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Lean Construction: Fundamentals, Principles and Critical Success Factors.

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ABSTRACT:

In the realm of construction industry, pervasive challenges such as low productivity and inefficiency, exacerbated by labour-intensive projects, persist. The industry's adoption of Lean Construction, a forward-looking methodology aimed at optimizing customer satisfaction while minimizing waste, represents a shift from conventional practices. However, understanding and implementing Lean principles in the intricate and dynamic landscape of construction projects remain hurdles. An increasing number of constructions, academics and professionals have been referring Lean approach, in an effort to deliver better value to owners while making real profits. This paper mainly concentrates on integrating and implementing, alongside elucidating the fundamental principles and critical success factors (CSF) essential for the effective application and integration of Lean methodologies, promising a transformative and revolutionary change in the construction sector.

Keywords: Lean Construction, Production planning, production management, critical success factors, factor analysis, lean implementation tools & techniques.

1.INTRODUCTION

Construction is a major industry that will generate 35% of net value growth, ranging from 7.4 trillion dollars in 2010 to 10.3 trillion dollars in 2020. Even though the industry experienced a tremendous rise in its net value, the fragmented nature of the industry might sometimes result in low profits because of the competitive structure of the construction business. As well as considering the project constraints, such as scope, time, cost, and quality, environmental constraints are also of paramount importance in terms of reducing or eliminating waste. The construction industry produces more waste than any other industry in the world. Its management, as a field of applied science, has escaped canonical definition. One' typical definition, is that of wherein Construction Management was defined as “The judicious allocation of resources to complete a project at budget, on time, and at desired quality”. This definition captures the essence of what inspired, drove, and guided practice, teaching, and research in the Construction Management field. However, the failure and inability of the conceptual models of Construction Management (time-cost-quality, work breakdown structure, critical path methods, and earned value) to deliver on the mantra of 'on-time, at budget, and at desired quality' is evident to practitioners and academics alike. For example, recurring negative experiences on projects, as manifested by endemic quality problems and rising litigation, indicate that construction projects are low efficiency systems. According to the Construction Industry Institute (CII), the percentage of value-adding activities cover 62%, support activities cover 12%, and only 26% of work is wasted in the manufacturing industry, whereas the percentages are 10%, 33%, and 57%, respectively, in the construction industry.

In order to address the various negative impacts in the construction sector, the adoption of Lean Principles has emerged as the most effective approach thus far. Lean construction, akin to existing practices, aims to enhance customer satisfaction while reducing resource consumption. However, unlike conventional methods, lean construction is grounded in production management principles. This results in a novel project delivery system applicable to various construction types, especially beneficial for intricate, uncertain, and time-sensitive projects. Lean Construction emphasizes a relationship-oriented, production management-centred strategy for project delivery, prioritizing the management and design of the construction process over solely focusing on the final product. Fundamentally, its primary objectives are to maximize stakeholder value while minimizing inefficiencies.

However, it is still challenging for construction professionals to understand and implement Lean concepts. Indeed, various companies lack the information to benefit from Lean practices. Apart from the lack of knowledge, another misconception is that companies find Lean practices costly and are unfamiliar with the long-term benefits or the overall profit that Lean practices can generate. This clearly requires a better understanding of Lean practices and a clear identification of success factors in Lean implementation. This article aims to answer the question of how one can assess fundamentals, principles and success factors in regards to Lean implementation and how these factors might be prioritized depending on their importance. The reason why this article focuses at determining a set of comprehensive critical success factors (CSFs) for Lean implementation is that most Lean implementers do not have a clear roadmap to how to best benefit from applying Lean practices. Considering the limited number of studies regarding Lean construction and problems in

the adoption of Lean practices in construction firms, this article aims to provide a set of CSFs for better adoption of Lean practices in construction business along with the Lean fundamentals, principles, tools and techniques.

II. LEAN CONSTRUCTION DEFINITION

A commonly accepted definition characterizes Lean Construction as a "methodology for designing production systems to minimize wastage of materials, time, and effort, thereby maximizing the creation of value" (Koskela et al., 2002). Lean construction is not merely another method within the construction realm; rather, it challenges the conventional norms and practices of the industry. Its objective is to embrace the advantages of the Master Builder concept. Essentially, Lean Construction acknowledges that the desired outcomes influence the methods used to achieve them and that the available methods will impact the outcomes realized (Lichtig, 2005). Another definition says that "Lean Construction is described as a comprehensive approach to facility design and delivery, aiming to maximize value for all involved parties. This is achieved through systematic, synergistic, and continuous enhancements in contractual agreements, product design, construction process design and method selection, supply chain management, and the reliability of on-site operations workflow".

