on the response of people. The Relative Important Index (RII) was used for the determination of the rank between various challenges for the adoption of Last Planner System in the construction industry and to prioritize them. The values between 0.5 to 1 is considered as the range of RII. Higher the value, it indicates the most important challenge. The five-point Likert Scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree) was adopted and transformed to the relative importance index (RII) for each variable. The obtained data is mathematically added up and ranked using this general RII formula. The ranking of challenges based on RII method is shown in Table 3. The graphical representation of the challenges and RII is shown in Fig.14. An equation expressed below was used to determine the value of RII for each variable.

$$RII = \frac{\sum w}{(A \times N)} = \frac{5n_5 + 4n_4 + 3n_3 + 2n_2 + 1n_1}{5 \times n}$$ (Source: Tam and Le, 2006)

Where:
W= Weight allotted to each challenge (by response to questionnaire survey)
A= Highest weight
N= Total number of people (responses) who completed the questionnaire survey (who are aware about Last Planner System)

Fig.14 Graphical representation of Challenges and RII

Table 3 Ranking of challenges

Challenges	∑w	A*N	RII	Rank
Resistance to change	429	605	0.709	3
Lack of Effective LPS Training Programme	452	605	0.747	2
Negative Attitude towards new systems	427	605	0.705	4
Lack of Understanding of new system	465	605	0.766	1
Lack of Leadership or Non-Supportive Organizational Climate	387	605	0.639	7
Lack of stakeholder support	368	605	0.608	8
Lengthy approval procedure from client and top management	405	605	0.669	6
Poor use of information generated during implementation of LPS	426	605	0.704	5
Contracting and legal issues	362	605	0.598	10
Partial or late implementation of LPS.	364	605	0.601	9
Bad team work or lack of collaboration	358	605	0.591	11
Bad work ethics and cultural issues	340	605	0.561	12

The challenges were ranked based on RII method and the highest value obtained was 0.766 that is the lack of Understanding of new system.

IV. CONCLUSION AND DISCUSSION

LPS is one of the approaches of lean construction. In recent years, many projects have increasingly used LPS in the field of building construction. However, project managers still struggle with figuring out how the LPS could be applied on their specific projects. The literature review reveals that Resistance to change, Lack of Effective LPS Training programme, Negative attitude towards new systems, Lack of understanding of new system, Lack of leadership, Lack of stakeholder support, Lengthy approval procedure from client and top management, Poor use of information generated during implementation of LPS, Contracting and legal issues or structure, Partial or late implementation of LPS, Bad team work or lack of collaboration, Bad work ethics and cultural issues are major the challenges for the adoption of Last Planner System in the Indian construction industry. While LPS is a widely utilized material worldwide, it remains unfamiliar to numerous professionals in the construction industry.

In this study, questionnaire survey was conducted among clients, contractors, consultants, managers, engineers and other construction professionals from 21 Indian states to identify the major challenge for the adoption of Last Planner System in construction projects. The challenges were ranked based on RII method and the highest value obtained was 0.766 that is the lack of Understanding of new system and the least value obtained was 0.561 which is bad work ethics and cultural issues. The establishment and execution of LPS implementation strategies, along with comprehensive training, are crucial milestones for effectively implementing and utilizing LPS within organizations and projects. Good leadership as well as management commitment to the implementation are also very important for bringing needed changes for positive results and continuous improvement in LPS. Future research should use these findings to assess the challenges faced by construction professionals in India during implementation and use of LPS and to propose guidelines to address these issues.

V. ACKNOWLEDGMENT

We would like to express our deepest gratitude to all those who have contributed to the completion of this research paper.

REFERENCES

[1] Aarrestad Marie E., Bohne Rolf A., Lohne Jardar and Nesteby Åse I., (2016). Integration of BREEAM-NOR in Construction Projects: Utilizing the Last Planner System, Energy Procedia, 96(5):100–111.

[2] Abbott Sidney Leslie Ernest, Chua Huat Kim David, Heigermoser Daniel and Soto de García Borja (2019), BIM-based Last Planner System tool for improving construction project Management, Automation in Construction, (104) 246–254.

[3] Alarcón Luis Fernando, Herrera Rodrigo Fernando and Lagos Camilo Ignacio (2019), Assessing the Impacts of an IT LPS Support System on Schedule Accomplishment in Construction Projects, Journal of Construction Engineering and Management, 145(10): 04019055.

[4] Ali Ezzeddine, Farook Hamzeh, Gunnar Lucko and Lynn Shehab (2022), Forecasting Construction Project Performance with Momentum Using Singularity Functions in LPS, Journal of Construction Engineering and Management,148(8): 1943-7862.

