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Lean Construction: Enhancing Efficiency And Quality In The Construction Industry

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Abstract
Background. Lean Management and Lean Construction have been widely recognized as effective approaches to improving efficiency, reducing waste, and enhancing organizational performance. However, the readiness of construction organizations—particularly State-Owned Enterprises (SOEs)—to implement Lean Management remains insufficiently explored, especially in developing countries.
Aims. This study aims to assess the factors influencing Lean Management implementation and to evaluate the readiness level of Indonesian construction SOEs using a quantitative approach. The research adopts Lean Management as its theoretical foundation and applies the Lean Construction Maturity Model (LCMM) as the primary measurement framework to capture organizational readiness comprehensively.
Methods. Data were collected through a structured questionnaire distributed to management-level respondents across six Indonesian state-owned construction companies, involving division heads, section managers, staff, and project managers, with a total sample of approximately 250 respondents. The analysis employs linear regression within a structural model to examine the relationships among key readiness factors, including leadership, culture and behavior, competence, continuous improvement support, processes and tools, organizational change, work environment, business results, and learning and competency development.
Result. The findings are expected to provide empirical insights into the interdependencies among these factors and to identify critical readiness gaps that may hinder effective Lean Management implementation.
Conclusion. This study contributes theoretically by extending the application of LCMM to Lean Management readiness assessment and practically by offering a structured diagnostic framework for SOEs seeking to enhance Lean adoption in the construction sector.

Keywords: Lean Management, Lean Construction, Readiness Assessment, LCMM, State-Owned Enterprises

INTRODUCTION

Research on Lean Management, Lean Construction, and Lean Organization has developed significantly over the past three decades, originating from the Toyota Production System and expanding across manufacturing, services, healthcare, public administration, and construction sectors. Lean Construction adapts core Lean principles—value, value stream, flow, pull, and continuous improvement—to project-based environments characterized by uncertainty, fragmentation, and stakeholder complexity.

Existing studies have demonstrated that Lean Construction improves efficiency, reduces waste, enhances collaboration, increases quality, and mitigates project risks. Tools such as the Last Planner System (LPS), Target Value Design (TVD), Integrated Project Delivery (IPD), Kaizen, and Visual Management are widely recognized as effective operational mechanisms. Empirical studies largely focus on project-level implementation, tool effectiveness, and case-based performance outcomes.

Meanwhile, Lean Management and Lean Organization literature emphasize organizational culture, leadership commitment, competency development, continuous improvement systems, and performance measurement. Several maturity and assessment tools have been proposed, including Lean checklists, qualitative diagnostics, and manufacturing-oriented readiness models. The Lean Construction Maturity Model (LCMM) represents a more comprehensive framework, capturing leadership, culture, competence, processes, change, work environment, business results, and learning dimensions.

However, most prior research applies LCMM or Lean tools descriptively, qualitatively, or in isolated dimensions, with limited empirical testing of inter-factor relationships, particularly at the organizational readiness level within construction enterprises—especially in developing-country contexts and State-Owned Enterprises (SOEs).

Lean Construction has emerged as a transformative approach in the construction industry, aiming to minimize waste and maximize value throughout the project lifecycle. Originating in Lean manufacturing principles pioneered by Toyota, Lean Construction adapts them to address the unique challenges of the construction sector. This article explores the key concepts, principles, benefits, challenges, and applications of Lean Construction, supported by relevant literature and case studies.

Lean Construction is a management philosophy that seeks to optimize efficiency, minimize waste, and improve overall project outcomes by focusing on continuous

improvement and value creation (Alarcon et al., 2016). Unlike traditional construction methods that often suffer from inefficiencies and delays, Lean Construction emphasizes collaboration, streamlined processes, and lean thinking across all project stages—from design to completion. The foundational principles of Lean Construction include:

1. Value: Identifying and delivering what the customer truly values.
2. Value Stream: Mapping the entire construction process to eliminate non-value-adding activities (waste).
3. Flow: Ensuring smooth and continuous workflow to reduce delays and bottlenecks.
4. Pull: Triggering production based on actual demand rather than pushing work regardless of need.
5. Perfection: Continuously striving for improvement in processes and outcomes (Koskela, 1992).

These principles guide practitioners in implementing Lean methodologies effectively, aiming for greater productivity and quality in construction projects.

The adoption of Lean Construction methodologies offers numerous advantages:

1. Improved Efficiency: By eliminating waste and optimizing processes, Lean Construction reduces project duration and costs.
2. Enhanced Collaboration: Emphasizing teamwork and communication among stakeholders leads to better project coordination and fewer disputes.
3. Higher Quality: Focusing on value and continuous improvement results in better-built structures and higher client satisfaction.
4. Risk Reduction: Proactively identifying and addressing potential issues minimizes project risks and improves overall safety (Ballard, 2002).

