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EVALUATION OF LEAN CONSTRUCTION AND PROJECT PERFORMANCE USING RII: A CASE STUDY OF KHUDI SUBSTATION, NEPAL

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ABSTRACT

This research evaluates the application of lean construction methods and their effect on project outcomes in the Khudi Substation project placed in Nepal. A mixed-methods approach was used, incorporating questionnaire surveys, interviews, and site remarks. Data were gathered from 25 professionals in building and evaluated using the Relative Importance Index (RII) to prioritize major factors influencing performance. Findings indicate that ineffective planning (RII = 0.75), interruptions in material supply (RII = 0.82), and geographical challenges (RII = 0.88) are the most critical elements leading to delays and inefficiencies. The research points out a lack of awareness and implementation of lean practices within Nepal's infrastructure sector. It suggests the need for better planning systems, improved supply chain management, and focused training initiatives to align lean theory with practical application.

KEYWORDS: *Lean Construction, Project Performance, RII, Construction Delays, Nepal, Infrastructure Projects.*

1. INTRODUCTION

The construction sector is vital for economic expansion but often encounters inefficiencies like delays, overruns in costs, and store wastage. Lean construction, which is based on the values of lean manufacturing, seeks to decrease waste and improve value by civilizing workflow and coordination. Although it has demonstrated benefits, the uptake of lean construction remains limited in developing nations such as Nepal. Infrastructure projects, particularly those situated in difficult terrains, encounter extra challenges including poor

convenience, disruptions in material supply, and a deficiency of skilled labor. The Khudi Substation project exemplify a circumstances where these obstacles very much influence project performance. This research intends to assess the level of lean construction application and its effect on project outcomes by means of the Relative Importance Index (RII) method.

2. LITERATURE REVIEW

Previous research has shown that lean construction improves project efficiency by minimizing waste and enhancing coordination. Koskela (2002) focused on the transformation-flow-value theory, while Ballard and Howell (1998) developed the Last Planner System to improve workflow dependability.

The principles of lean construction involve value identification, continuous flow, pull systems, and ongoing improvement. Various tools, including Just-in-Time (JIT), 5S, Value Stream Mapping (VSM), and Building Information Modeling (BIM), aid in effective implementation.

However, most investigate has taken place in residential countries. investigation in developing regions make known challenges like be short of of responsiveness, limited training opportunities, and inadequate infrastructure. Studies conducted by Salem et al. (2006) and Watfa&Sawalha (2021) pointed out that planning inefficiencies and weak coordination are significant obstacles.

There is a distinct research gap in grasping lean implementation in infrastructure projects in developing contexts.

3. RESEARCH GAP

Existing studies highlight the benefits of lean construction in improving project performance; however, most are conducted in developed or controlled environments. There is limited research on its practical implementation in developing countries like Nepal, especially in infrastructure projects with challenging geographical conditions, creating a gap between theory and real-world application.

a) Lack of practical studies on lean implementation in real infrastructure projects.
b) Limited research addressing geographical challenges such as hilly terrain, landslides, and poor accessibility.
c) Gap between theoretical benefits of lean construction and its actual application in real project environments.

4. OBJECTIVES OF THE STUDY

a) To evaluate the impact of lean construction practices on project performance.
b) To identify major causes of delays and inefficiencies in construction activities.
c) To analyse the effect of geographical conditions on project execution and lean implementation.

5. RESEARCH METHODOLOGY

5.1 Research Design

Descriptive case study design with mixed-method approach combining qualitative observations and quantitative analysis to evaluate lean construction implementation and performance.

5.2 Data Collection

Data collected from primary and secondary sources including questionnaires, interviews, site observations, journals, reports, and project documents for comprehensive analysis.

5.3 Sample Size and Sampling Technique

A total of 25 respondents, including engineers and supervisors, were selected using purposive sampling based on their experience and involvement in the project.

5.4 Data Analysis Method

Data analysed using Relative significance Index (RII) method to rank factors influencing lean construction implementation, project presentation, delays, and overall efficiency.

6. DATA ANALYSIS AND RESULTS

Table 1: RII Ranking of Factors Affecting Project Performance.

S.N.	Factor	RII Value	Rank
1	Geographical Challenges	0.88	1
2	Material Supply Delays	0.82	2
3	Poor Planning	0.75	3
4	Lack of Training	0.72	4
5	Weak Coordination	0.70	5

The findings show that the biggest factor influencing project performance is geographical challenges. The second most important factor is material supply disruptions, which are mostly caused by landslides and transportation problems. Lean implementation is challenging due to geographical issues that have a substantial impact on workflow and

resource availability. Efficiency is further diminished by poor stakeholder coordination.

7. DISCUSSION

The findings are consistent with previous studies that highlight planning inefficiencies and supply chain issues as major contributors to project delays. However, this study uniquely emphasizes the role of geographical challenges in Nepal.

Unlike developed countries where lean tools are effectively implemented, the Khudi Substation project shows minimal adoption due to lack of awareness and training. This confirms the gap between theory and practice.

8. KEY FINDINGS

a) Lean construction adoption in the Khudi Substation project is minimal due to limited awareness and lack of training.
b) Poor planning and weak workflow management significantly contribute to project inefficiencies.
c) Major delays are caused by material supply disruptions, especially due to landslides and road access issues.
d) Geographical challenges are the most critical barrier affecting implementation of lean practices.
e) Lack of stakeholder coordination and delayed labor payments further impact project performance.
f) Overall, a gap exists between lean theory and its practical application in challenging project environments.

9. IMPLICATIONS OF THE STUDY

a) Highlights the need for practical adaptation of lean construction in geographically challenging environments like Nepal.
b) Emphasizes importance of proper planning, workflow management, and coordination to improve project performance.
c) Suggests strengthening supply chain systems to reduce delays caused by material disruptions.
d) Indicates necessity of training and awareness programs for effective lean implementation.
e) Provides insights for policymakers to develop strategies supporting infrastructure efficiency in developing countries.

10. LIMITATIONS OF THE STUDY

a) The study is based on a single case project, limiting generalizability to other projects or regions.
b) Small sample size (25 respondents) may not fully represent all stakeholder perspectives.
c) Geographical constraints restricted extensive data collection and site access.
d) Reliance on self-reported data may introduce bias in responses.
e) Limited time and resources affected the depth of analysis and scope of findings.

11. CONCLUSION

The study concludes that lean construction has strong potential to improve project performance by reducing waste and enhancing efficiency. However, its implementation in the Khudi Substation project is limited due to poor planning, weak coordination, and challenging geographical conditions. Material delays and workflow inefficiencies significantly affect outcomes. Bridging the gap between theory and practice requires improved training, better supply chain management, and context-specific strategies to successfully implement lean construction in developing countries like Nepal.

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