[5] Ariovaldo Denis Granja, Hylton Olivieri, Min Liu, Natalie M. Scala, Olli Seppänen, Thais da C. L. Alves and Vincent Schiavone, (2019), Survey Comparing Critical Path Method, Last Planner System, and Location-Based Techniques, Journal of Construction Engineering and Management, 145(12):1943-7862.

[6] Ballard Glenn, Gross Allan, Hasse H. Neve, Lerche Jon, Teizer Jochen and Wandahl Søren, (2020), Application of Last Planner System to Modular Offshore Wind Construction, Journal of Construction Engineering and Management. 146(11): 1943-7862.

[7] Brenda Y. McCabe and Luai M. El-Sabek, (2018) Framework for Managing Integration Challenges of Last Planner System in IMPs, Journal of Construction Engineering and Management. 144(5): 0733-93.

[8] Brioso Xavier, Calampa, Sarah and Humero Antonio, (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: 12-19.

[9] Camilo Lagos, Daniel Pérez, and Luis Fernando Alarcón (2022), Key Last Planner System Metrics to Assess Project Performance in High-Rise Building and Industrial Construction Projects, Journal of Construction Engineering and Management. 148(1): 0733-9364.

[10] Campestrini T.F, Garrido M.C., Mendes R. Jr., and Scheer S., (2015), Using BIM for Last Planner System: Case Studies in Brazil, Computing in Civil Engineering. 101: 604-611.

[11] Castillo Tito, Alarcón Luis F., Salvatierra and José Luis (2018), Effects of Last Planner System Practices on Social Networks and the Performance of Construction Projects, J. Constr. Eng. Manage. 144(3): 1943-7862.

[12] Christine Pasquire, Emmanuel Itodo Daniel and Graham Dickens, (2019), Development of Approach to Support Construction Stakeholders in Implementation of the Last Planner System, J. Manage. Eng., 35(5): 1943-5479.

[13] Conrad Boton, Daniel Forgues, Ivanka Iordanova and Yaya Pitti (2021), Investigating the challenges related to combining BIM and Last Planner System on construction sites, Frontiers of Engineering Management, 8:172–182.

[14] Du Jing, Fernández-Solís José L., Lavy Sarel and Rincón Jorge L. (2019), Effect of Autonomous Agents on Last Planner System Performance in Texas, Journal of Management in Engineering, 35(1): 04018050.

[15] Eyad Aboseif and Rana Khallaf, (2019), A Framework for Last Planner System Implementation in Egypt CIGOS 2019, Innovation for Sustainable Infrastructure, Lecture Notes in Civil Engineering, 54: pp 1019–1024.

[16] Farook R. Hamzeh, Ghali El Samad and Samir Emdanat, (2019) Advanced Metrics for Construction Planning, Constr. Eng. Manage., 145(11): 1943-7862.

[17] Gao S. and Low S.P., (2014), The Last Planner System in China's construction industry — A SWOT analysis on implementation, Int. J. Proj. Manag.,32(7): 1260-1272.

[18] Ha Duy Khanh and Soo Yong Kim, (2015), A Survey on Production Planning System in Construction Projects Based on Last Planner System, KSCE Journal of Civil Engineering (0000) 00(0):1-11.

[19] Howell Gregory, Hsiang Simon M., Liu Min and Russell Marion M. (2015), Case Studies of the Allocation and Reduction of Time Buffer through Use of the Last Planner System, Journal of Construction Engineering and Management, 141(2), 04014068.

[20] Hsiang Simon M., Liu Min and Wambeke Brad W., (2012), Using Last Planner and a Risk Assessment Matrix to Reduce Variation in Mechanical Related Construction Tasks, Journal of Construction Engineering and Management, 138(4): 491–498.

[21] Mughees Aslam and Zhili Gao (2020) Development of Innovative Integrated Last Planner System (ILPS), International Journal of Civil Engineering, 18: 701–715.

[22] Nieto-Morote A. and Ruz-Vila F., (2012), Last Planner Control System Applied to a Chemical Plant Construction, Journal of Construction Engineering and Management, 138(2): 287–293.

[23] Noueihed Karim, Pourrahimian Elyar, Salhab Diana and Shehab Lynn (2022), Machine Learning Framework to Predict Last Panner System Performance Metrics, Construction Research Congress 2022.

[24] Priven Vitaliy and Sacks Rafael (2015), Effect of the Last Planner System on Social Networks among Construction Trade Crews, Journal of Construction Engineering and Management,141(6):04015006.

[25] Priven Vitaliy and Sacks Rafael. 2016. Impacts of the Social Subcontract and Last Planner System Interventions on the Trade-Crew Workflows of Multistory Residential Construction Projects. Journal of Construction Engineering and Management,142(7): 04016013.