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A Comparative Study of Lean Construction Adoption in Public Vs. Private Sector Projects in India

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Abstract

The study looks at the differences between Lean Construction adoption in public and private sector projects in India, covering how often it is used in each sector which specific Lean practices are applied and the main difficulties encountered. Data were gathered from a diverse set of operation management corporations using a research design that included both survey questions and interviews. The results suggest that private sector organizations use Lean Construction more widely, with 45% fully adopting it, while only 24% of public sector organizations do so. Lean systems are shown in private organizations, while public sector projects are behind due to slow processes, reluctance to adopt innovation and lacking know-how. People skills are an issue for both sectors, but more money issues concern the private sector. Based on its findings, the study suggests creating strategies by sector that simplify regulation in government, improve restructuring in the public sector, manage front-end costs for companies and build their capacity to fully join Lean Construction trends in India. As a result of this research, construction projects are done more efficiently, waste is reduced and sustainable development is encouraged.

Keywords: Lean Construction, Public Sector, Private Sector, India, Construction Efficiency, Waste Minimization, Barriers to Adoption, Lean Practices.

1. INTRODUCTION

Building activities in India help the economy by aiding development of infrastructure, generating employment and promoting development of all sectors. Still, even though this industry is vital, it has long been affected by issues like inefficiencies, delays, going over budget and wasting resources. By adopting Lean Construction, a trend inspired by lean manufacturing, people in construction believe they can enhance value, cut out waste and make project delivery simpler. Using Lean Construction methods in construction is likely to increase efficiency, improve the finished product's quality and make projects more sustainable. Still, how much sustainability is implemented depends greatly on the organization's structure, how it buys goods, regulations and resources they possess.

There are two major parts of the construction industry in India: public and private which deal with their own sets of challenges and operations. Because public sector projects deal with strict regulations and procedures, they usually show slower acceptance of new innovative solutions than private sector projects which enjoy more independence. The private sector is quickly introducing Lean to work more efficiently and cost-effectively, while public projects are held back by certain systemic problems that hinder their Lean implementation. It is important for policymakers, practitioners and researchers to understand the different rates of Lean Construction adoption in these two sectors so they can encourage better construction methods everywhere.

The study will compare how Lean Construction is used in construction projects carried out by both the public and private sectors in India. It looks at the extent of adoption, the main Lean practices in operation and the challenges met by each sector. Examining the various approaches and factors in this manner is meant to show what drives the use of Lean and offer useful ways to encourage more widespread use. All in all, this study adds

to the effort to make Indian construction better by using Lean Construction and emphasizes customized interventions to close the gaps and improve project results everywhere in India.

2. LITERATURE REVIEW

AlBalkhy et al. (2021) looked at the challenges to using Lean Construction in the Jordanian construction industry. The study found that three main problems: opposition to change, not enough trained employees and poor support from managers, prevented applying Lean effectively. They showed that targeted techniques are best for managing these issues and helping with Lean implementation in construction projects.

Dehdasht et al. (2020) used a method that mixes entropy and TOPSIS approaches to discover the main factors for the successful and sustainable application of Lean Construction. The study says that working together, ongoing staff training and using the right technology help improve Lean practices. With their framework, critical elements beneficial for Lean Construction were arranged systematically.

Devkar et al. (2020) examined the influence of different institutions on the way PPP projects are carried out by comparing Australia and India. Authorities concluded that how systems are regulated and run affects the way projects are carried out. The results showed that supportive institutions and flexible management were needed for projects to be completed well, suggesting these are also important for Lean Construction in government buildings.

Ershadi et al. (2021) carried out a study by comparing PMO functions in successful construction companies from both the public and private areas. Private sector organizations, according to their study, display more adaptable and coordinated PMO teams which help improve how projects are carried out. It became clear that sectors with varied governance and operations had varying levels of project management efficiency.

Huaman-Oroscoetal. (2022) explored the reasons why Lean Construction is not commonly used by SMEs in Peru. Among the major problem areas they noticed were money shortages, a lack of experts and organizations that are reluctant to change. It pointed out that customized education and assistance are required so that small companies in developing construction markets can adopt Lean methods efficiently.

Li et al. (2018) constructed a RBL-PHP simulation model for studying how Lean Construction and information technologies can be adapted to prefabricated housing. According to their research, using Lean together with technology could make production more efficient and help eliminate waste. It was shown in the study that using technology aligned with Lean approaches greatly improves how construction projects are delivered.

