Readiness Factors for Sustainable Lean Transformation ofConstruction Organizations

Subjects: Construction & Building Technology

Contributor: Kudrekodlu V. Prasad , Venkatesan Vasugi

Readiness for lean transformation is considered an essential requirement. Several studies have been conducted to identify lean readiness factors and develop assessment frameworks in other sectors such as manufacturing, healthcare, pharmaceutical, emergency, higher education, etc., but none in construction. The work assesses the criteria and factors of lean readiness.

lean readiness factors change culture construction sustainability

1. Introduction

Construction projects underpin economic development [1] and the progress of all nations. The construction industry adds significantly to the Gross Domestic Product (GDP) in a vast majority of countries with nearly 13% of the global GDP [2][3]. However, construction projects are seldom completed within the planned time and cost [4]. Projects linger with management change problems, time overruns, cost escalations, claims, and disputes [5] resulting in huge wastages of time, effort, and all resources. It has also been a concern that over the years construction productivity has remained flat as compared to the manufacturing industry, and this lag translates to about USD 1.6 trillion of loss every year [6]. Research studies have indicated that construction sector productivity can be boosted by 5 to 10 times in some areas by adopting a manufacturing-style production approach [6].

The lean production system originated from Toyota's production system which, when implemented properly, has provided significant dividends to organizations. Despite the huge benefits of the lean production system, many organizations have been unsuccessful in their journey towards lean transformation and most organizations failed to reach the summit stage [7]. Successful lean transformation requires a transformation in the organizational culture [8]. If not addressed appropriately, the project of introducing lean culture into an organization may not only end up as a failure but may also significantly impair the prevalent practices and routine business processes of the organization as well [9].

Organizational lean readiness reflects upon the organization's ability to undergo a smooth and sustainable lean transition and is developed by setting up practices, conditions, and resources facilitating lean change [10]. Studies have indicated lean implementation failure is also attributed to the fact that little attention is paid to organizational lean readiness [11][12]. To eliminate/reduce the failures in lean implementation, there needs to be an assessment of the organizational readiness levels before committing [13][14]. To ensure successful lean transformation, there needs to be an assessment of the organizational readiness levels [14]. This prior assessment of organizational readiness

is intended to cut down the wasted effort and any waste during the process of lean transformation and will help ensure minimum disruption to the organizational process and business [8]. A planned organizational change would be more effective and efficient and would help organizations to measure the ability within the organization and aid in improving organizational capabilities [15].

2. Readiness Themes and Factors for Lean Transformation

To assess the works that were carried out on lean readiness, a systematic literature review (SLR) was carried out. The search query string—"Lean readiness" OR "readiness for lean" OR "readiness for lean implementation" OR "lean readiness assessment"—was set to include all journal research articles on lean readiness published in the English language in the Scopus and Web of Science (WOS) databases over the last decade. The search string resulted in 260 documents from Scopus and 119 documents from the WOS database. The duplicates in the databases were removed with the help of Zotero software. A team of three experts from academia and industry helped to identify and narrow down the literature relevant to the objectives and eliminate any bias for further review. Finally, 53 research articles were selected for analysis.

As may be seen from **Figure 1** and **Figure 2**, out of the 53 articles, 27 of the studies (~51% of the studies) have focused on the manufacturing sector only. A total of 23 studies (43%) have been conducted in the service sectors. Again, as can be seen from **Figure 2**, these studies have been conducted in healthcare facilities [12][13][15][16][17][18][19][20], in emergency departments [21][22][23], higher education [24][25][26][27][28], and the construction industry [29][30][31][32]. The three service sectors—healthcare, higher education, and emergency—make up 70% of the studies within service sectors.