Several tools and techniques support the implementation of Lean Construction principles:

1. Last Planner System: Facilitates collaborative planning and scheduling, enhancing project predictability.
2. Visual Management: Uses visual aids to monitor progress, identify problems, and promote transparency.
3. Kaizen: Encourages continuous small improvements through employee involvement and feedback.
4. Lean Supply Chain Management: Streamlines material procurement and delivery to reduce delays and costs.

These tools empower construction teams to streamline operations and achieve better project outcomes.

Despite its benefits, Lean Construction faces several challenges:

1. Cultural Resistance: Traditional practices and resistance to change among stakeholders can hinder adoption.
2. Complexity: Implementing Lean principles in large-scale or complex projects may require tailored approaches.
3. Education and Training: Adequate training and education are essential to ensure all team members understand and support Lean principles.
4. Measurement of Success: Defining and measuring success in Lean Construction projects can be challenging due to varying project metrics (Howell & Ballard, 2000).

Addressing these challenges requires commitment, leadership, and a willingness to adapt existing practices to optimize performance.

Numerous case studies highlight successful applications of Lean Construction across different projects and contexts:

1. Toyota Production System: Adapting manufacturing Lean principles to construction led to significant improvements in efficiency and cost-effectiveness.
2. The Big Dig, Boston: Implementing Lean principles reduced project costs and completion time while improving safety and quality.
3. Integrated Project Delivery (IPD): Collaborative project delivery methods align with Lean principles, fostering teamwork and efficiency.

These examples underscore the versatility and effectiveness of Lean Construction in diverse construction settings. In conclusion, Lean Construction represents a paradigm shift in the construction industry, offering a systematic approach to minimize waste, enhance efficiency, and improve project outcomes. By embracing Lean principles and leveraging appropriate tools and techniques, stakeholders can foster a culture of continuous improvement and deliver projects that meet or exceed client expectations. As the industry continues to evolve, further research and application of Lean Construction principles will undoubtedly shape the future of construction practices worldwide.

This study introduces several key novelties:

1. Organizational-Level Lean Readiness Focus. Unlike dominant project-centric Lean Construction studies, this research shifts the analytical unit to the organizational readiness of construction SOEs, offering a strategic and systemic perspective.

2. Integration of Lean Management Theory with LCMM. The study explicitly adopts Lean Management as the theoretical foundation while employing the Lean Construction Maturity Model (LCMM) as a quantitative readiness measurement tool—bridging conceptual Lean Management theory with construction-specific maturity assessment.
3. Quantitative Structural Analysis of Readiness Factors. The research develops and applies a regression-based structural model to empirically analyze interdependencies among eleven LCMM dimensions (e.g., leadership, culture, competence, continuous improvement, processes, change, work environment, business results, and learning).
4. Contextual Contribution to Developing Countries and SOEs. By focusing on Indonesian state-owned construction enterprises, the study provides rare empirical evidence from a context underrepresented in Lean literature, where bureaucratic structure, organizational inertia, and public accountability strongly influence Lean adoption.
5. Extended Application of LCMM. The research extends LCMM usage beyond maturity description toward a diagnostic readiness framework, capable of identifying priority gaps that hinder Lean Management implementation.

LITERATURE REVIEW

Lean Organization

Lean Organization is a management philosophy derived from the Toyota Production System, emphasizing efficiency, waste reduction, and continuous improvement. This literature review explores the evolution, principles, applications, and outcomes of Lean Organization, drawing from a variety of sources to provide a comprehensive overview.

Evolution of Lean Organization

The concept of Lean Organization has its roots in the post-World War II era when Toyota Motor Corporation developed the Toyota Production System (TPS) to optimize manufacturing processes. The term "Lean" was popularized by Womack, Jones, and Roos (1990) in their seminal book, *The Machine That Changed the World*. Since then, Lean principles have expanded beyond manufacturing to various sectors, including healthcare, services, and public administration (Womack & Jones, 2003).

Core Principles of Lean Organization

Lean Organization is built on five fundamental principles:

1. Value:Define value from the customer’s perspective.
2. Value Stream:Map the value stream and eliminate waste.

3. Flow: Ensure that value-creating steps flow smoothly without interruptions.
4. Pull: Produce only what is needed when it is needed.
5. Perfection: Strive for continuous improvement in all processes (Womack & Jones, 2003).

These principles guide organizations in creating more value with fewer resources, thereby increasing efficiency and effectiveness.