3. RESEARCH METHODOLOGY

The authors used a descriptive approach with stratified random sampling to learn about construction firms' practices, how they adopted Lean and what obstacles they noted in this process. Analysts looked at the data with both descriptive statistics and visual tools to emphasize differences between sectors.

3.1. Research Design

The researchers used a descriptive design to examine how Lean Construction is being used in India's public and private construction projects. The purpose of the design was to methodically monitor and compare rates of Lean adoption and note the obstacles in each area, resulting in an accurate overview of industry trends today.

3.2. Data Collection

Data was gathered by distributing a questionnaire designed for construction companies working in all parts of the construction market. The survey included questions about how much Lean Construction is used which elements are applied and any obstacles that may exist to adoption. We collected requirements by email and during in-person interviews, thus making sure that a wide variety of sectors and regions were included. The sample consisted of companies with various sizes to represent different points of view in construction.

3.3. Sampling Technique

Both private and public firms were included by using stratified random sampling. The distribution of firms by strata was based on their sector type and the proportion of their activity. Thanks to this approach, we could look at the data fairly and confidently apply what we learned.

3.4. Data Analysis

To show the adoption rates, kinds of practices and main barriers in the two sectors, the data were simply analyzed and illustrated with percentages. A comparison of public and private sector firms was carried out to note their differences. Using bar charts and graphs made explaining the results much easier.

4. DATA ANALYSIS AND INTERPRETATION

Table 1 shows the proportions of Lean Construction adoption in both public and private sector construction projects in India. The numbers indicate that private companies are far more likely to use Lean Construction; 45% use it fully, while public companies use it in just 24% of cases. In both sectors, Lean principles are being used by around a quarter of businesses. Notably, 36% of public sector firms suggest they aren't adopting Lean, compared to only 12% in the private sector. Approximately 20% of both groups either do not know about Lean Construction or left the question blank. According to Figure 1, private companies tend to adopt digital technology more fully than public sector companies.

Table 1: Adoption of Lean Construction by Sector

Adoption Level	Public Sector (%)	Private Sector (%)
Full Adoption	24	45
Partial Adoption	20	23
No Adoption	36	12
Unaware/No Response	20	20

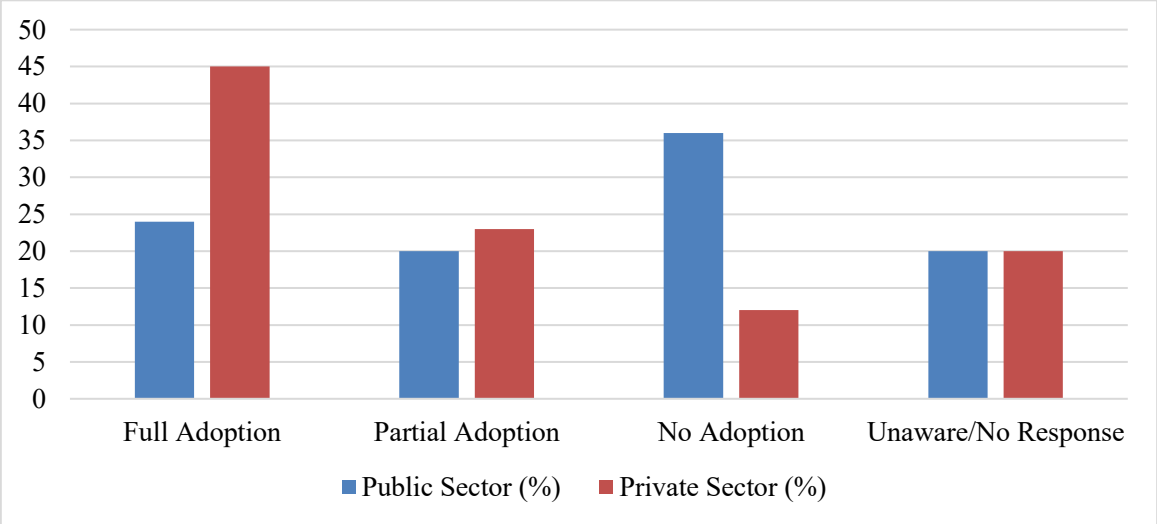

Figure 1: Graphical Representation of Adoption of Lean Construction by Sector

It appears that Lean Construction is more deeply adopted by the private sector than by government projects in India. Because private firms tend to fully adopt Lean, they are probably more flexible, have more resources and are eager to improve through Lean Methods. Meanwhile, the higher share of no adoption among public sector companies suggests there are barriers such as inefficient government bureaucracy, fixed purchasing procedures

or low awareness. Both verticals are halfway to adopting Lean, but there is greater need for the public sector to achieve full implementation. Seeing an equal number of unaware or non-responders in all sectors indicates that more training on Lean Construction is still required. From these results, we see that policymakers and industry leaders need to focus on improving Lean practices to increase project efficiency and decrease expenses in the public construction sector.

