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PRINCIPLES OF LEAN CONSTRUCTION MANAGEMENT ISSUES WITH IMPLEMENTATION

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Abstract

The application of lean thinking in the construction industry is beginning to provide potential benefits, as it has revolutionized several industries. Applying lean thinking to the construction sector is the focus of the lean construction concept. Lean construction, for example, is said to be one approach that can potentially lower construction process costs. The only method that allows for simultaneous, trade-off-free increases in time, money, and quality is the lean approach. Delivering exactly what the customer and end user desire is the main goal of lean construction. The goal of this research is to use a quantitative analysis to investigate the challenges related to lean construction implementation. To gather information from lean practitioners around the nation, a questionnaire was created. The variables were prioritized using the Analytic Hierarchy Process after the acquired data were statistically examined. The quantitative investigation yielded results that highlighted the main challenges in implementing lean, namely a lack of support from upper management, a lack of engagement among project stakeholders, and a reluctance to adopt the new strategy. In the Kerala construction setting, which is still in the beginning phases of the advancement of lean construction, the application possibility of not set in stone to be poor.

Keywords: *Principles, Lean Construction Management, Issues Implementation.*

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1. INTRODUCTION

Kerala, a rising Indian city, struggles in its construction industry with a lack of risk data and tardy adoption of contemporary methods to reduce risk variables' impact on project goals. An emerging idea for managing construction output is lean construction. It initiates productive flows to design control systems to reduce process losses. Lean construction, based on the Toyota Production System (TPS), reduces waste. Production, time, transportation, processing, stock, movement, and defective goods are TPS wastes.

Lean construction is a production management strategy that eliminates time and resource waste to improve a contractor's entire business process and deliver a better product or service to customers. Stream change exercises in lean construction see the task as a progression of client esteem producing exercises. Koskela and Thomas et al. characterize lean construction as in the nick of time, pull-driven booking, work efficiency changeability decrease, stream unwavering quality improvement, squander end, activity rearrangements, and benchmarking.

Ballard proposed the Last Organizer Framework (LPS) in light of lean creation to lessen framework squander through task level preparation or broad look-ahead planning. Ballard and Howell's last organizer procedure concentrates on show that consistent creation requires formal and adaptable creation arranging. Everyday creation plans, imperative investigation, look-ahead, and PPC might be executed quickly on any place of work. LPS, created by Ballard and Howell to carry lean ideas to construction, is generally utilized. LPS arrangements implementation to make a productive timetable arranging structure by pulling work process, grouping, and rate, matching work process and limit, building work execution methods, and expanding exchange correspondence. It is a little piece of undeniable level programming with meticulousness and no quality control tasks.

The LPS look-ahead approach has different aims:

- Organize and pace work process.
- Adjust work process and limit.
- Partition ace timetable errands into work bundles and activities.

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- Formulate exact work fruition systems.
- Keep a work overabundance with prepared errands.

LPS further develops WWP tasks when matched with the look-ahead cycle to begin and control work process. WWP proactively secures assets, utilizes plan data, and screens past work or necessities to administer stream and get ready tasks.

1.1.Principles of Lean Construction Management

The goal of lean construction management principles is to maximize value while reducing waste during the building process. Important ideas consist of:

1. Determining Value: Clearly stating what benefits the client in the first place.
2. Mapping the Value Stream: Determining and refining the order in which value-delivering activities occur.
3. Creating Flow: Making sure that work moves along smoothly and continuously without hiccups or delays.
4. Establishing Pull: To prevent waste and overproduction, production should be in line with real demand.
5. Aiming for Perfection: Improving procedures on a constant basis to raise standards for effectiveness, quality, and client pleasure.

1.2.Objectives of the Study

- To research the application of lean construction in Kerala, with an emphasis on the obstacles and enablers.
- To use AHP to identify and priorities the main obstacles to effective Lean processes.
- To make suggestions on how to improve Lean adoption in Indian construction and get beyond obstacles to its implementation.