Applications of Lean Principles

Lean principles have been widely applied across different industries, each adapting the methodology to its specific context:

1. Manufacturing: Lean principles were first applied in manufacturing, where techniques like just-in-time (JIT), 5S (Sort, Set in order, Shine, Standardize, Sustain), and Kaizen (continuous improvement) are used to reduce waste and enhance productivity (Liker, 2004).
2. Healthcare: Lean has been adapted to healthcare to improve patient flow, reduce waiting times, and enhance the quality of care. Techniques such as value stream mapping and root cause analysis are employed to identify and eliminate inefficiencies (Kim et al., 2006).
3. Services: In service industries, Lean is used to streamline processes, improve customer service, and reduce operational costs. Service organizations apply Lean tools like Kanban (visual scheduling) and standard work to manage workflows more effectively (Swank, 2003).
4. Public Administration: Lean has also found applications in public administration to enhance service delivery and reduce bureaucratic inefficiencies. Governments use Lean principles to improve processes in areas such as licensing, permitting, and public safety (Radnor & Walley, 2008).

Outcomes of Implementing Lean Organization

The implementation of Lean principles has been associated with numerous positive outcomes:

1. Efficiency:Lean organizations typically achieve higher efficiency by eliminating waste and optimizing processes (Womack & Jones, 2003).
2. Quality: Continuous improvement efforts lead to higher quality products and services, meeting or exceeding customer expectations (Liker, 2004).
3. Employee Engagement: Lean practices often involve employees in problem-solving and decision-making, leading to higher levels of engagement and job satisfaction (Bortolotti et al., 2015).

4. Customer Satisfaction: By focusing on value from the customer's perspective, Lean organizations are better positioned to meet customer needs and enhance satisfaction (Hines et al., 2004).

Challenges and Criticisms

Despite its benefits, Lean Organization is not without challenges and criticisms:

1. Implementation Difficulties : Successfully implementing Lean requires a cultural shift and strong leadership commitment, which can be challenging to achieve (Bhasin, 2012).
2. Sustainability:Maintaining Lean improvements over the long term can be difficult, as organizations may revert to old habits (Bateman & David, 2002).
3. Misapplication: Misapplication of Lean principles, such as focusing too much on cost-cutting rather than value creation, can lead to negative outcomes, including employee dissatisfaction and reduced quality (Czabke et al., 2008).

Lean Organization is a powerful methodology that has transformed numerous industries by enhancing efficiency, quality, and customer satisfaction. While the journey to becoming a Lean organization is fraught with challenges, the potential benefits make it a worthwhile endeavor. Future research should continue to explore the evolving applications of Lean principles and address the challenges associated with sustaining Lean transformations.

Differences and Similarities Between Lean Management, Lean Construction, and Lean Organization

Lean Management, Lean Construction, and Lean Organization are methodologies that share the same foundational principles, aimed at improving efficiency, reducing waste, and fostering continuous improvement. Despite their shared roots, these methodologies have unique applications and practices tailored to different contexts. This article explores the differences and similarities between these approaches, providing a comprehensive comparison.

Origins and Core Principles

Lean Management originated from the Toyota Production System (TPS) in the mid-20th century, emphasizing efficiency and waste reduction in manufacturing. The core principles are:

1. Value: Define value from the customer's perspective.
2. Value Stream: Map the value stream to identify and eliminate waste.
3. Flow: Ensure smooth flow of value-creating steps.

4. Pull: Produce only what is needed when it is needed.
5. Perfection: Strive for continuous improvement (Womack & Jones, 2003).

Lean Construction adapts these principles to the construction industry. It emerged in the 1990s with the establishment of the Lean Construction Institute, focusing on project-based workflows and variability management (Howell, 1999).

Lean Organization extends Lean principles across various organizational functions, not limited to manufacturing or construction. It encompasses a holistic approach to improving overall organizational efficiency and effectiveness (Womack & Jones, 2003).

Key Differences

Industry Focus:

1. Lean Management: Primarily applies to manufacturing but has been adapted to other sectors like healthcare and services (Liker, 2004).
2. Lean Construction: Specifically tailored for the construction industry, dealing with its unique challenges such as project variability and complex stakeholder coordination (Koskela, 1992).
3. LeanOrganization: Broader application across all organizational functions, including finance, HR, and IT, aiming for comprehensive organizational transformation (Womack & Jones, 2003).

Implementation Techniques:

1. Lean Management: Uses tools like 5S, Kaizen, Kanban, and Just-In-Time (JIT) to optimize manufacturing processes (Liker, 2004).
2. Lean Construction: Employs techniques such as the Last Planner System (LPS), Target Value Design (TVD), and Integrated Project Delivery (IPD) to manage construction projects (Ballard & Howell, 2003).
3. Lean Organization: Utilizes a wide array of Lean tools and techniques across different departments, emphasizing a holistic improvement approach (Hines et al., 2004).

Process Nature:

1. Lean Management: Deals with repetitive and standardized processes in a controlled environment.
2. Lean Construction: Focuses on one-off, project-based processes with high variability (Salem et al., 2006).
3. Lean Organization: Addresses both repetitive processes and unique projects, aiming for overall organizational efficiency (Bhasin, 2012).