Lean construction enables us to focus on "preventing illnesses" rather than solely "treating illnesses." At its core, lean construction aims to transform construction sites into assembly locations rather than fabrication sites. Essentially, the more construction work conducted off-site, the greater the efficiency. Utilizing methods such as panelised construction, structural insulated panels, pre-cast concrete, structural steel, raised-access floors, and movable walls facilitates this transition. It's crucial to note that to realize cost savings from off-site fabrication, two key elements must be in place:

a) Coordination and alignment of the entire supply chain, achievable through the implementation of Lean Design and Lean Supply practices.

b) Ensuring reliable workflow on-site, which can only be achieved through waste-free site practices (Muda in lean production) and the utilization of the Last Planner System.

LEAN CONSTRUCTION THEORY:

After conducting an outward-oriented investigation into the prevailing production paradigms in manufacturing industries, namely craft, mass, and lean production, and drawing insights from the Toyota Production System's ideal production model, Koskela formulated a broader production management paradigm tailored for project-based production systems.

Koskela introduced the 'TFV' theory of production, which conceptualizes production in three interconnected ways: Transformation (T) involving the conversion of raw materials into standing structures, Flow (F) encompassing the movement of raw materials and information across production processes, and Value (V) generation aimed at minimizing value loss and maximizing realized outcomes compared to the best possible outcomes for owners.

In today's construction market, many companies prioritize cutting corners and margins to secure projects rather than identifying and addressing waste within their processes. However, reducing and eliminating waste, which includes non-value-added activities, is a fundamental aspect of Lean Project delivery. Shifting focus towards identifying waste necessitates a change in behaviour and mindset.

LEAN CONSTRUCTION PRACTICE:

Lean construction is not about imposing or grafting lean production techniques onto existing construction methods. Companies attempting this approach often fail because the existing processes lack foundational principles and operate with inefficiencies. The correct application of lean construction involves considering how principles can be implemented through specially developed techniques and processes (Pavez and Alarcon, 2007).

A growing number of construction academics and professionals are challenging conventional construction management practices to provide better value to owners while ensuring real profits (Jang et al., 2007). Consequently, lean-based tools have emerged and have been successfully applied to both simple and complex construction projects. These tools are briefly outlined below.

a) Establishing a clear set of objectives for the delivery process, with a thorough understanding of customer needs and requirements.

b) Concurrent processing to prioritize customer needs - This approach involves parallel design processes to enhance positive iteration within the process while minimizing negative iteration.

c) Shifting design responsibilities across the supply chain to minimize variation and align work content.

d) Structuring work throughout the entire process to enhance value and decrease waste at the project delivery level. Improving performance at the planning level contributes to enhanced performance at the project level.

The Last Planner System (LPS) is a production planning and control system designed to enhance the reliability of workflow in construction projects. It aims to improve project predictability, increase collaboration among project participants, and ultimately reduce waste in the construction process. The Last Planner System typically involves the following key components:

*Master Schedule***:** This is the overall project schedule that outlines major milestones and deliverables.

Phase Scheduling: The project is broken down into smaller phases, and detailed schedules are created for each phase.

*Look-Ahead Planning***:** Short-term schedules are developed to focus on upcoming work periods, typically covering a few weeks ahead.

*Weekly Work Planning***:** During weekly meetings, teams collaborate to plan and coordinate tasks for the upcoming week, ensuring that resources are available and potential obstacles are addressed.

*Daily Work Planning***:** Each day, teams review the planned work and make any necessary adjustments based on site conditions or unforeseen circumstances.

*Learning and Continuous Improvement***:** The Last Planner System encourages learning from past experiences and continuously improving planning and execution processes.

Overall, the Last Planner System promotes transparency, accountability, and collaboration among project stakeholders, leading to more efficient and reliable project delivery.

III. LEAN CONSTRUCTION PRINCIPLES

In traditional construction projects, stakeholders typically operate within their designated roles across phases from design to closeout, as outlined in contracts.

