

## PRACTICES AND BARRIERS OF LEAN CONSTRUCTION IMPLEMENTATION IN SELANGOR

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**Abstract:** *Lean Construction (LC) emphasizes waste reduction and increased efficiency in projects to maximize value for stakeholders. Although LC practices are considered as having a lot of potential advantages in achieving better project performance, reducing construction costs, and making the entire process more efficient. However, there are a lot of challenges that are faced in the implementation of LC in the construction industry in Selangor. This study investigates the current level of LC implementation and the critical barriers hindering its adoption. A quantitative research approach was employed, involving a structured questionnaire distributed to 251 G7 contractor firms in Selangor. The findings indicate that while the respondents generally had an awareness of lean construction, actual implementation is relatively moderate, particularly in collaborative planning, standardization, and performance measurement. While critical barriers identified include general lack of awareness and understanding of lean principles, fragmented project delivery systems, resistance to change, and financial constraints. The study contributes to understanding the implementation*

*challenges and paves the way for more sustainable and efficient construction practices in Malaysia. These insights are valuable for policymakers, industry stakeholders, and researchers aiming to facilitate LC adoption at both operational and strategic levels.*

**Keywords:** *Lean Construction, Implementation, Barriers, Contractors*

## Introduction

The construction industry in Malaysia plays a crucial role in national economic development, contributing significantly to GDP and employment. However, it is often characterized by inefficiencies, high waste generation, and frequent project delays (Marhani et al., 2018). In response, Lean Construction (LC), an adaptation of lean manufacturing principles to the construction sector, has emerged as a viable solution for enhancing productivity and value creation. LC seeks to streamline processes, reduce non-value-adding activities, and improve stakeholder collaboration throughout project lifecycles (Ballard, 2000; Shah & Ward, 2007).

Sustainable construction is a path ahead for the construction industry to achieve development sustainability while taking environmental, socioeconomic, and cultural factors into account. Yet, numerous building wastes are created as a result of the construction industry's fast expansion, which has solely impacted the environment (Marhani et al., 2018). Lean manufacturing has altered several sectors today, and its implementation in construction is steadily showing benefits (Keleş & Yılmaz, 2022). The implementation of LC in Malaysia is not without difficulties. Although the concept has acquired considerable popularity in the country, it still faces a number of obstacles that prevent it from being implemented. Cultural obstacles, a lack of awareness and comprehension, aversion to change, limited technological uptake, and a lack of uniformity are among the hurdles.

One of the most serious problems with LC in Malaysia is a lack of awareness and understanding among industry participants. Many construction professionals are unfamiliar with the principles and methods of Lean Construction and, as a result, are unable to properly execute them. Marhani (2012) concluded that, although it is well known to offer a good platform for the stakeholders to gain value for money for their projects, the current use and implementation of LC in the Malaysian construction industry is still in its infancy or at a very early level. Jaapar A (2012) stated that despite the fact that the concepts of LC are utilised in their line of work, they are unable to properly comprehend the terminology. This is because, although LC principles were stated to be used in the building process, the technical approach of LC was not fully utilised in the manufacturing process.

Malaysian culture and social values can occasionally present limitations to Lean Construction implementation. For example, the hierarchical structure of Malaysian construction organisations may make collaborative decision-making procedures, which are important for Lean Construction, difficult to execute. LC bestows additional responsibilities on leaders that are not always warmly received, as they might provide the impression of more workload without immediate results (Mano et al., 2023). Marhani (2012) described the issues originating from the lack of support and dedication from upper management, which in addition to generating delays in implementation, negatively interfere with the outcome of the lean construction. Moreover, Malaysia's building sector has a reputation for being reluctant to change. This reluctance may stymie the adoption of Lean Construction, which necessitates a fundamental transformation in the management and execution of building projects.

The Construction Industry Development Board (CIDB) of Malaysia has actively promoted LC since 2015 through the establishment of the Lean Construction Institute of Malaysia (LCIM), which provides training, consultancy, and research support. Despite these efforts, adoption rates remain low, particularly in key industrial regions like Selangor. This gap suggests the presence of significant barriers, ranging from technical and organizational to cultural and financial.