Key Similarities

Waste Reduction:

All three methodologies emphasize eliminating waste to improve efficiency. In Lean Management, waste can be excess inventory or production steps. In Lean Construction, waste often includes delays and rework. Lean Organization targets inefficiencies across all organizational processes (Womack & Jones, 2003; Howell, 1999).

Customer Focus:

Each approach prioritizes delivering value to the customer. Lean Management aims for high-quality products, Lean Construction seeks to deliver projects on time and within budget, and Lean Organization focuses on overall customer satisfaction by optimizing various functions (Hines et al., 2004; Koskela, 1992).

Continuous Improvement:

The principle of continuous improvement, or Kaizen, is central to all three methodologies. Regular reflection and incremental changes are encouraged to enhance processes and outcomes (Womack & Jones, 2003; Liker, 2004).

Collaboration and Teamwork:

Effective communication and teamwork are crucial across all three approaches. Lean Management fosters cross-functional teams, Lean Construction emphasizes collaboration among project stakeholders, and Lean Organization promotes interdepartmental cooperation (Ballard & Howell, 2003; Bortolotti et al., 2015).

Lean Management, Lean Construction, and Lean Organization share common principles aimed at enhancing efficiency and reducing waste. However, their applications and specific techniques vary significantly due to the distinct nature of the industries they serve. Understanding these differences and similarities can help organizations tailor Lean methodologies to their specific needs, leading to more effective implementation and improved outcomes.

Unexplored Areas In The Intersection Of Lean Management, Lean Construction, And Lean Organization

Lean Management, Lean Construction, and Lean Organization are methodologies with a shared foundation in optimizing processes, reducing waste, and enhancing value. Despite their common origins, there remain unexplored areas at their intersection that present significant opportunities for cross-disciplinary research and practical innovation. This article

aims to highlight these unexplored areas, offering a roadmap for future research and implementation.

Integration of Advanced Digital Technologies

Lean Management has embraced Industry 4.0 technologies such as the Internet of Things (IoT), big data analytics, and artificial intelligence (AI) to enhance process monitoring and optimization (Buer et al., 2018).

Lean Construction, however, has been slower in adopting these advanced technologies beyond Building Information Modeling (BIM). There is a considerable potential for integrating IoT and AI to improve construction site management, predictive maintenance, and real-time decision-making. Future research could explore how these technologies can bridge the gap between Lean Management and Lean Construction, driving innovation and efficiency (Dave et al., 2013).

A Lean Organization could benefit from these technologies by enhancing data-driven decision-making across all organizational functions. Investigating the synergies between these technological advancements and Lean methodologies across domains can yield significant improvements in organizational efficiency and effectiveness.

Cross-Disciplinary Learning and Best Practices

The cross-pollination of best practices between Lean Management, Lean Construction, and Lean Organization remains underexplored. Manufacturing's experience with automated quality control systems and just-in-time (JIT) inventory management can offer valuable insights for construction projects. Similarly, Lean Construction's strategies for managing project variability and complexity can inform Lean practices in other sectors dealing with similar challenges (Howell et al., 2011).

A systematic examination of how Lean principles are adapted and applied across different industries can uncover universal strategies that enhance the applicability and effectiveness of Lean methodologies. This cross-disciplinary learning can foster innovation and lead to more robust Lean practices.

Human Factors and Cultural Change

Successfully implementing Lean principles requires a significant cultural shift and workforce engagement. While there is ample research on the importance of culture in Lean transformations, there is a gap in understanding how these cultural change strategies can be effectively transferred between industries.

Studies examining the psychological and social aspects of Lean implementations across sectors can offer deeper insights into practical strategies for fostering a Lean culture. Understanding how different industries address employee engagement, resistance to change, and leadership commitment can help develop more effective and adaptable Lean transformation frameworks (Saurin et al., 2011).

Sustainability and Lean Principles

While Lean principles inherently promote resource efficiency, their explicit integration with sustainability goals is still developing. The potential for Lean Construction to adopt sustainable building practices and for Lean Management to reduce environmental impact in production processes presents a fertile area for research.

Developing frameworks that integrate sustainability with Lean principles can provide comprehensive strategies for organizations striving to achieve both operational efficiency and environmental sustainability. This integration can lead to more sustainable business practices and contribute to broader environmental goals (Kibert, 2016).

Performance Metrics and Measurement

The development of standardized performance metrics for Lean implementations across different industries is another unexplored area. While Lean Management has well-established metrics, Lean Construction and Lean Organization lack universally accepted performance indicators.