However, in lean construction, the emphasis shifts from stakeholders working in isolation within their specific roles to fostering a collaborative team approach. By applying lean construction principles, the project gains additional dimensions as all participants consider the entire life cycle of the project when making decisions about what to build and how to build it. This shift encourages holistic thinking and collaboration among stakeholders, ultimately leading to more efficient and effective project outcomes.

1.*FOCUSING ON THE PROCESS & FLOW:*

In both construction and many other industries, participants often prioritize their individual interests, resulting in transactional relationships primarily governed by contracts.

However, in a lean project environment, the focus shifts towards the construction process itself. When stakeholders adhere to lean construction principles, they optimize every aspect of the process with the final product in mind.

For instance, if you're a subcontractor involved in a lean project, you'll participate in the design phase alongside all other project participants. As a general contractor, you and the owner may consider design variations proposed by subcontractors if they benefit the project. In a lean project setting, regardless of your role, your input is valued and taken into account.

Moreover, lean construction tailors the process to fit the specific needs of the project. Rather than adhering to traditional methods simply because they've always been used, lean construction advocates for using building methods and materials that have been optimized by the team for each project component. This approach ensures that each aspect of the project is executed in the most efficient and effective manner possible.

2.*PLANNING RATHER THAN REACTING:*

In many modern construction projects, teams often focus on short-term objectives due to the fast pace of work. However, in the design phase of a lean construction project, participants take a different approach by considering the entire life cycle of the structure. This involves not only assessing its condition at midlife but also planning for its eventual end-of-life stage.

In addition, participants in lean construction projects evaluate how their individual interests impact each other and strive to align both short-term and long-term goals for the overall benefit of the project.

Success in today's projects serves as a predictor of future success. Analysing both successes and failures provides valuable insights. In lean construction projects, participants value the future by integrating lessons learned from past experiences at every level of the project. This commitment to continuous improvement ensures that future projects benefit from the knowledge gained from previous endeavours.

3.*CREATING STRUCTURES TO ACHIEVE GOALS*

In a lean project, preparation for commencing an activity follows a systemic approach. Once ready, individuals responsible for the work make a firm commitment to fulfil all requirements, ensuring that activities commence "at the last responsible moment." This approach involves "pulling" work rather than "pushing" it, which enhances efficiency and minimizes waste.

As work progresses, all participants actively engage with the lean construction practices in place to anticipate and address potential challenges that may jeopardize project completion. A strong commitment from everyone involved is essential, and in a lean project, this commitment is inherent from the moment participants sign on to the project. Additionally, participants understand that support is readily available from all directions, fostering a collaborative environment where individuals are not left to tackle challenges alone.

4.*MANAGING THE PROJECT SUPPLY CHAIN*

On typical construction projects, the supply chain is fragmented, with each participant responsible for managing their own materials and equipment. In contrast, in a lean construction project, all parties collaborate to enhance supply chain performance. This collaborative effort allows them to mitigate

market variabilities, such as price fluctuations, shortages, and extended lead times. By working together, participants in lean construction projects can effectively reduce the negative impacts of market uncertainties and ensure smoother project execution.

5.*ALWAYS WORKING TOWARDS CONTINOUS IMPROVEMENT*

Continuous improvement stands as a cornerstone principle within lean construction, influencing all other aspects of the methodology. It underscores the notion that any area with potential for enhancement and optimization warrants attention. As stated in the Lean Tenets, lean methodology urges teams to collaborate in compiling a log of constraints hindering productivity on a project. While perfection fosters a more productive environment and facilitates the implementation of all other lean principles.

IV. DISCUSSION ON LEAN IMPLEMENTATION USING CSF'S

The construction industry, known for its dynamism and receptiveness to change, is increasingly embracing new concepts. One such concept gaining traction among construction professionals is "Lean." Specifically, there are six major critical success factors which are useful in effective implementation of Lean Management.

Koskela was among the pioneering figures in Lean methodology, developing Lean principles with the aim of maximizing value for customers while minimizing waste. Central to Lean construction is the transformation–flow–value generation model, which facilitates streamlined processes and eliminates non-value adding activities. Lean construction practices encompass experience in just-in-time (JIT) planning, pull-driven scheduling, reduced variability in labour productivity, and enhanced flow reliability.