2. LITERATURE REVIEW

Barros Neto (2007) highlighted production strategy and the need to define strategic goals before implementing Lean Production/Construction in construction organisations. Two key causes drove this investigation. First, even at IGLC conferences, few construction management papers address

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strategic issues and Lean. The second is that construction businesses seem to have implemented Lean operationally using simple tools and principles without tying them to strategic goals. Like other performance-improvement projects, Lean implementation may fail without strategic guidance. This study employed literature review, field research, and interviews with construction company managers and specialists. The authors studied Lean-implemented construction enterprises to find evidence that operational activity leads to strategic planning. The article finishes with cross-analysis of instances and interviews and recommendations to ensure construction businesses properly address Lean and strategic concerns.

Torp (2018) implemented lean in a Norwegian contractor company. The contractor has multiple sister-companies acquired over 40 years. Some sister-companies have implemented lean well, while others have not. The writers will assess how the organisation planned and implemented lean efficiently and sustainably and what factors affected it. The sister-companies are the cases in the case study research approach. Lean implementation case study research will help with comparable scenarios. It will also discuss ways to overcome implementation issues in comparable scenarios. Lean methodology has been proved to benefit organisations. However, integrating new principles like Lean Construction always presents obstacles. Examples include lack of basic knowledge about lean theory/philosophy, unwillingness to change, organisational implementation process, lack of defined objectives/visions, and top management engagement.

Akanbi (2019) expressed Lean creation ideas for construction depend on the change (T), stream (F), and worth age (V) hypothesis of creation management. Three creation perspectives incorporate change (assets, gear, staff), materials stream, and client centre, as per the TFV hypothesis. After the typical undertaking management method fizzled, lean construction further developed management and task yields. The developing thought of lean construction applies lean reasoning to construction. In the UK construction business, lean thinking seems to focus on quality and efficiency.

Ahmed (2020) recognised and prioritised lean construction implementation issues in Bangladesh. The global obstacles of lean construction were shortened by a comprehensive literature analysis. These issues were then incorporated into a survey form. Bangladeshi construction workers in

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various organisations provided 164 valid responses. Results were analysed using RAI and Mann–Whitney U test. The study found 41 lean building implementation issues in Bangladesh. The biggest challenges are lack of lean construction awareness, skills, training, and techniques, unwillingness to change the culture, management commitment, fragmented and cyclic construction project, and poor communication between project participants. The report also offers universal remedies to these issues.

Madanayake, U. H. (2015) examined Lean Construction applications and their barriers. To answer the research issue, qualitative methodologies were used. This paper presents an exploratory study from extensive literature, mostly based on a case study of a project management organisation. A conceptual framework was used to strengthen the arguments about lean construction's role in sustainable construction. The insights would assist stakeholders use lean theories. Lean thinking is now a radical concept that has spread beyond industry. Lean thinking optimises work flow and outcomes for sustainable building. Accordingly, applying lean theories and principles to construction can enhance work quality, function effectiveness, cost components/waste, and strategic and operational profit. Lean methodologies appear to have greatly reduced project management costs. Contrarily, few lean implementation impediments exist.

Kim (2006) evaluated entire project lean construction implementation. Case studies examined the linkages between lean planning systems, organisation structure, project participant attitudes, and company strategy that affected lean implementation. Since Lean Construction was presented as another management way to deal with further develop construction efficiency, much exploration is in progress to foster lean ideas and principles for better implementation and to assess the effective variation of lean thoughts from assembling for construction. A few US construction organizations are executing lean construction in order to further develop project results. Involving lean principles and cycles in building projects and on genuine construction locales is troublesome. Subsequently, there are requests to share information on how different associations apply lean construction, distinguish its advantages and disadvantages in construction, and upgrade its implementation.

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3. RESEARCH METHODOLOGY

3.1.Sample size

Out of the 150 participants in the research sample, the following roles were represented: 46% were Construction Managers (69 participants), 43% were Engineers (64 participants), 8% were Project Managers (12 participants), and 3% were Lean Consultants (5 people). In terms of experience levels, the following groups of participants made up 29% (44), 26% (39), 30% (45), and 15% (22), respectively, with less than three, five, and ten years of experience. The purpose of this distribution was to offer a thorough and accurate picture of the diversity of the workers in the business.