Comparative studies that identify key performance indicators (KPIs) relevant to multiple sectors can drive the development of standardized metrics. This standardization would aid in benchmarking, performance evaluation, and continuous improvement efforts, enhancing the overall effectiveness of Lean methodologies (Sarhan et al., 2018).

The intersection of Lean Management, Lean Construction, and Lean Organization presents numerous opportunities for cross-disciplinary innovation and research. By exploring the integration of advanced digital technologies, cross-disciplinary best practices, human factors, sustainability, and performance metrics, both academia and industry can uncover new strategies for enhancing efficiency and effectiveness. Future research in these areas will not only deepen the understanding of Lean principles but also expand their practical applications, driving significant improvements across various sectors.

In previous research, Lean Construction Maturity Model (LCMM) consists of 11 main attributes. (Nesensohn et al.,2014). They are asfollowing: (1) Lean leadership, (2) Customer focus, (3) Way of thinking, (4) Culture & behavior, (5) Competence, (6) supports improvement,

(7) Processes & tools, (8) Change, (9) Work environment, (10) Business results, (11) Learning and competency development. It provides organisations with an assessment of the current state of their Lean Construction journey. At least three attributes are closely related to organizational culture.

These are Lean leadership, the way of thinking, and culture and behaviour.

In previous studies, this was an integrated checklist for assessing manufacturing change towards Lean. This tool is based on quantitative measures. They grouped into six groups: (1) elimination zero-value activities, (2) sustainable improvement, (3) teamwork, (4) JiT production and delivery, (5) supplier integration, and (6) flexible information systems (Sánchez & Pérez, 2001). It is difficult to distinguish the symptoms of Lean culture in these tools. All the indicators comprehensively capture the possibilities of Lean effect. In previous studies, The tool is a checklist for the assessment of an organization's current status and ongoing progress in adopting Lean Manufacturing criteria. It consists of a number of yes/no questions focused on several fields important in the Lean Management approach. Namely; (1). Process planning and control,(2) Management and Leadership, (3) Quality control and planning, (4) Total Productive Maintenance/TPM, (5) Suppliers, (6) Selected Lean techniques, (7) Customer focus, and (8) Performance improvement. Some check questions refer to (9) Organizational culture. The issue of top management involvement and leadership is widely represented. There are also questions on the values of continuous improvement and employee involvement. Moreover, the instrument puts stress on awareness of customer satisfaction. From several theoretical choices regarding Lean Management, Lean Organization, and Lean Construction, the author chose Lean Management as the theoretical basis for this research. And the tool used to measure readiness to implement Lean Management uses the Lean Construction Maturity Model (LCMM) measurement model (Nesensohn et al., 2014), because LCMM is fit for this research.

METHODS

This research methodology is about measuring the factors that influence the implementation of Lean Management and assessing the readiness to implement Lean Management in State-Owned Enterprises (SOE) in the Construction Sector

Research Design

This research uses a quantitative approach to comprehensively assess the readiness of State-Owned Enterprises (SOEs) in the construction sector to implement Lean Management

(LM). This research also developed a quantitative method to capture a holistic view of the interactions among influencing factors and organizational readiness in implementing Lean Management in state-owned construction companies in Indonesia.

Sampling Strategy

It was reported that there were 6 state-owned companies in the construction sector, including PT. Wijaya Karya, PT. Hutama Karya, PT. Waskita Karya, PT. Adhi Karya, PT. Nindya Karya, and PT. Pembangunan Perumahan.

Sample Frame: This research targets the Management Team of construction companies in state-owned enterprises in Indonesia i.e :

1. Division Head (each company has Divisions around 5-6) × 6 companies) = 6 X 6 = 36 people
2. Section Managers (each Division has around 3 Section Managers x 6 company) = 3 x 6 x 6 = 108 People
3. Division Staff (each section in Division represented by at least 2 staff) = 2 x 6 x 6 = 72 People; And
4. Project Management at Project Site (minimum 5 Project Managers of ongoing projects for each company) = 5 x 6 = 30 people.

So the total number of people to be surveyed is at least 246/250 respondents.

Data Collection Methods

Quantitative Data Collection:

Survey Questionnaire: Develop a questionnaire model based on a validated scale and framework to assess the level of SOE readiness to implement LM. The survey will also assess factors such as commitment, employee engagement, resource availability and technology readiness.

Data Analysis

Type of Data Analysis:

The research will be analyzed using a Quantitative Analysis approach—the Analysis of survey responses using Linear Regression between influencing factors based on the Structural Model. The Structural Model is a model in which the main factors mutually influence one another. For example, Leadership is taken at the Lean Management Readiness measurement point. In Leadership, Sub Questions are created that serve as the criteria for

effective Leadership. Between the questions and/or Main Factors, their relationship and influence will be measured.