In both Lean production and construction, eight types of waste are identified: transportation, inventory, motion, waiting, overproduction, overprocessing, defects, and skills misuse. Additionally, Womack and Jones established the five principles of Lean production—value, value stream, flow, pull, and perfection—which collectively form the theoretical foundation known as "Lean Thinking." This framework distinguishes production activities and guides Lean practices in both manufacturing and construction contexts.

1.MOTIVATIONAL FACTORS:

Motivational factors are pivotal in Lean implementation, with communication of Lean practices emerging as the foremost influence. Availability of resources and employee morale are also key determinants of successful implementation. Building projects often have better access to Lean resources due to their commonality and familiarity with Lean methods. Employee morale significantly impacts Lean success, as noted in various studies. Initiatives like Lean research groups and incentives further motivate engagement in Lean practices. While incentives and government support are beneficial, their effectiveness depends on alignment with Lean objectives. This underscores the importance of understanding motivational factors in Lean implementation. Effective communication and morale-boosting strategies play vital roles in achieving Lean project success. Recognizing the complexity of worker motivation in Lean contexts, emphasizing communication of Lean practices becomes crucial. By prioritizing motivational factors, organizations can devise strategies to foster worker engagement, thereby enhancing the likelihood of success in Lean projects.

2. PROJECT FACTORS:

Project factors play a pivotal role in Lean implementation, encompassing customer satisfaction, morning huddle organization, Lean training, and the efficacy of value stream mapping (VSM). Lean training during projects emerges as the most critical variable, facilitating successful implementation and enhancing employee engagement. Customer satisfaction ranks second, serving as a key driver for maximizing value in Lean endeavours. Effective value stream mapping is also crucial, as it helps eliminate non-value-added activities, thereby enhancing responsiveness and competitiveness. Morning huddles serve as another significant factor, fostering improvement discussions among workers and ensuring efficient work planning and safety considerations. The study's results underscore the importance of these project factors in Lean implementation success. Particularly, effective Lean training during projects leads to smoother implementation processes and heightened customer satisfaction. It is evident that addressing these project factors effectively contributes to the overall success of Lean initiatives, emphasizing the need for comprehensive strategies to integrate them seamlessly into Lean operations.

3. STRATEGIC & POLICY FACTORS:

Strategic and policy factors crucial for project and firm success in Lean implementation include adopting a Lean culture, incorporating Lean into company strategy, and having certified Lean personnel. Adopting a Lean culture is rated as the most important factor, as it fosters successful Lean practices and boosts productivity. Making Lean a company strategy also significantly influences Lean implementation success, correlating strongly with performance improvements. The presence of certified and qualified Lean personnel further enhances implementation strategies and norms adherence. Building projects tend to have more potential for qualified Lean personnel due to their prevalence and extensive application of Lean practices. Additionally, a clear marketing strategy and market share play significant roles in facilitating Lean activities and building trust. Visionary marketing strategies and market growth contribute to the wider adoption and effective implementation of Lean practices, aligning with global market trends and competitiveness.

4.COMPANY FACTORS:

Company factors crucial for Lean implementation include management commitment, Lean leadership, creating awareness for Lean, and willingness to invest in Lean practices. Management commitment is rated as the most important driver, fostering successful Lean implementation through top and middle management participation. Similarly, Lean leadership plays a vital role, with contractors placing particular emphasis on its significance. Creating awareness for Lean and a willingness to invest in Lean practices are also key factors, enabling collaborative structures and facilitating implementation

processes. Older companies tend to prioritize management commitment and willingness to invest more than younger companies, likely due to their greater experience and capital resources. Overall, these company factors are essential for achieving operational excellence through successful Lean implementation.

5.TECHNICAL FACTORS:

Technical factors essential for Lean implementation encompass understanding technical requirements, availability of Lean tools and techniques, technical capacity for implementing Lean tools, and the availability of consulting team members. A clear understanding of technical requirements is paramount, ensuring successful implementation by avoiding repeated processes. Availability of Lean tools and techniques follows closely, as their proper use is crucial for achieving Lean goals. Technical capacity for implementing Lean tools is equally significant, necessitating competency in construction techniques and project management. Additionally, the availability of consulting team members provides valuable insights and solutions, enhancing productivity. While some firms prioritize in-house Lean personnel over external consultants, integrating consultants into implementation processes remains vital for optimal outcomes. Project type influences the need for consultancy services, with transportation projects often requiring more external support due to their complexity. Overall, addressing these technical factors effectively is crucial for successful Lean implementation in construction projects.