The aim of this study is to assess the current implementation of LC practices in Selangor, identify the key challenges hindering its widespread adoption, and propose actionable strategies to overcome these obstacles. Specifically, the study addresses two core research questions:

1. What is the current state of Lean Construction implementation in Selangor?
2. What are the critical barriers to LC adoption among construction stakeholders?

Construction waste remains a persistent challenge in the Malaysian construction industry, particularly in Selangor—the nation’s most urbanized and industrially advanced state. Despite growing awareness of sustainable construction practices, Selangor continues to generate a high volume of construction and demolition (C&D) waste due to rapid urbanization, infrastructure expansion, and high-density residential developments (Zainon et al., 2020; Yusoff et al., 2022). By focusing on Selangor, a state with one of the most active construction sectors in Malaysia, this research provides localized insights with broader implications for national LC policy and practice.

Furthermore, the enforcement of lean-aligned policies and regulations remains weak, with contractors frequently prioritizing speed and cost over long-term sustainability and process optimization (Abdul Rahman et al., 2011). These localized challenges—unique to Selangor’s socio-economic context—highlight a gap between policy aspirations and on-ground practices. While Lean Construction presents a viable pathway toward reducing construction waste and improving project performance, its effective implementation in Selangor remains constrained by structural, educational, and regulatory shortcomings. Addressing these issues is essential to realizing the full benefits of LC and advancing sustainable development goals in Malaysia’s construction sector.

## Literature Review

### Lean Construction Principles

Lean Construction (LC) is grounded in lean manufacturing concepts pioneered by the Toyota Production System. It emphasizes reducing waste, improving workflows, and maximizing value for the end user (Ballard, 2000). Five core principles underlie lean thinking: (1) specifying value from the customer’s perspective, (2) identifying the value stream, (3) ensuring continuous workflow (flow), (4) enabling customer pull, and (5) striving for perfection through continuous improvement (Womack & Jones, 1996).

In the construction context, these principles translate into collaborative project planning, stakeholder engagement, and waste minimization across all project phases (Ily, 2009). Value stream mapping, the Last Planner System (LPS), and 5S practices are commonly used tools that align with these principles to optimize construction activities.

### Tools and Techniques

Several tools facilitate LC implementation. The 5S methodology—Sort, Set in order, Shine, Standardize, and Sustain—is widely used to organize and maintain clean, efficient workspaces

(Hiwale et al., 2018). The Last Planner System (LPS) improves project planning by involving all stakeholders in weekly planning meetings to improve reliability and reduce workflow variability (Ballard, 2000). Value Stream Mapping (VSM) provides a visual representation of construction workflows, helping identify delays, bottlenecks, and waste (de Carvalho et al., 2017).

### **Waste in Construction**

Waste in construction encompasses time, materials, labor, and productivity losses. Studies show the sector produces far more waste than value-added output compared to manufacturing industries (Vilasini & Gamage, 2010). Common types of waste include overproduction, waiting, transportation, over-processing, excess inventory, defects, and underutilized skills (Marhani et al., 2012). These can be mitigated through lean principles such as Just-in-Time (JIT) delivery, pull planning, and standardization.

### **Current Situation in Malaysia**

Globally, especially in countries like the United States, the United Kingdom, Japan, and Scandinavian countries, LC has gained significant traction due to strong support from industry bodies, client demand for efficiency, and an innovation-driven construction culture. In contrast, Malaysia's LC adoption remains relatively low.

According to studies by Abd Shukor et al. (2020) and Zulkipli et al. (2022), common barriers in Malaysia include:

- Low awareness and understanding among contractors
- Perception that LC is only suitable for large firms
- Lack of training and education on LC tools
- Fragmented project delivery system

This contrasts with countries like the UK or Finland, where lean practices are included in formal construction curricula and national strategies.