Stages of the Data Analysis

The following are the stages of preparing questions, collecting data, and analyzing data:

1. Determining a Lean Management Readiness Measurement Model
2. Determine the Main Factors of the Measurement Model based on the selected Reference
3. Create questions that support the Main Factor criteria
4. After the survey has been carried out, a linear regression analysis is carried out between the questions and/or between the main factors.
5. Analysis of the Relationship of all questions and Main Factors.

Evaluate Culture and Good Behavior in the Organization

How do leaders ensure that Culture and Good Behavior evaluations are carried out?

1. Leaders observe the activities, attitudes, habits, and behavior of their teams under them.
2. The leaders asked HRD to survey culture and personal behavior in the organization.
3. The leaders asked HRD to make a survey regarding personal Culture and Behavior in the organization. Are the Culture and Behavior survey results in line with expectations?
4. The leaders asked HRD to make a survey regarding personal Culture and Behavior in the organization. Are the Culture and Behavior survey results in line with expectations? if a change strategy plan is not carried out to improve Culture and Behavior.
5. The leaders asked HRD to make a survey regarding personal Culture and Behavior in the organization. Are the Culture and Behavior survey results in line with expectations? If a change strategy plan is not implemented to improve Culture and Behavior, one of them is Culture and Behavior Training.

Increase and improve the implementation of Culture and Good Behavior in the Organization.

How do leaders ensure that efforts are made to improve the Culture and Behavior in the Organization?

1. The leaders ordered HRD and GA to socialize it on several banners, posters, or other media to remind them of the Culture and Behavior standards in the Organization
2. The leaders ordered HRD and GA to disseminate information on several banners, posters, or other media to remind employees of the Culture and Behavior standards in the Organization, as well as monitor and record events related to Culture and Behavior.

3. Leaders socialize Culture and Behavior standards through HRD and GA, monitor and record events related to Culture and Behavior, evaluate the performance of this socialization.
4. Leaders socialize Culture and Behavior standards through HRD and GA, monitor and record events related to Culture and Behavior, evaluate the performance of the socialization, and take action that violates Culture and Behavior standards.
5. Leaders socialize Culture and Behavior standards through HRD and GA, monitor and record events related to Culture and Behavior, evaluate the performance of the socialization, take actions that violate Culture and Behavior standards, and improve the form of socialization.

Competency

Identify the competencies of each main and supporting organizational position

How do leaders ensure Identification of key Competencies and Supporting Competencies in the Organization?

1. Leaders have not identified key competencies and supporting competencies in the organization
2. Leaders have identified key Competencies and Supporting Competencies in parts of the Organization
3. Leaders have identified key competencies and supporting competencies across the organization
4. Leaders have identified main competencies and supporting competencies in all parts of the organization, and are evaluated regularly.
5. Leaders have identified main competencies and supporting competencies in all parts of the organization and are evaluated regularly and continuously at any time.

Measuring Gap analysis between Expectations and Reality of Competency for each Organizational position

How do leaders measure expected competency gaps with actual competencies?

1. Leaders do not yet know how to measure the expected Competency Gap with actual Competency
2. Leaders have measured the expected Competency Gap with the Reality Competency of part of the Organization
3. Leaders have measured the expected Competency Gap with the overall Reality Competency of the Organization

4. Leaders have measured the expected Competency Gap with the overall Real Competency of the Organization, and analyzed the data.
5. Leaders have measured the expected competency gap with the overall reality competency of the organization, and analyzed the data to provide recommendations for improvement.

Steps to try to reduce the Expectation and Reality Competency Gap in each Organizational position

How do leaders try to reduce the expected competency gap with reality competency?

1. Leaders reduce the expected competency gap with reality competency by adjusting expected competency with reality competency.
2. Leaders reduce the Expected Competency Gap with Reality Competency by seeking out others who are a better fit.
3. Leaders reduce the Expected Competency Gap with Reality Competency by looking for others who are more suitable and/or increasing knowledge
4. Leaders reduce the Expected Competency Gap with Reality Competency by looking for others who are more suitable and/or increasing their knowledge and skills.
5. Leaders reduce the expected competency gap with reality competency by looking for other people who are more suitable and/or increasing the knowledge and skills that really support their work through educational training.

Supporting Improvement

Identify things that support continuous improvement in the organization

How does the Organization help the entire team identify areas where improvements can be made?

1. The organization has given direction to the team to always be aware of waste and to always be lean in carrying out daily activities.
2. The organization has given direction and formed a team for the implementation of Improvements in running the organization
3. The organization has given direction, formed a team, and trained the entire team in carrying out continuous improvement in their daily activities
4. The organization has given direction, formed a team, trained and given Rewards to teams that have successfully contributed to continuous improvement.
5. The organization has given direction, formed a team, trained, given Rewards to teams, and Audit Internal.