6.WORKFORCE AND RESOURCE FACTORS:

Workforce and resource factors play a crucial role in Lean implementation success. Clear roles in Lean are paramount, ensuring everyone understands their responsibilities for a smooth process. A supportive environment for workforce efficiency is equally vital, addressing concerns such as safety and stress. Efficient human resource management activities enhance operational performance and facilitate Lean implementation. While supportive governmental regulations are less significant, they can still facilitate Lean adoption. Overall, prioritizing these factors is essential for higher success rates in Lean implementation, highlighting their importance despite being often overlooked.

Common Factor	Variable
1. Motivational factors	Employee morale and motivation
	Existence of communicating Lean practices
	Existence of Lean research groups and initiatives
	Availability of resources for Lean
	Incentive mechanisms
	Government incentives
2. Project factors	Customer satisfaction with the project
	Organizing morning huddles for Lean
	Lean training during project
	Effectiveness of Value Stream Mapping
3. Strategy and policy factors for project and firm	Adopting a Lean culture
	Lean as a firm strategy
	Existence of certified and qualified Lean personnel
	Existence of a clear marketing strategy
	Market Share
4. Firm factors	Lean leadership
	Management commitment
	Creating awareness for Lean
	Willingness to invest in Lean practices
5. Technical factors	Clear understanding of technical requirements in Lean practices
	Availability of consulting team members in Lean
	Technical capacity for implementing Lean tools
	Availability of Lean tools and techniques
6. Workforce and resource factors	Existence of clear roles in Lean
	Supportive environment for workforce efficiency
	Efficiency of human resource management activities
	Supportive nature of governmental regulations in Lean

This article listed CSFs under six factor groups. This grouping might provide a roadmap for those who struggle with the Lean implementation process and help them identify a sound roadmap for their projects. By considering the complexity and dynamic nature of construction projects and revealing the

benefits of Lean implementation, this article provides a unique set of parameters when implementing Lean in projects and achieving operational excellence.

V.RESEARCH METHODOLGY

This article delves into the construction industry's limited understanding of the benefits of Lean tools and techniques, aiming to establish their connection with the success factors of Lean implementation. Through an online survey distributed among members of the Lean Construction Institute and external practitioners, critical success factors (CSFs) were evaluated using a Likert scale. The survey, encompassing respondents' profiles and perceptions of CSFs, yielded a 35% response rate, ensuring data reliability from participants with both Lean and construction industry experience.

Analysis, including the Kruskal–Walli's test, explored potential variations in responses based on participants' roles, project types, and construction experience. This research underscores the significance of prioritizing CSFs in Lean implementation to bolster project outcomes and overall operational efficiency. It emphasizes the need for construction professionals to grasp the pivotal role of Lean practices and to align them with the broader objectives of project success. Through comprehensive data analysis and the involvement of diverse industry stakeholders, this study sheds light on the critical factors influencing Lean implementation success in construction projects. By elucidating the relationship between Lean principles and project performance, it provides valuable insights for practitioners seeking to optimize their processes and maximize project value.

Moving forward, this research suggests the importance of continued education and awareness-building efforts within the construction industry to foster a deeper understanding of Lean methodologies. By disseminating knowledge and promoting best practices, stakeholders can enhance their capacity to implement Lean principles effectively and reap the associated benefits of improved project outcomes and operational excellence. The survey intended to quantify the impacts of different factors on the Lean implementation success. The survey included two sections: 1) general information about the respondents and 2) CSFs for Lean implementation. In the first part of the survey, questions regarding the company and respondent profile were addressed, such as field of operation and years of experience in the construction industry. In the second part, the questions regarding the CSFs were addressed to reveal the level of importance. The respondents were asked to evaluate the level of importance for the CSFs based on a 1–5 point Likert scale, where 1 indicates a very low level of importance, and 5 indicates a very high level. The tools and techniques which are used for the Lean Implementation alongside their definitions are enlisted below for clear understanding.