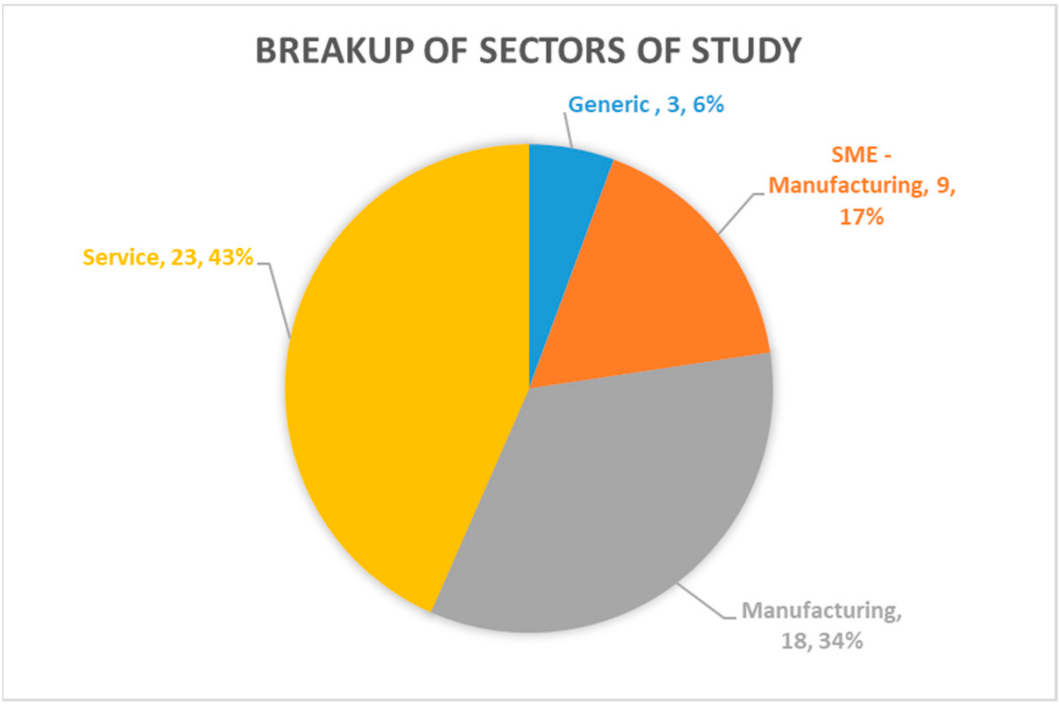

Figure 1. Distribution of articles by sectors.

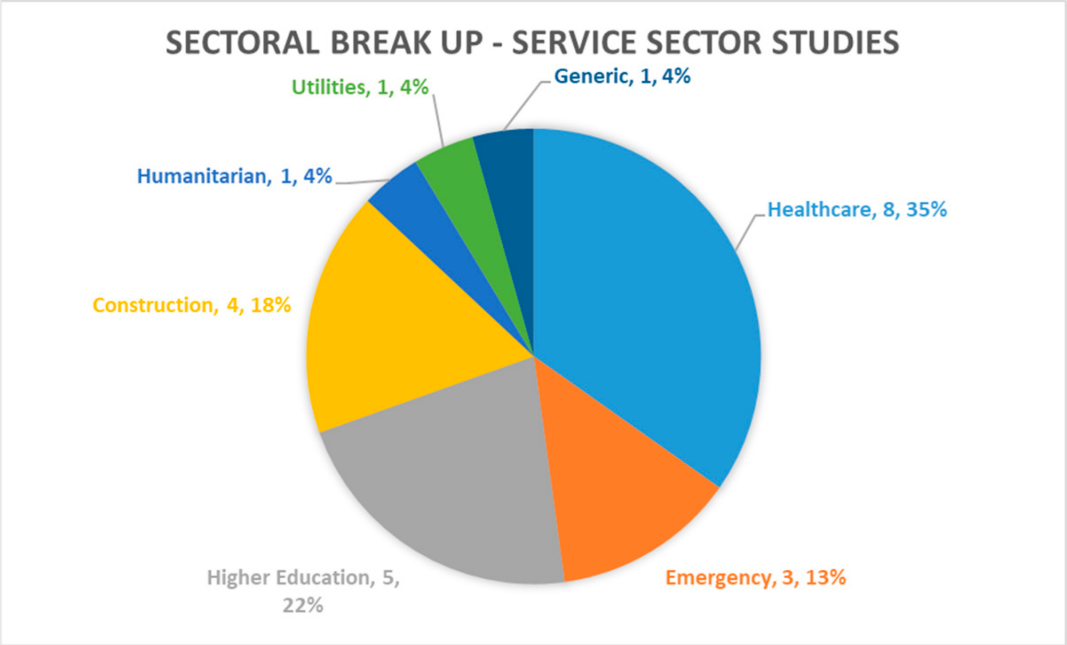

Figure 2. Distribution of service sector articles.