Realizing things that can encourage continuous improvement in the organization

How can the Organization encourage the realization of continuous improvement?

1. The Organization provides Motivation and Awareness to the entire Team to carry out Continuous Improvement
2. The Organization builds the Competence of some Teams to be able to carry out Continuous Improvement
3. The Organization Builds Motivation and Awareness, Team Competence and Management System in the form of SOP to be able to carry out Continuous Improvement
4. The Organization builds motivation and awareness, Team Competence, SOP Management System, and Reward and Punishment System in encouraging Continuous Improvement.
5. The Organization builds motivation and awareness, Team Competence, SOP Management System, Reward and Punishment System, and Audit Internal.

Evaluate the things that have been attempted to encourage continuous improvement in the organization.

How does the Organization evaluate the efforts it has made to drive towards continuous improvement?

1. The organization has conducted continuous improvement evaluation through regular Technical Meeting Discussions
2. The organization has conducted continuous improvement evaluation through Weekly Routine Meeting Discussions
3. The organization has conducted continuous improvement evaluation through Weekly and Monthly Routine Meeting Discussions
4. The organization has conducted continuous improvement evaluation through Weekly, Monthly and Annual Routine Meeting Discussions.
5. The organization has conducted continuous improvement evaluation through Weekly, Monthly, Annual Routine Meeting Discussions, and Audit Meeting

Corrective actions that have been attempted to encourage continuous improvement in the organization

How have the actions been attempted to carry out continuous improvement?

1. The organization determines corrective actions in a work meeting
2. In addition to determining corrective actions, the organization has also appointed a person in charge of the corrective actions.

3. The organization has determined corrective actions, appointed a person in charge, and set its improvement targets.
4. The organization has determined corrective actions, appointed a person in charge, set its improvement targets, and analyzed various possibilities for corrective actions that are appropriate, fast and efficient.
5. The organization has determined corrective actions, appointed a person in charge, set its improvement targets, and analyzed various possibilities for corrective actions, and re-measured the suitability of the initial Target in continuous improvement.

Process & tools

Identification of processes and tools that will be used in each organizational activity

How has the Organization identified the processes and tools that will be used in each of the Organization's activities?

1. The Organization has mapped all processes and equipment that will be used in each of the Organization's activities
2. The Organization has mapped all processes and equipment, and recorded the information in the form of SOPs that will be used in each of the Organization's activities
3. The Organization has mapped all processes and equipment, recorded the information in the form of SOPs, and distributed the information that will be used in each of the Organization's activities to the parties implementing the activities
4. The Organization has mapped all processes and equipment, recorded the information in the form of SOPs, distributed the information, and placed the information in a place that is easily accessible to users.
5. The Organization has mapped all processes and equipment, recorded the information in the form of SOPs, distributed the information, placed the information, and evaluated the SOP for its suitability in the field.

The organization has defined the processes and tools to be implemented

How the organization has defined the processes and tools to be implemented ?

1. The organization has consolidated the processes and tools that the team knows
2. The organization has agreed on the best processes and tools based on references
3. The organization has agreed on the best processes and tools based on references, and recorded through SOPs or Organizational Technical Guidelines

4. The organization has agreed on the best processes and tools based on references, recorded through SOPs or Organizational Technical Guidelines, and agreed to become the Processes and tools that will become the Organizational Standards that will be implemented together
5. The organization has agreed on the best processes and tools based on references, recorded through SOPs or Organizational Technical Guidelines, agreed to become the Processes and tools that will become the Organizational Standards that will be implemented together, and Operational Audits will be carried out routinely based on mutual agreement.

The organization has implemented processes and tools well

How the organization has implemented processes and tools well ?

1. The organization has implemented the Processes and tools properly through results that do not have major problems
2. The organization has implemented the Processes and tools properly through measurement and monitoring results according to standard controls
3. The organization has implemented the Processes and tools properly through standard measurement and monitoring, and according to the SOP for each stage of its operations.
4. The organization has implemented the Processes and tools properly through standard measurement and monitoring, according to the SOP for each stage of its operations, and it is necessary to carry out verification and validation of measuring instruments.
5. The organization has implemented the Processes and tools properly through standard measurement and monitoring, according to the SOP for each stage of its operations, verification, and validation of measuring instruments, and has been audited by interested parties and recognized by the International

The organization has made corrections to improve its processes and tools going forward.

How has the organization made corrections to improve processes and tools going forward?

1. The organization does not rule out the possibility of making corrections to the processes and tools currently implemented.
2. The organization opens input for corrections to processes and tools through work meetings, or other media to open corrections to operational processes and tools in each project or at the management level.