3.2.Data Collection

This study collects data using structured questionnaires and interviews. The questionnaires analyses Construction Managers and Engineers' demographics, experience, and planning methodologies including Critical Path Method (CPM) and Work Breakdown Structure (WBS). They also examine Lean construction benefits and implementation problems, including managerial support and stakeholder participation. Structured interviews supplement quantitative data by studying qualitative factors affecting Lean adoption in Kerala construction. These tools aim to explain Lean methods' existing dynamics and potential for improvement in the local construction sector.

3.3.Data Analysis

Microsoft Excel and SPSS were used for the statistical analysis of the gathered data. In the first place, involving recurrence dispersion examination in SPSS, the General Significance List (RII) was processed utilizing the strategy

$$RII = \frac{\sum W}{A * N}$$

where $\sum W$ denotes the weightings assigned by the respondents, A the highest weighting response integer, and the total number of respondents.

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3.4.Analytic Hierarchy Process (AHP)

The basis for deciding the weights in the Analytic Hierarchy Process (AHP) was the RII values. To determine the relative relevance of each variable, pairwise comparisons were conducted using Saaty's scale, which ranges from 1 to 9. A matrix containing these comparisons was created, and it was normalized by dividing each member by the total of its column elements. The AHP weights for the corresponding variables were obtained by adding the elements in each row of the normalized matrix.

4. DATA ANALYSIS

Study participants are categorized in the table based on their roles and levels of experience. Project managers make up 8%, engineers make up 43%, construction managers make up 46%, and lean consultants make up 3%. In terms of experience, 29% have less than three years, 26% have three to five years, 30% have five to ten years, and 15% have ten years or more. By using this distribution, a representative and varied sample of important roles and experience levels across the industry is guaranteed.

Table 1: Demographic Profile

Categories	Sub- Categories	Percentage (%)
Role	Construction Managers	46%
	Engineers	43%
	Project Managers	8%
	Lean Consultants	3%
Experience (Years)	Less than 3 years	29%
	3 - 5 years	26%
	5 - 10 years	30%
	More than 10years	15%

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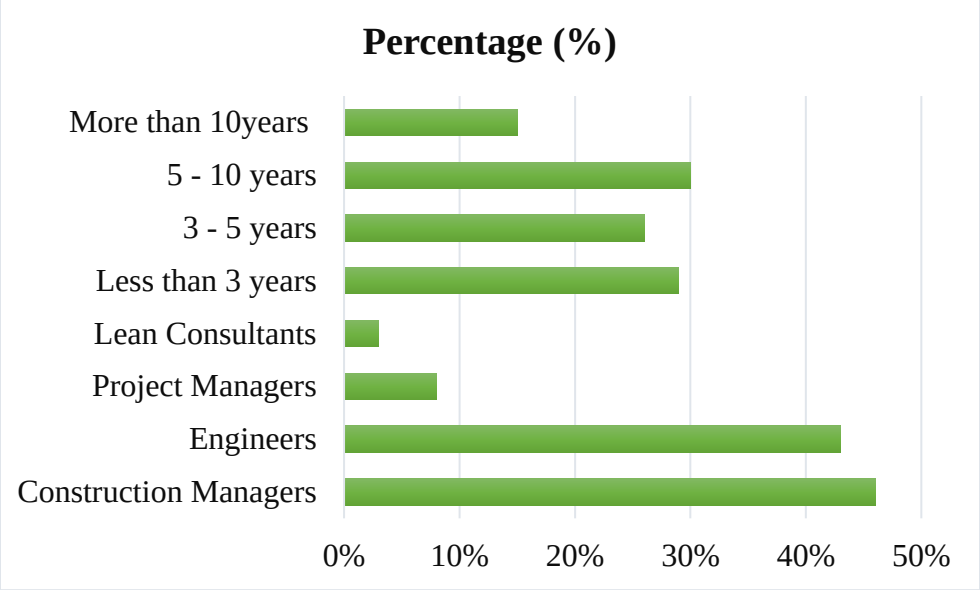

Figure 1: Demographic Profile

4.1.Choice of planning methods

A construction project's planning method selection is crucial since it determines how well the project will be executed. The most popular approaches for planning in different organisations are the Critical Path Method (CPM) (0.355), Work Breakdown Structure (WBS) (0.239), and Daily Progress Reports (0.147) (Table 2). The use of WBS and CPM demonstrates how reluctant experts are to adopt new techniques and abandon outdated ones.