The four studies conducted in the construction sector, the study objectives, and the limitations are outlined in **Table 1**.

Table 1. Studies on lean readiness in the construction sector.

Study	Focus Area of the Study	Limitations of the Study
[29]	Lean Culture	Focuses only on cultural readiness; no holistic study on all the aspects of lean readiness
[30]	Lean readiness of Azerbaijan construction industry	Themes and factors such as those of the manufacturing sector studies adopted as they are; not customized to the construction industry; the study does not address the construction project lifecycle or processes
[31]	Construction Operations	Focuses only on the implementation of lean construction principles, but not readiness; lacks focus on softer attributes of lean readiness; outdated
[32]	Lean procurement	Focuses on the procurement process alone

As can be seen from **Figure 1** and **Figure 2**, and also **Table 1**, no comprehensive study has been carried out investigating the lean readiness factors for construction organizations.

This phase of review summarized “Organizational Readiness” themes and associated factors, which are largely applicable irrespective of the type/sector of the organization. These themes and factors represent the soft lean practices which apply to an organization in any sector/stream. These themes are discussed in the following section and factors are presented in **Table 2**. Twenty-eight lean readiness factors within the themes of leadership and top management commitment, organization Culture, employee/human Resources engagement, customer focus, communications and processes, and technology management were identified from the review of the fifty-three articles.

2.1. Top Management Commitment and Leadership

Any change management programme, including lean, needs the management’s unwavering support throughout the implementation phases as well as the leadership’s willingness to mentor and mitigate the risks of failure. Leadership should be able to create a vision that enables the employees to internalize the anticipated change and shift from current practices to best-in-class practices [24]. Top management must be prepared and show a willingness to be involved in resolving challenges that develop throughout the implementation, and leadership must completely enable the lean implementation teams by providing the necessary resources and infrastructure [16][33].

2.2. Organization Culture

Organizational culture can be defined as the shared assumptions regarding deep-rooted organization-wide values, norms, and beliefs [28], and the very definition of lean itself calls for a shift that relates to elements of cultural change. The culture of an organization greatly influences how well Lean transformations happen [34]. Organizational culture subtly directs the actions and behaviours of an organization’s members [35]. Organizations can accomplish strengthening the “soft aspects” required for firms to be more successful in their lean transformation by enhancing these positive behaviours and attributes.

2.3. Employee/Human Resources Engagement

The success of lean implementation depends on the level of awareness of employees [36] on the concepts of lean, lean tools and techniques, and the benefits which can be realized from the implementation. Hence, educating and involving every employee in and around lean principles, methodologies, and practices is crucial [16]. One of the crucial key criteria for effective adoption is lean training [37]. Management should align organizational objectives with employee performance KPIs, motivate with reward systems, [38] and should encourage to take full ownership and corrective actions to improve the processes [33].

2.4. Customer Focus/Customer Relationships

The capacity to define the customer is one of the crucial elements for successfully implementing lean practices in any firm [39]. A well-defined value for a given customer group prevents conflicting needs and objectives and reduces resistance to change [16]. Organizational processes must be structured with the needs of the customer at

the centre, and all initiatives for improvement must systematically take customer feedback into account at every stage [24].

2.5. Technology/Process Management

Organizations need to set up processes that can analyze the waste across the value stream, cut down on the non-value-adding activities, and improve the quality and value [14]. Organizations must make sure that performance is tracked to decrease variability and find ways to improve. There must be procedures in place to evaluate the costs and benefits of major undertakings and manage risks [12][33].

2.6. Communication

Communication is one of the cornerstones of lean practices [40]. Lack of effective communication with the stakeholders of the lean initiative can lead to failure [41] and organizations need to establish clear and effective communication channels to ensure communication with all team members [42]. The organization should set up a communication process that encourages the horizontal and vertical exchange of information and also share lessons on failures and short-term wins [33].

3. Readiness Themes and Factors from Lean Construction Studies

Having identified the lean readiness studies in other sectors, it was important to review the lean construction literature to identify lean readiness factors spanning the construction project lifecycle. The Lean Project Delivery System (LPDS) proposed by Prof. Ballard [43], shown in **Figure 3**, was taken up as a starting point.

