Implementation of Lean Construction Techniques in the Indian Construction of Row House

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ABSTRACT
To increase efficiency in the construction industry, lean construction is a powerful management tool. To apply lean ideas from the manufacturing sector to the construction industry, significant research has been conducted recently and is still being done. Lean construction is a modern management technique that aims to increase productivity and reduce waste. The Indian construction sector is facing several difficulties in applying the lean approach. The adoption of the lean management approach for a construction project is still in progress because of a lack of interest in and ignorance of the concept among stakeholders including builders, contractors, engineers and project management organisations, etc. With the use of a questionnaire survey, attempts are made in this article to identify the primary obstacles to the application of lean principles in the Indian construction sector. Additionally, practical site implementations are made to create a process map for active projects. The survey's results indicated that in order to improve the lean building process, several lean practices should get greater attention. The findings indicate that the non-value-added and essential non-value-added activities have the greatest influence on the project's length. Because of this, by using the suggested lean strategies, the NVA and ENVA operations are enhanced, and their durations may be significantly decreased.

Key words: Lean techniques, Lean construction, Non-value added activities & Essential non-value added activities

1 Introduction
The construction business in India employs millions of people and is the country's second biggest employer, after the agricultural sector. The construction industry creates the second-most jobs in India after agriculture, but despite its employment potential and economic significance, the sector still faces challenges like low productivity, high costs, waste production, inefficient use of energy, a need for fresh water, delays in project completion, and a lack of professional standards. The GDP is impacted by the construction industry's productivity, which is a significant activity in most nations.

Lean construction is defined as a "way to design manufacturing processes and to eliminate waste of resources, time, and labour to achieve the highest amount of value." Even if it is disorganised from an Indian viewpoint, the building sector has value just like any other kind of company. Investing in the project's future by implementing lean principles is a promising move that will pay off and provide a certain return on investment. There are a lot of new players entering the Indian market, including corporations and management companies that are now a part of the country's recent infrastructural expansion. There is increasing rivalry amongst businesses as a whole as a result of the enormous demand and profit margin. The scarcity of competent personnel is a significant issue for the Indian construction sector. A project's quality might sometimes be questioned due to untrained personnel and subpar craftsmanship.

Construction companies demand the use of cutting-edge creative technologies to prevent such an issue and to develop quality. Lean management is a kind of method that was applied in the research. Lean methodology assists in tackling labour issues as well as some other issues that are also connected to the calibre of building. Utilizing lean methods in the construction sector will hasten the completion of projects while improving their profitability and quality.
2 Literature Review

Construction projects may effectively utilise lean manufacturing methods when customised for that purpose. One of the most important elements in the effective use of these instruments is the top management's support.

1. The supply of inputs at the precise time they are needed is, in Henry Mwanaki Alinaitwe's opinion, the biggest impediment. In addition, each barrier's ease of removal was rated in relation to the others. The most straightforward obstacle to overcome is remembering to maintain the necessary goods in the proper location at the proper time.

2. Mohd Arif Marhanietal found that a key factor in ensuring that the LC's guiding principles are broadly used in the workplace is stakeholders' expertise of the subject matter. Lean is unable to realise its full potential because the stakeholders have a vague knowledge of the fundamental terms used in the methodology. Lean construction practices have been demonstrated to increase value and enhance sustainability, which helps the industry.

3. In a 2015 analysis, Ashwin Amarshi Maru examines the advantages of applying lean techniques to building.


5. Aini Jaapara, Nur Amami Maznana get aware about the practice of Lean management.


3 Principles Of Lean

To reduce waste and inefficiency in its production processes, Toyota first developed lean. The method was so effective that it was adopted by several industrial industries all over the globe. The objective of every process is to cut out operations that don't bring value. Unless a process has been lean numerous times, it also includes some waste.

Leaning effectively may result in significant reductions in costs and increased competitiveness by increasing efficiency, productivity, and reducing waste, cycle time, material prices, and cycle costs. Lean does not only apply to production; it can also enhance how a team interacts with customers and maintains inventories.

![Fig: 01 Principles of Lean Construction Techniques](image)

- **Value** - Determine the anticipated value from the viewpoint of the end user.
• Chain- Determine the value chain's structure and cut away operations that offer no value.
• Flow- Aim for unity coordinate all operations and maintain a constant flow.
• Pull- Don't start something unless it is necessary.
• Perfection- accelerate the flow and strive towards excellence.

4 Methodology, Results, And Discussions

Based on a comprehensive review of the literature and knowledge of lean construction approaches, including their benefits and drawbacks, the questionnaire that will be used to collect data for this study's goals was developed. Because they can all be answered quickly and simply, all of the questions are presented in a yes-or-no manner. After carefully reading the research, some of the measure hurdles are given, and the reader is asked to rate their likelihood of occurring on a scale of 1 to 5.