The Construction Industry Development Board (CIDB) Malaysia has recognized the limited adoption of Lean Construction (LC) within the local construction sector and addressed this issue through strategic initiatives such as the Construction Industry Transformation Programme (CITP) 2016–2020. According to the CITP Annual Report 2018, less than 30% of industry stakeholders possessed sufficient awareness or exposure to core LC tools, including Value Stream Mapping, 5S, and the Last Planner System (CIDB, 2018). This statistic reflects a significant gap in industry knowledge and practice. Additionally, CIDB has highlighted two major obstacles to LC implementation: the absence of structured training programs and persistent resistance from traditional construction players who are reluctant to deviate from conventional project delivery methods.

### **Challenges and Barriers to Lean Construction Implementation**

Numerous specialized fields and specialties, many of which are dependent on cyclical processes, are found in the building companies. Advocates of lean construction claim that it is feasible to pinpoint inefficient activities within the processes and implement adjustments for them. Lean Construction is still in its infancy in Malaysia, with only a few firms embracing the methodology. The literature has identified several obstacles and constraints to Lean Construction implementation in Malaysia. The main barriers to LC adoption range from complexities in understanding LC to a general myth that LC is a gradual implementation

process when the construction industry is looking for immediate results, to a lack of formidable strategies to implement LC at the micro-level (the level at which downstream players operate) (Aslam et al., 2020).

This leads to the assumption that one of the most major challenges is a lack of understanding and awareness of Lean Construction among construction professionals. Absence of qualified personnel to operate LC, as well as a lack of knowledge and training of supplier employees regarding their implementation on various building construction sites (Ahmed & Wong, 2020a). He also stated that because the bulk of the workers are migrants, they lack experience and training in various software programmes such as BIM, as well as the importance of BIM in providing resources on time.

There are undoubtedly a number of obstacles in the way of the present attempts to spread the idea of lean construction. These barriers relate to the attitudes, roles, interactions, behaviours, and communications between the many contractors, subcontractors, and clients/owners in the construction sector (Abdullah et al., 2009). A few of the obstacles to benchmarking are the industry's fragmentation, cyclicity, variability in organizational sizes and structures, ambiguity in inputs and outputs, and absence of a standard approach (Alinaitwe, 2009). The primary obstacles to lean implementation were categorized into four groups through an interview in a related case study research among Iranian SMEs (Moradlou & Perera, 2017): organizational culture, lack of top management support, financial capability, and employee skill and expertise deficiencies.

Key challenges include a limited understanding of LC concepts among industry professionals and a prevailing misconception that LC is a slow, incremental process—contrary to the industry's preference for rapid, tangible results. Additionally, there is a lack of effective strategies for implementing LC at the micro level, particularly among downstream stakeholders (Aslam et al., 2020). One of the most significant obstacles is the widespread lack of awareness and understanding of LC among construction practitioners. This is compounded by a shortage of qualified personnel and inadequate training for supplier staff involved in project delivery (Ahmed & Wong, 2020a). Many of the construction workforce, being migrants, often lack experience with digital tools such as Building Information Modelling (BIM), despite its critical role in ensuring timely resource allocation.

Efforts to promote LC are further hindered by deep-rooted structural and behavioural issues within the construction ecosystem. These include fragmented industry practices, poor communication and coordination among stakeholders (contractors, subcontractors, and clients), and a lack of shared understanding and roles (Abdullah et al., 2009a). Other systemic challenges include industry fragmentation, cyclical demand, variability in organizational size and structure, and the absence of standardized benchmarks and processes (Alinaitwe, 2009). A case study involving Iranian SMEs further categorized LC implementation barriers into four main areas: organizational culture, lack of top management support, limited financial resources, and deficiencies in employee skills and expertise (Moradlou & Perera, 2017).



## Research Methodology

### Research Design

This study employed a quantitative research design to examine the current state of Lean Construction (LC) implementation in Selangor and identify critical barriers. The approach allowed for systematic collection and statistical analysis of data from a large sample of construction professionals.

### Population and Sampling

The target population comprised G7 contractors registered with the Construction Industry Development Board (CIDB) Malaysia and operating in Selangor. These contractors represent the highest registration grade and are typically engaged in large-scale construction projects. According to CIDB records, there are approximately 3,430 G7 firms in Selangor.

Using Raosoft's sample size calculator and assuming a 90% confidence level and a 5% margin of error, a sample size of 251 companies was determined. A simple random sampling technique was used to select respondents, ensuring that each firm had an equal chance of participation, thus improving the generalizability of the findings.