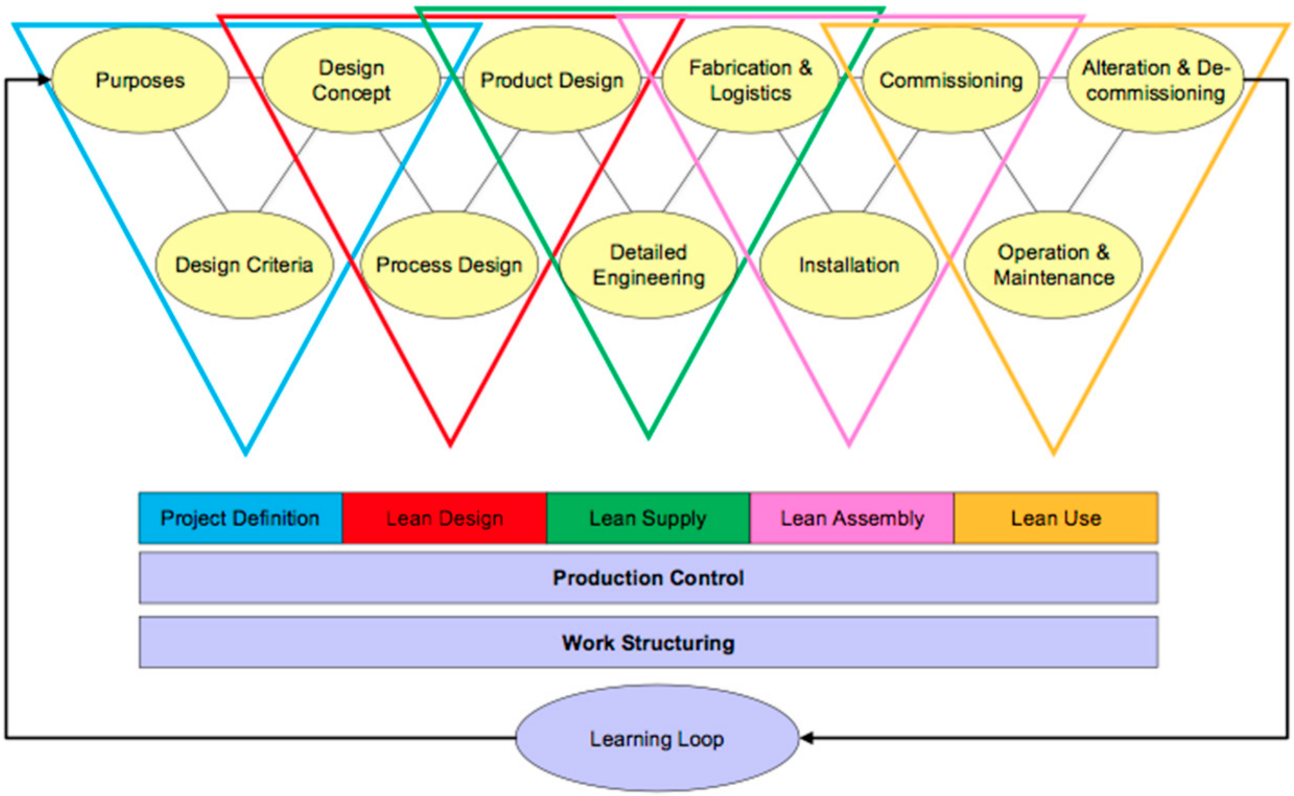

Figure 3. Lean Project Delivery System [43].

3.1. Engineering and Design

As can be seen from **Figure 3**, Project definition starts with the conceptual stage of engineering and design development and this process translated the project objectives to definitive outcomes. The study by [44] investigated the parameters that build lean ideology in the engineering and design management processes in construction projects. The factors identified by this study are selected for the study and listed in **Table 3**.

3.2. Project Planning, Monitoring, and Control

The Last Planner System® (LPS) has been one of the most commonly adopted production control methodologies based on lean philosophy. LPS was proposed as a novel solution by [45] to increase workflow predictability and increase work plan predictability by controlling the quality of assignments in weekly work plans. Studies by [46][47] identified parameters for planning and production control processes based on the LPS philosophy. The recently updated guideline [48], which was also considered, has touched upon the factors of work structuring and the visual management of plans in great detail.