Thirty civil engineering professionals—including contractors, site engineers, project managers, etc.—were given the questionnaire. And according to their point of view, they were asked to respond. The likelihood of each response is examined, and the results indicate the obstacles that are most likely to materialise. So that we could have a clear understanding of the most likely hurdles, the responses to the questionnaire were collated.

The reaction from consultants and contractors was prompt; the majority of consultants are familiar with lean and accept that it would be a helpful undertaking for the Indian development area to lessen burn through and time factor. As indicated by the overview's discoveries, coming up next are the main obstacles that need to be overcome in order to apply lean in the Indian construction sector, as illustrated in Fig.

- lack of awareness and comprehension.
- Problems with human attitudes and culture.
- Economic strain.
- Insufficient training.
- Time-consuming installation process.
- A lack of commitment from high management.
- Problems with education.

![Analysis of Questionnaire](image)

Additionally, a building site for a Row House project was chosen to employ the lean principles, and observations were made. In the parts that follow, the findings are discussed. I have decided to utilise a Row House construction project in Mumbai, Maharashtra's Dahisar, as the location for my site implementation. G+3 residential
buildings make up this area. And Table 1 lists the key aspects of the project. The study focused on the building's RCC and concrete processes.

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Type</td>
<td>Row House Building</td>
</tr>
<tr>
<td>Project Value</td>
<td>2.08 CR.</td>
</tr>
<tr>
<td>Contract Type</td>
<td>Pre-measured/ Design Bib Build</td>
</tr>
<tr>
<td>Scope of Work</td>
<td>Concrete Works/Steel Structure</td>
</tr>
<tr>
<td>Project duration</td>
<td>5 months</td>
</tr>
</tbody>
</table>

Table no.1

Lean tools were used after evaluating the project's process map for all different sorts of activities, and the effect they had on the process's time was noted. Construction wastes have been categorised once the process has been investigated. After analysing the real data, the appropriate lean strategies were used. Following are the steps that were used to make the improvements:

1. By using alternative techniques, increase the effectiveness of value-added operations.
2. With the aid of lean strategies, enhance the working procedures for the crucial non-value-added operations.
3. By employing appropriate planning & timing techniques, eliminate the tasks that don't offer value.
4. Deciding which lean tools are best to use to complete the previous three tasks. Based on information from published works, the effectiveness of lean tools was determined. In comparable nations, improvements varied from 25% to 31% during the course of projects. Since they provided a general framework, these percentages were used to assess the effect on each activity's duration. In this study, 25% improvement in each activity was the percentage that was used.

Time that was freed up for NVA, ENVA, and VA tasks when lean approaches were put into practise. Conclusion: After using lean techniques, there has been a significant decrease in the number of days (total) that a task takes. According to Table 2, the ENVA and VA activities may both be cut in half, while the NVA activities can be lowered to 100%.

<table>
<thead>
<tr>
<th>Table no. 2 Table Once the suggested framework is in place, there is time saved each cycle.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of activity</td>
</tr>
<tr>
<td>------------------</td>
</tr>
<tr>
<td>NVA</td>
</tr>
<tr>
<td>ENVA</td>
</tr>
<tr>
<td>VA</td>
</tr>
<tr>
<td>TOTAL</td>
</tr>
</tbody>
</table>

Table 3 shows the decrease in activity after the imposition of the suggested framework. While the number of ENVA and VA activities cannot be lowered, the number of NVA activities may be decreased to 27%. According to Table 3, the total number of activities has decreased by 13% overall. The quantitative analysis of the decreased number of activities is shown in Fig. 3.
Table No. 3 shows how many activities there were after using the suggested framework.

<table>
<thead>
<tr>
<th>Activity Type</th>
<th>No. of activities Before Lean</th>
<th>No. of activities After Lean</th>
<th>Reduction %</th>
</tr>
</thead>
<tbody>
<tr>
<td>NVA</td>
<td>15</td>
<td>11</td>
<td>27%</td>
</tr>
<tr>
<td>ENVA</td>
<td>09</td>
<td>09</td>
<td>0%</td>
</tr>
<tr>
<td>VA</td>
<td>07</td>
<td>07</td>
<td>0%</td>
</tr>
<tr>
<td>TOTAL</td>
<td>31</td>
<td>17</td>
<td>13%</td>
</tr>
</tbody>
</table>

5 Conclusions And Recommendation

According to the study, more than 80% of the respondents agree that commercial pressure, changes made to the owner's orders, a lack of contractor communication, discrepancies in document delivery, and changes made to the project's actual completion dates are some of the major factors delaying the project's actual completion date in India. The lean idea was unknown to 45% of the respondents, and the notion was only vaguely known to 55% of the respondents.

The effects of different activity categories on the total project time were shown by the site implementation outcomes. On the percentage of improvement in process durations, the variables impacting lean tools have a significant influence. The use of lean technologies results in a substantial decrease in durations (total number of days), with a project's duration dropping by around 25% and its process activities by about 13%.

References