Lean implementation tools and techniques	Definition
The Last Planner System	It is a collaborative framework for supporting Lean project planning and execution. The system is designed to come up with a predictable work flow and rapid learning in design, construction, and commissioning of projects.
Visual Management	It is a management strategy for managing visual ability thanks to sensory systems and visual cues for facilitating information flow and work control.
Mistakeproofing (Poka-yoke)	These are tools and systems to design control or prevent process errors from turning into defects. Mistakeproofing tools and systems provide several benefits such as zero quality control, improved safety, and reduced set up time.
5S	It is an improvement system to organize workplace for creating an efficient, safe, and clean workplace. It refers to Japanese words meaning sort, straighten, shine, standardize, and sustain.
JIT	It is a system, where materials are delivered before they are required for minimizing storage costs. It aims to reduce flow times and optimize stocks along with work-in-progress.
VSM	It is a material and information flow technique used to evaluate the current and future state of a production by bringing up the improvement opportunities.
Takt Time Planning	It is pacing the work for matching the customer's demand rate. Takt time planning helps creating a pull system.
Work Structuring	Work structuring is the essence of process design to decide how work chunks are designed and be assigned to specialists. It aims to deliver value to customer while making work flow quick and reliable.
Modularization and Prefabrication	These are construction processes used to increase productivity on construction sites. It helps reducing the risk of health and safety hazards, and low quality by modularizing and prefabricating construction components.
Huddle Meetings	It is a technique used to communicate with project team to ensure worker involvement Training is sometimes provided to increase project awareness and develop problem solving skills.
Work Standardization	It is a technique, where the work has been
	standardized by sequencing the job elements in an organized manner. It is often times followed by the standardized work documents.
Kanban (Pull system)	Kanban refers to a Japanese word meaning "billboard or signboard". The system refers to control processes, where flow of resources is regulated based on a set of cards, signals, and tokens.
Kaizen	Kaizen is a Japanese management philosophy referring to continuous improvement. The technique aims to increase workplace efficiency and productivity by revealing how small improvements might lead to higher quality and reduced costs.

FIG. TOOLS & TECHNIQUES IN LEAN IMPLEMENTATION

VI. RESULTS

The study highlights that Management commitment, Lean training on the project, and Customer satisfaction emerge as the most pivotal drivers of successful Lean implementation. Conversely, factors such as market share, the supportive nature of governmental regulations in Lean, and Government incentives are deemed less influential in the implementation process. These findings underscore the paramount importance of organizational commitment, targeted training initiatives, and customer-centric approaches in achieving Lean implementation success within the construction industry. Further analyses were performed to indicate whether significant differences exist in the responses for different groups based on their role in the project, the type of project, and years of experience in the construction industry. It is further shown that significant differences exist between the responses based on the project type in terms of availability of consulting team members in Lean or creating awareness for Lean. Similarly, there is a significant difference in the responses in terms of existence of Lean research groups Variations in Lean initiatives were evident across project types, notably impacting initiatives and employee morale. Management commitment and investment willingness in Lean practices showed noteworthy distinctions based on project roles, indicating diverse levels of commitment across parties. Furthermore, differences in Lean training and leadership correlated with construction experience, suggesting that

expertise in the field may influence training and leadership approaches in Lean practices. Resources for Lean and the presence of certified Lean personnel are deemed more crucial in building projects compared to infrastructure projects. Transportation projects place greater emphasis on having a consulting team proficient in Lean. Additionally, older companies prioritize management commitment, Lean training, and investment in Lean practices more than younger ones, likely due to their extensive experience with Lean, making it a fundamental strategy.

VII. CONCLUSION

The construction industry grapples with challenges in meeting project goals like cost, time, quality, and safety. Lean methodology offers solutions, yet its benefits remain underappreciated due to factors like tool costs and limited implementation experience. This study aimed to simplify Lean adoption by identifying critical success factors (CSFs). From a survey of 106 Lean practitioners, 27 CSFs were identified, with management commitment, Lean training, and customer satisfaction emerging as pivotal drivers. Conversely, market share, government incentives, and regulatory support ranked lower. Significant variations were noted based on project roles, type, and experience levels. For instance, contractors prioritized Lean leadership and investment willingness more than designers did. Additionally, certified personnel and resource availability were deemed crucial for building projects compared to transportation or infrastructure endeavours. Older companies showed greater sensitivity to management commitment, training, and investment willingness than younger counterparts. Factor analysis revealed six groups: motivational, project, strategic and policy, company, technical, and workforce factors, with motivational factors holding significant importance. This study offers insights to industry professionals for better Lean implementation, aiding project managers in understanding the conducive factors and benefits of Lean tools. While the findings are U.S.-centric, they offer valuable guidance for global research endeavour's due to the prevalence of Lean practices in American companies.

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