Table 2 presents a comparative analysis of the relative significance and efficacy of different project management planning techniques. The techniques are evaluated in relation to several categories, including Work Breakdown Structure (WBS), Critical Path Method (CPM), Look-ahead Plans, Weekly Plans, Daily Progress Reports, Productivity Measurement, Constraint Analysis, and Allocation of Work Weight. The impact of each planning technique differs in these categories, highlighting its unique advantages and contributions to project management and planning. Project managers may make well-informed judgements to optimise planning processes and guarantee

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project success by using this category to determine which strategies have a greater impact on particular areas of project execution.

Table 2: Normalized criteria comparison matrix of planning methods

Planning methods	**WBS**	**CPM**	**Look forward plans**	**Week after week designs**	**Day to day progress reports**	**Efficiency estimations**	**Requirement examination**	**AHP weight $**
WBS	0.223	0.195	0.272	0.231	0.252	0.2678	0.224	0.239
CPM	0.450	0.384	0.335	0.274	0.388	0.359	0.260	0.355
Look forward plans	0.054	0.079	0.065	0.142	0.062	0.043	0.072	0.073
Week after week designs	0.043	0.067	0.020	0.045	0.041	0.029	0.072	0.045
Day to day progress reports	0.110	0.130	0.133	0.142	0.135	0.178	0.187	0.147
Efficiency estimations	0.073	0.098	0.134	0.142	0.064	0.092	0.150	0.105
Requirement examination	0.035	0.058	0.032	0.022	0.023	0.020	0.035	0.032

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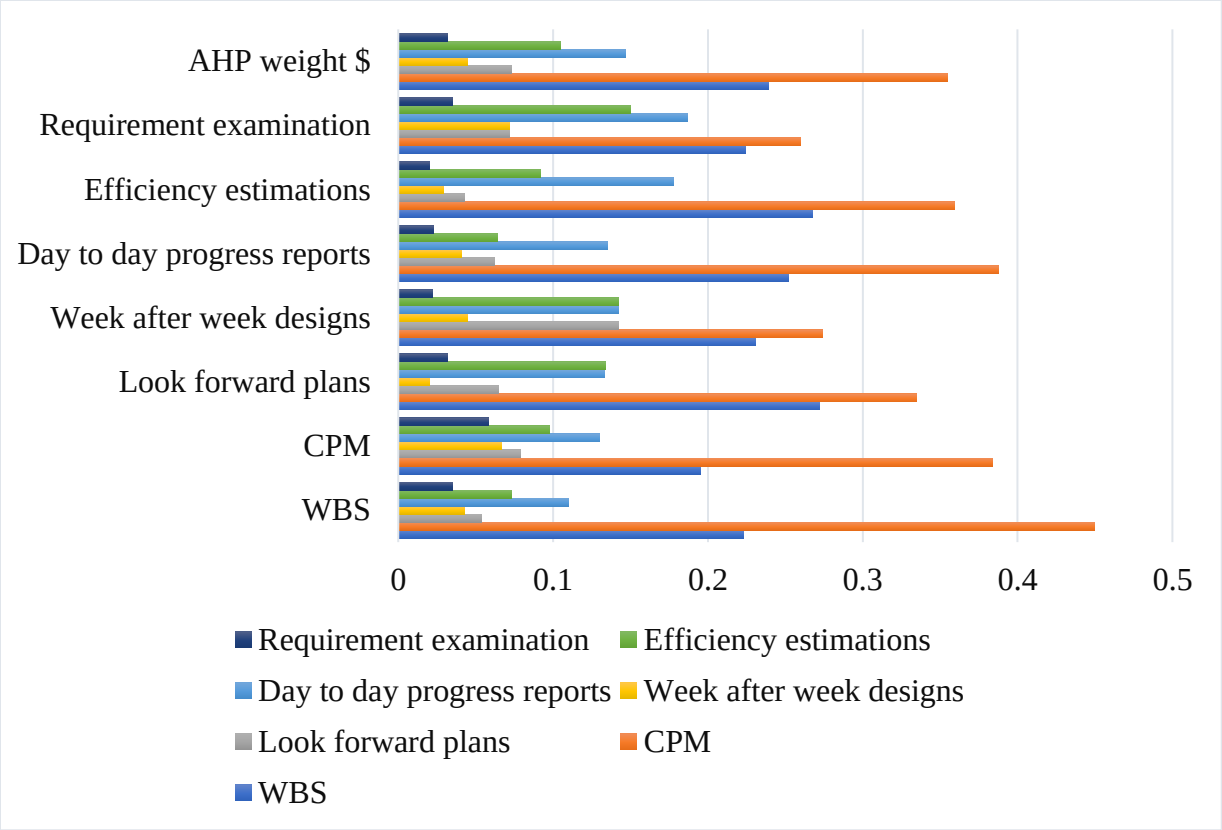