### Data Collection

Primary data was collected through a structured questionnaire distributed electronically via email and *WhatsApp* medium to the selected G7 contractors. Before the questionnaire is being distributed to the selected respondent, the questionnaire must go through research ethics committee from the respective institutional and got consent. The questionnaire was developed based on an extensive literature review and contained three key sections

- Section A: Demographics of the respondents
- Section B: Level of LC implementation
- Section C: Perceived barriers to LC adoption

Respondents rated their agreement with various statements using a 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree).

### Data Analysis

Data were analyzed using descriptive statistics to identify trends and patterns in LC awareness, practices, and barriers.

## Finding and Discussion

There was a total of 251 surveys that were distributed to the companies who work as contractors, and 126 of them were collected, resulting in a response rate of 50% percent. Malnik (2023) and Wu(2022) has stated that above 30% is considered as a good response rate for email survey. An adaption of SPSS is used to perform an analysis on the 126 answers that were gathered by all of the respondents from the surveys.

### Level of Lean Construction Implementation

The study found that awareness of Lean Construction (LC) among G7 contractors in Selangor is relatively high, with most respondents indicating familiarity with LC principles. However, actual implementation remains moderate, particularly in areas such as collaborative planning, standardization, and performance measurement.

In the planning and design phase, the use of tools like the Last Planner System (LPS) and Value Stream Mapping (VSM) was limited. Only a portion of contractors reported involving all stakeholders in early design decisions or utilizing standardized processes across projects. This suggests that while the theoretical benefits of LC are known, practical adoption during early project stages remains weak.

During the production and execution phase, some LC principles such as Just-In-Time (JIT) delivery and pull planning were observed, but not consistently. Many firms lacked a structured system for tracking performance indicators such as waste reduction or workflow efficiency, which are central to lean thinking.

In the collaboration and communication phase, only a few firms had established mechanisms for real-time communication or conflict resolution. Fragmented communication and hierarchical organizational structures likely contribute to this gap.

**Table 1: Barriers to Lean Construction Adoption**

Item	Descriptions	Mean	Std. D.	Rank
1.	Lack of awareness and understanding of LC principles among stakeholders.	4.47	0.641	3
2.	Fragmented project delivery systems and limited collaboration	4.51	0.616	1
3.	Resistance to change and cultural barriers within organizations	4.49	0.642	2
4.	Lack of skilled practitioners and training programs	4.36	0.572	9
5.	Financial constraints and limited investment in Lean Construction initiatives	4.46	0.689	4
6.	Lack of government support and incentives for LC adoption	4.40	0.705	8
7.	Inadequate legal framework and regulations for LC implementation	4.01	0.429	11
8.	Poor communication between all stakeholders	4.41	0.673	7
9.	Long implementation periods for new processes	4.44	0.676	5
10.	Lack management support and commitment	4.43	0.686	6
11.	Lack of standardization	4.27	0.625	10

Apparently from table above, several barriers of Lean Construction Implementation were identified. Comprehending these obstacles is essential to formulating strategies to overcome them and promote wider implementation of LC practices. Fragmentation in project delivery systems and limited collaboration among stakeholders have been identified as the most significant barrier, receiving an average score of 4.51. Multiple parties, including owners, contractors, subcontractors, and suppliers, frequently participate in construction projects; each has its own objectives and procedures. As a consequence of this fragmentation, isolated operations, miscommunications, and inefficiencies ensue. Kanafani & Watson (2015) also confirms that isolating execution from the design process, which is connected with the fragmented nature of the construction sector, causes conflicts over the project life cycle until the operational phase which impact on the implementation of Lean". The absence of a unified and cooperative structure hinders the smooth incorporation of LC principles, which are significantly dependent on coordinated endeavours and mutual objectives. Based on findings

from Aslam (2020), shows that decision-making influenced by fragmented design and construction can be related to the barriers of LC.