Table 2 presents the adoption of main Lean Construction approaches in the construction projects of both public and private groups in India. Just-In-Time (JIT) Material Delivery is the most widely used approach, supporting 75% of private companies and 48% of public companies. More than twice as many private sector firms use the 5S concept as public sector firms. Most private projects (62%) now use daily huddle meetings, while public projects have seen 40% adoption so far. Less than half (44%) of private projects and only one in four (28%) public projects use the Last Planner System. In both the private and public sectors, Value Stream Mapping has the lowest adoption than other quality management methods. Figure 2 shows clearly that Lean practices are adopted much more widely by the private sector than by the public sector.

Table 2: Adoption Rates of Lean Practices by Sector

Lean Practice	Public Sector (%)	Private Sector (%)
Just-In-Time Material Delivery (JIT)	48	75
5S Methodology	42	68
Daily Huddle Meetings	40	62
Last Planner System	28	50
Value Stream Mapping	20	45

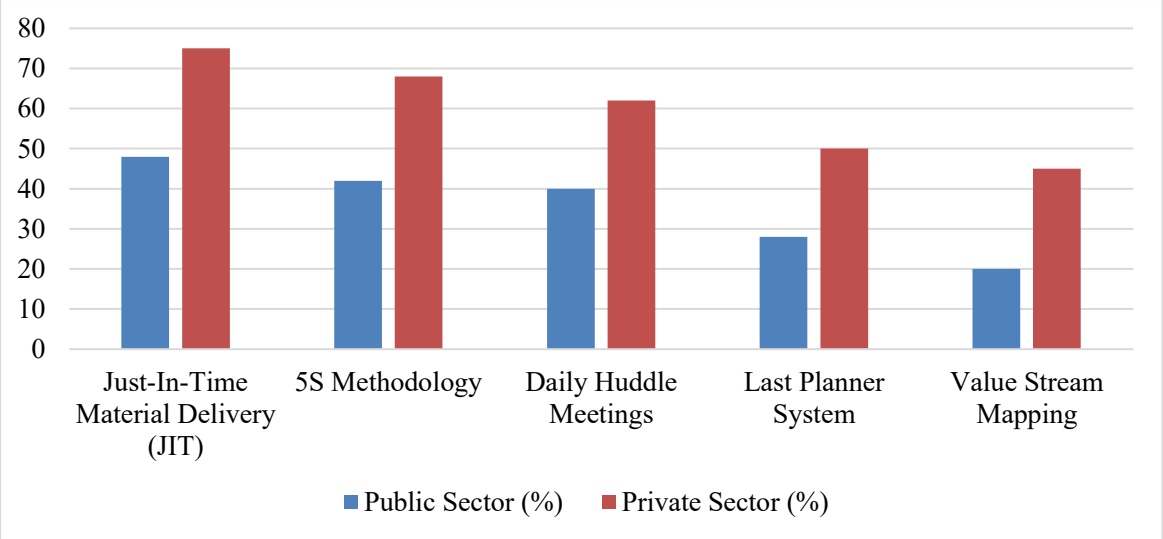

Figure 2: Graphical Representation of Adoption Rates of Lean Practices by Sector

Data shows that private sector construction firms in India are more likely to use Lean practices than their public sector partners. The wide use of JIT and 5S in private projects shows these firms pay more attention to organizing their workplaces and making operations more efficient. Even though both sectors have accepted more straightforward Lean tools, they have used Last Planner System and Value Stream Mapping less often, possibly because of limited technical knowledge or uneasiness with major changes, yet the issue is stronger in the public sector. It is believed that government projects suffer from issues such as unclear procedures, untrained

workforces and few good incentives. Ultimately, the results point out that stronger, strategic use of Lean should be promoted in the public sector, moving beyond the usual basic Lean tools.