Figure 2: Normalized criteria comparison matrix of planning methods

4.2.Benefits of lean construction

The respondents stated that the three biggest advantages of lean construction are cycle time reduction (0.335), waste, defect, and rework reduction (0.235), and employee culture development (0.140) (Table 3). Collaborative planning, a feature of lean technologies like the Last Planner System (LPS), is responsible for advantages including a sharper emphasis on client requirements and early problem detection. Because using lean construction tools requires an initial investment and would preclude better returns even in the case of increased productivity and efficiency, the respondents do not view the benefit of higher profits as popular as others.

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sssssssssTable 3: Standardized criteria in a lean benefits comparison matrix

Lean construction benefits	**Diminishes process duration**	**Makes a culture among the represent-atives**	**Higher benefits**	**Decrease in waste, abandons and revise**	**Expanded centre around client necessities**	**Distinguishing proof of early issues**	**Oversees clashes**	**AHP weights**
Diminishes process duration	0.364	0.393	0.225	0.440	0.359	0.318	0.235	0.335
Makes a culture among the representatives	0.120	0.133	0.134	0.107	0.178	0.160	0.142	0.140
Higher benefits	0.075	0.045	0.043	0.046	0.028	0.028	0.025	0.039
Decrease in waste, abandons and revise	0.182	0.259	0.225	0.217	0.269	0.239	0.235	0.235
Expanded centre around client necessities	0.089	0.063	0.134	0.070	0.092	0.160	0.188	0.116
Distinguishing proof of early issues	0.089	0.062	0.134	0.070	0.047	0.080	0.138	0.088
Oversees clashes	0.075	0.045	0.089	0.042	0.025	0.028	0.045	0.052
Consistency Ratio (CR)								**0.043**