Resistance to change and cultural barriers within organisations rank as the second most significant obstacle, attaining an average score of 4.49. The construction industry is traditionally conservative, with many stakeholders accustomed to established practices. Resistance to change and cultural barriers within organisations rank as the second most significant obstacle, attaining an average score of 4.49. Many stakeholders in the construction industry have gotten used to standard procedures, which contributes to the industry's traditional conservatism. Many organisations encounter difficulty in implementing LC principles due to the need for mindset transition and cultural adjustment. Avoidance to embracing new ideas, apprehension towards unfamiliarity, or a preference for maintaining the status quo can all contribute to resistance. To overcome this resistance, it is imperative to implement comprehensive change management strategies, maintain ongoing education, and foster unwavering leadership dedication. Thus, Nwaki (2021) suggests that making lean part of the organisational culture is a powerful motivator for the rapid spread of the lean idea among construction professionals and other employees.

Furthermore, a lack of awareness and understanding of LC principles among stakeholders, with a mean score of 4.47, is another significant barrier. For LC to be implemented effectively, it is imperative that all stakeholders possess an extensive understanding of its principles, advantages, and effective approaches. However, numerous professionals in the industry are either ignorant of LC or lack the knowledge necessary to effectively implement it. Based on Moradi & Sormunen (2023), lack of awareness of Lean Construction has become in the top three of barriers of implementing LC in their findings. The lack of understanding regarding LC practices hinders their implementation and emphasises the importance of focused educational efforts and awareness raising campaigns.

Additionally, financial constraints and limited investment in Lean Construction initiatives, with a mean score of 4.46, also pose a substantial barrier. Implementing LC sometimes incurs initial expenses associated with training, overhauling processes, and technology adoption. Obtaining the required funding might be difficult in an industry where profit margins are frequently tight. Organisations may hesitate to allocate cash without a comprehensive grasp of the long-term advantages, resulting in insufficient investment in LC initiatives. Kanafani & Watson (2015) shows the important of finance by stating in the process of Reaching a progressive stage of lean understanding should be supported by the necessary financial resources.

Next, an average score of 4.41 indicates that poor communication among all parties involved further complicates the implementation of LC. The alignment of objectives, coordination of efforts, and exchange of information are all dependent on effective communication. Kanafani & Watson (2015) suggests that improving communication among all project participants is very vital, as the success of lean construction is strongly dependent on having a cohesive team working towards congruent aims and objectives. Misunderstandings, errors, and delays can result from disruptions in communication, which undermines the collaborative spirit necessary for the successful adoption of LC.

The average score of 4.36 indicates that there is a skills gap in the industry due to an absence of trained professionals and training programmes. The construction staff lacks the specialised expertise and abilities needed for LC. This is also supported by Ahmed & Wong (2020), lack



of skilled labours as well as lack of mutual trust between the contractors and suppliers or pre castors as a main barrier of adopting JIT in construction. In order to develop the required skills and back the implementation of LC, it is crucial to create and promote thorough training programmes.

Finally, the insufficiency of the legal framework and regulations pertaining to the implementation of LC is underscored by the regulatory obstacles, which received an average score of 4.01. The current regulations might not adequately accommodate the inventive methodologies employed by LC, and legal obstacles pertaining to contracts, liability, and compliance could arise. Reforming the legal framework is imperative in order to facilitate and promote the widespread adoption of LC practices.

The construction industry encounters a multitude of interrelated and complex barriers to the implementation of Lean Construction. A holistic strategy involving financial investment, management commitment, supportive policies and regulations, and education and awareness is required to overcome these obstacles. The construction industry can enhance efficiency, minimise waste, and optimise project results by recognising and addressing these obstacles through the application of LC principles.

## Conclusion and Recommendations

### Conclusion

This study explored the current practices, barriers, and strategies associated with Lean Construction (LC) implementation among G7 contractors in Selangor, Malaysia. The findings indicate that while awareness of LC is relatively high, its implementation remains inconsistent and limited in depth. Most firms lack robust systems for collaborative planning, performance measurement, and standardization, which are critical to LC success.

The study identified several critical barriers to adoption, including limited understanding of LC principles, organizational resistance to change, fragmented project delivery systems, and lack of financial and managerial support. Additionally, structural challenges such as inadequate government incentives and poor communication among stakeholders further constrain widespread implementation.

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