Table 3 covers the main factors preventing the use of Lean Construction on projects in both the public and private sectors in India. According to the report, the top difficulty in public administration comes from delays by bureaucracy which impacts 56% of businesses, while it is reported by only 22% of private sector companies. About 4 in 10 respondents from the public sector and 48% from the private sector say that not having skilled workers is a major challenge for both sectors. More private than public companies are affected by high initial costs on their energy which impact 55% versus 30%. About one in three public sector firms and one in four private sector firms encounter resistance to change. Also, a lack of management backing is reported in 20% of private and 25% of public sector firms. The top part of Figure 3 illustrates and names the main challenges each sector encounters.

Table 3: Barriers to Lean Construction Adoption

Barrier	Public Sector (%)	Private Sector (%)
Bureaucratic Delays	56	22
Lack of Skilled Workforce	40	48
High Upfront Costs	30	55
Resistance to Change	35	30
Lack of Management Support	25	20

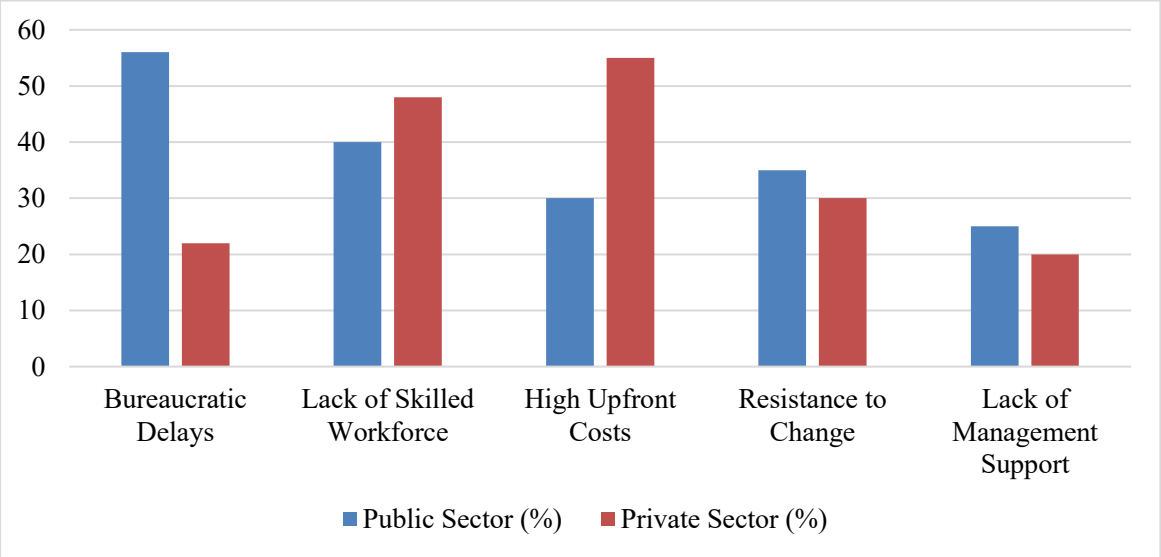

Figure 3: Graphical Representation of Barriers to Lean Construction Adoption

Research demonstrates different obstacles experienced by companies in both the public and private sectors when trying to use Lean Construction. Delayed decisions and actions happen in the public sector because strict rules and ineffective procedures cause slowdowns. In contrast, businesses in the private sector worry more about the upfront costs of implementing Lean because they are often more concerned about spending or because the risk of initial investment puts them off. They point out that finding qualified workers is a major trouble, so special training and strengthening programs are clearly required. It is shown that resistance to Lean is slightly stronger in the public sector because of existing cultural and organizational barriers. Since both sectors seem less worried about management support, maybe leadership is not much of a problem or perhaps other issues have a stronger

effect. To sum up, these results prove that sector-oriented approaches are necessary: streamlining public sector processes, handling and managing changes in the public sector and resolving costs and skill gaps in the private sector for Lean Construction to spread.

5. CONCLUSION

By looking at these projects, it is transparent that a lot more of India's private sector construction uses Lean Construction due to better availability of staff and resources, along with more motivation to save costs and be efficient. Many problems for public sector Lean include bureaucratic delays, people not welcoming change and a low awareness level. At the same time, private companies in transportation face the main issues of expensive initial investments and difficulties finding qualified workers. It turns out that a bit of Lean is being embraced by private and public sectors, though more advanced applications are rarely used in public area projects. It is clear from these findings that each sector requires specific actions: simpler procedures for public sector officials and relaxed budgets and training for employees in the private sector. Solving these adapted problems is key to ensuring Lean Construction is used more widely in Indian construction and boosts efficiency, reduces waste and supports a sustainable future.

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