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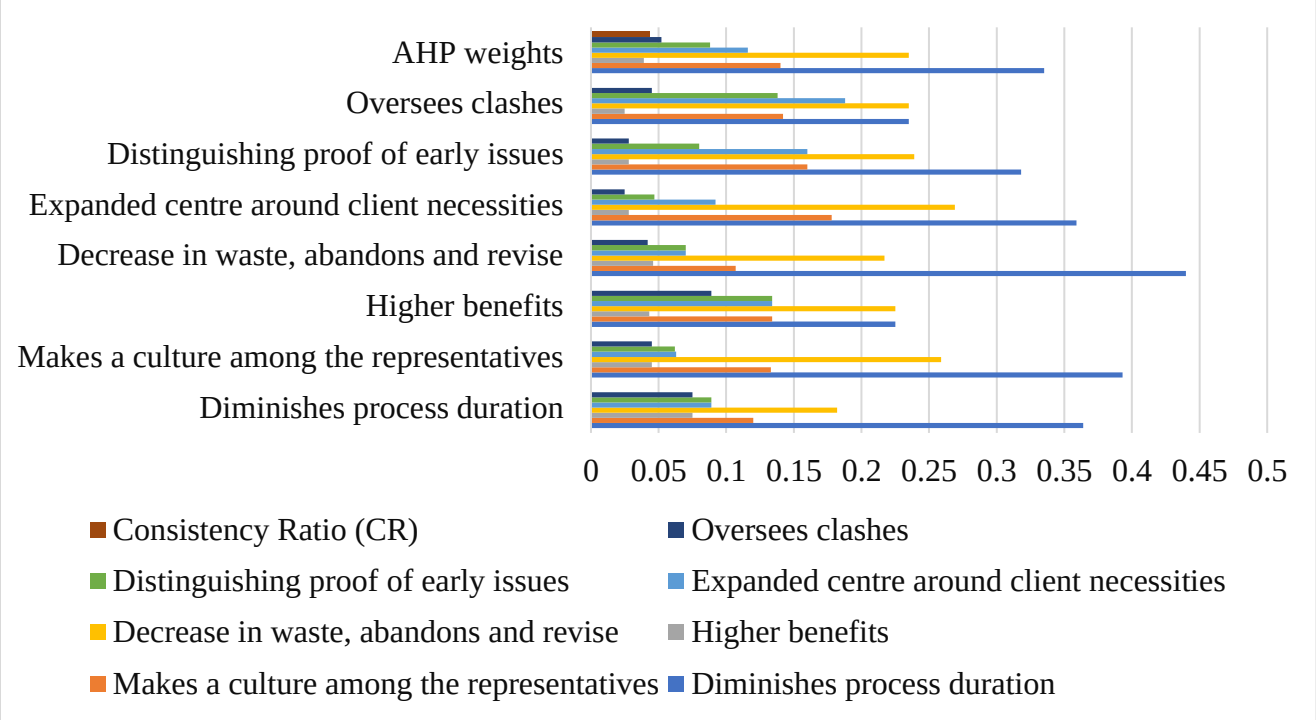

Figure 3: Standardized criteria in a lean benefits comparison matrix

A pairwise comparison matrix addressing the challenges of implementing Lean tools in an organizational setting is displayed in the table 4. As determined by experts or stakeholders, each cell in the matrix represents the relative severity or importance of a particular issue in relation to another. Important discoveries include noteworthy difficulties like "Lack of top management support," which stands out as the most important problem overall with a weight of 0.416 when compared to other issues. The following two points, which indicate differing degrees of perceived impact across various difficulties, are "Lack of collaboration from all stakeholders" at 0.210 and "Indifference among the labor force regarding Lean" at 0.072. The pairwise comparisons conducted during the evaluation showed a respectable degree of consistency, as indicated by the Consistency Ratio (CR) of 0.22, which suggests that the generated weights were reliable. These insights highlight the necessity of mitigating resistance and improving employee understanding and training regarding Lean principles and tools, as well as the significance of addressing managerial buy-in and stakeholder collaboration as the main focus areas for successful Lean implementation.

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Table 4: A comparison matrix of normalized criteria for implementation concerns

Lean devices implementation issues	**Absence of joint effort from every one of the partners**	**Absence of top administration support**	**Detachment among the works in regards to lean**	**Absence of information about lean principles/ devices**	**Hesitant inclination to follow the new technique**	**Absence of preparing to workers**	**Intricacy of the apparatus**	**Consistency Ratio (CR)**
Absence of joint effort from every one of the partners	0.210	0.182	0.236	0.215	0.257	0.240	0.215	0.220
Absence of top administration support	0.416	0.360	0.310	0.319	0.385	0.301	0.259	0.335
Detachment among the works in regards to lean	0.072	0.092	0.080	0.056	0.062	0.119	0.130	0.085
Absence of information about lean principles/devices	0.107	0.122	0.160	0.109	0.066	0.123	0.132	0.117
Hesitant inclination to follow the new technique	0.107	0.122	0.158	0.212	0.130	0.123	0.132	0.140
Absence of preparing to workers	0.050	0.070	0.040	0.056	0.066	0.063	0.085	0.059
Intricacy of the apparatus	0.040	0.062	0.028	0.038	0.045	0.032	0.045	0.042
Consistency Ratio (CR)								**0.22**