3.3. Procurement and Inventory Management

Integrating lean practices with the supply chain, procurement, and material management, has been the interest of many studies [32][49][50][51]. These studies have advocated pull-based procurement, the use of automation and IT to

minimise material requirements, standardized procurements, waste control, material reconciliation, housekeeping, and 5S methodologies in construction projects.

3.4. Contract Management

The other aspect of integrated lean project delivery is the aspect of work structuring, a process that designs and connects the project deliverables with suppliers, subcontractors, and other vendors. Towards this, studies [52][53][54] have advocated the practice of a relational contracting system that promotes balanced risk and opportunity sharing between the parties, transparency, and trust, and develops partnerships to build these in the supply chain contracts with all the vendors and contractors.

Twenty-five lean readiness factors were identified through a review of lean construction literature and are summarized in **Table 3**.

Table 2. Lean readiness themes and factors from the literature (organizational readiness themes).

Theme	Lean Readiness Factors
Top Management Commitment and Leadership	• Support and commitment to new initiatives by providing the needed infrastructure [33][55]; • Commitment from the organization to economic and financial objectives along with growth and long-term survival [15][33]; • Dedication of time by senior management to ensure the adoption of improvement initiatives [56]; • Humble leadership with mutual respect for subordinates and peers [12].
Organization Culture	• Strategic efforts and business goals, connected by systemic thinking [57]; • Cooperation between the organization and all of its stakeholders viz. customers, suppliers, etc. [12]; • Flexibility to respond to changing market conditions, client demands, and needs [33]; • Existence of a blame-free culture within the company [33];

Theme	Lean Readiness Factors
	• Focus on team collaboration in a project- or management-related environment [8].
Employee Engagement/HR	• Full participation of the workforce in all activities [16][21][33]; • Periodic multifunctional training employees to ensure employees develop the skill set to deploy problem-solving tools and techniques [15][58]; • Empowerment of the employees with full ownership to improve their work processes and implement corrective actions [14][33]; • Efforts of the employees are recognized and rewarded [8][59]; • Employee initiative to support projects and activities for continual improvement [33]; • Participation of lower-level or junior staff in project review meetings [56]; • Periodic feedback on employee performance [17].
Customer Focus	• Project selection based on organizational competencies [24][60]; • Existence of a mechanism for determining the needs of and adding value to customers [16][24]; • Participation of the client in the project's planning and development [11][14][56]; • Customer feedback processes and mechanisms for ongoing improvement [11][14][24][56].
Communication	• Regular communication on strategy and vision of key initiatives [18]; • Communicating with all employees the purpose, vision, strategy, goals, and objectives of the business [33][60][61]; • Information exchanges across the hierarchy—horizontal and vertical [15][33]; • Effective communication of short-term successes and failures [21][33][62].

Theme	Lean Readiness Factors
	• Benchmarking against the competition * [14][21][56]; • Using a performance measurement system (PMS) to comprehend the process's current state and potential improvement routes [33][60];

nes).

Stage of Project Development	Lean Readiness Factors
Engineering and Design	• Involvement of specialist designers [44]; • Exhaustive stakeholder requirement identification [44]; • Systematic participation of clients in the design phase [44]; • Collaboration with stakeholders during design meetings [44]; • Systematic identification, and release of the constraints [44]; • Consideration of all lifecycle stages in the design process [44].
Project Planning	• Formalized planning process [46]; • The correct definition of work packages [47]; • Standardization of planning meetings [46][47]; • Use of a transparent, understandable master plan; • Inclusion of constraint-free work packages [48]; • Shared decision-making [48].
Project monitoring	• Use of visual devices [47][48]; • Performance metrics [47]; • Constraint analysis [46]; • Workable backlogs [48]; • Analysis of physical flows [48];

Stage of Project Development	Lean Readiness Factors
	• Schedule performance indicators [48]; • Corrective actions [46][47][48].
Procurement and Inventory Management	• Pull-based procurement [32]; • Existence of housekeeping procedures and material classification by class or category [32][49][50][51].
Contract Management	• Risk sharing [54]; • Transparency [53]; • Regular communication [52]; • Incentives for performance linked with KPIs [54].

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