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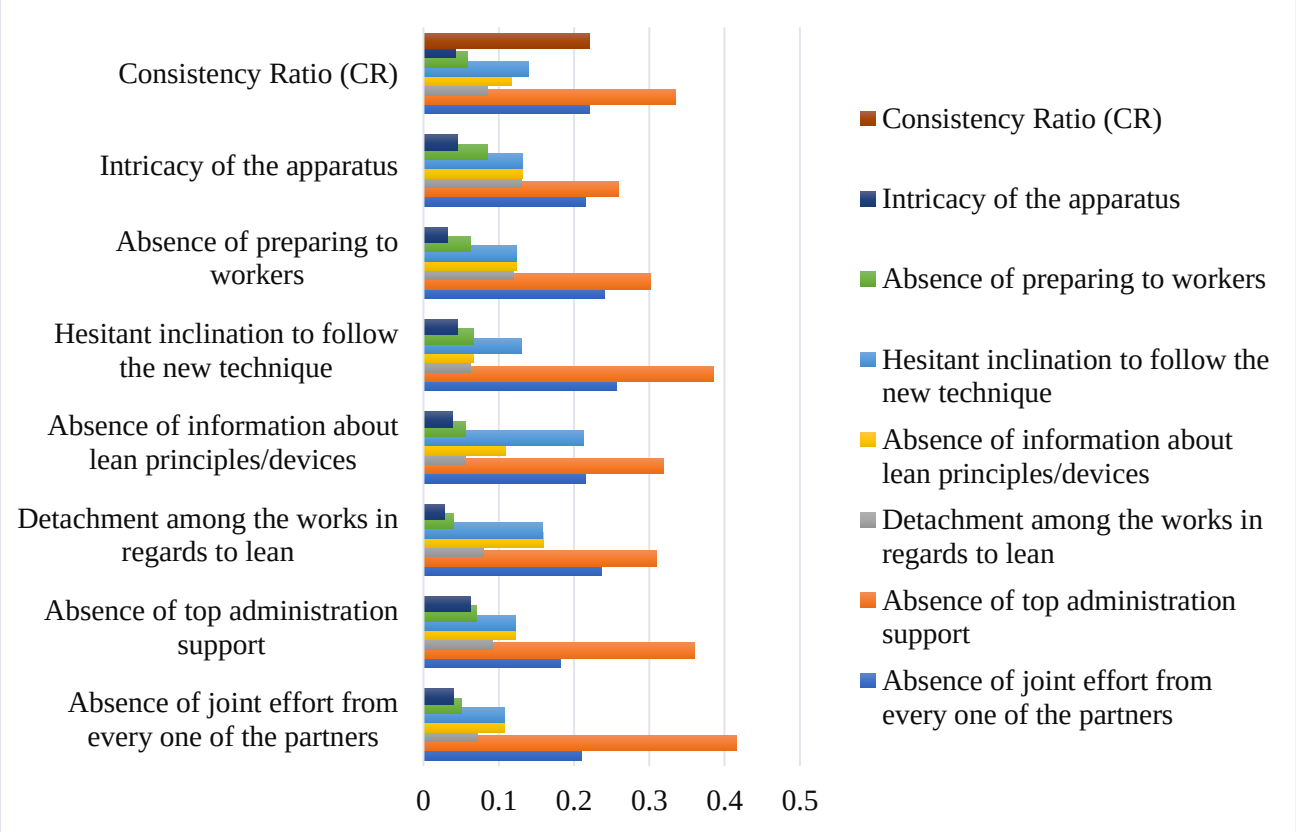

Figure 4: A comparison matrix of normalized criteria for implementation concerns

5. CONCLUSION

The study on the use of lean construction offers some important insights into the advantages and difficulties of implementing lean concepts in the Keralan construction sector. The results show that even while lean construction has a lot of potential advantages—like shorter cycle times, higher quality, and more stakeholder collaboration—there are a few obstacles that need to be removed before it can be put into practice. The absence of support from upper management, inadequate cooperation from interested parties, and reluctance to implement novel approaches are among the principal obstacles. These obstacles prevent Lean techniques like the Last Planner System (LPS), which tries to maximize efficiency and reduce waste, from being implemented effectively. Prioritizing these implementation challenges was made easier with the help of the Analytic Hierarchy Process (AHP) analysis, which also highlighted the significance of addressing

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managerial commitment and promoting a continuous improvement culture. The study also made clear the necessity of specialized training courses and improved Lean principles education for staff members with varying degrees of experience.

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