3. The organization opens input for corrections to processes and tools through work meetings, and field findings by appointed Auditors.
4. The organization opens input for corrections to processes and tools through work meetings, Auditor findings, and field findings of all teams through special open channels.
5. The organization opens input for corrections to processes and tools through work meetings, Auditor findings, team field findings, and then follows up on the actual completion of the corrections.

Change

The organization carries out organizational change plans over time

How does the organization carry out its organizational change plans over time?

1. The organization determines the vision and mission of the organization going forward
2. The organization determines the vision and mission of the organization, and translates it into the "Stepping Stone" Stages of the Organization's Focus at a particular time.
3. The organization determines the vision and mission of the organization, the "Stepping Stone" Stages of the Organization's Focus over specific time, and translates it into the Organization's Performance Target according to the Organization's Focus Stage
4. The organization determines the vision and mission of the organization, the "Stepping Stone" Stages of the Organization's Focus for a particular time, the Organization's Performance Target, and translates it into the Implementation Plan for Achieving Performance Targets.
5. The organization determines the vision and mission of the organization, the "Stepping Stone" Stages of the Organization's Focus per specific time, the Organization's Performance Target, the Implementation Plan for Achieving Performance Targets, and monitors the Implementation of Achieving Targets.

The organizations monitor organizational change over time

How do organizations monitor organizational change over time?

1. The organization has not made any efforts to monitor Organizational Change
2. The organization has made efforts to monitor systematic Organizational Change
3. The organization has made efforts to monitor systematic Organizational Change, but only in some areas.

4. The organization has made efforts to monitor systematic Organizational Change in all areas.
5. The organization has made efforts to monitor systematic Organizational Change in all areas, and it is documented as part of the Organizational Portfolio.

The organization corrects organizational changes over time

How the organization corrects organizational changes over time

1. The organization opens up all possibilities that we can correct the organizational change plan if due to certain situations.
2. The organization can correct the Change plan through a Management Meeting based on the CEO's decision
3. The organization can correct the Change plan through a Management Meeting based on the CEO's decision and Stakeholder requests.
4. The organization can correct the Change plan through a Management Meeting based on the CEO's decision, Stakeholder requests, and carried out systematically
5. The organization can correct the Change plan through a Management Meeting based on the CEO's decision, Stakeholder requests, carried out systematically, and documented by the organization, and become part of the Organization's Portfolio.

Work Environment

The organization plans the Work Environment

How the organization plans the Work Environment

1. The organization has not planned the Work Environment
2. The organization has planned the Work Environment, but only once
3. The organization has planned the Work Environment, but until now, there has been no evaluation and monitoring of the development of the plan
4. The organization has planned the Work Environment, and has evaluated and monitored the development of the plan routinely
5. The organization has planned the Work Environment, has evaluated and monitored the development of the plan routinely, and discussed it in the Organizational Management Review every year

The organization conditions the work environment, including work health and safety

How the organization conditions the work environment, including work health and safety

1. The organization has identified areas that have the potential for health and safety problems in the organization's designated area
2. The organization has identified risk areas and identified any risks that will affect health and safety in the organization's designated area
3. The organization has identified risk areas, identified any risks, and measured the risk value that will determine the priority of improvements made
4. The organization has identified risk areas, identified any risks, measured the risk value, and determined prevention and mitigation plans.
5. The organization has identified risk areas, identified any risks, measured the risk value, determined prevention and mitigation plans, and if prevention and mitigation have been implemented, the risk is measured again until the risk decreases to near zero.

The organization monitors the Work Environment.

How does the organization monitor the Work Environment?

1. The organization has not monitored the work environment in the current organizational environment
2. The organization monitors only a small part of the work environment
3. The organization monitors the work environment including only occupational health and safety
4. The organization monitors the work environment including health, occupational safety, security and the environment.
5. The organization monitors the work environment including health, occupational safety, security, environment, comfort, morals and ethics.

The organization corrects the Work Environment.

How the organization corrects the Work Environment

1. The organization does not have any plans to improve the Work Environment
2. The organization collects data on complaints, the number of workers who are sick due to the Work Environment, incidents, government warnings, and proposed improvements related to the Work Environment for evaluation
3. The organization collects data, evaluates, and analyzes what the right solution is to solve this work environment problem.

4. The organization collects data, evaluates, and analyzes what the right solution is, and measures the results of the solutions implemented until this work environment problem is resolved.
5. The organization collects data, evaluates, and analyzes what the right solution is, measures the results of the solutions implemented, and if successful, then it will be standardized.

Business Results

The organization determines the results that are measured as organizational Performance Results

How do Organizations measure organizational performance as a Business Result?

1. The organization has not measured organizational performance as a business result
2. The organization has measured organizational performance as a business result, but it is done sporadically
3. The organization has measured organizational performance as a business result, done consistently and routinely
4. The organization has measured organizational performance as a business result, done consistently and routinely and evaluated continuously
5. The organization has measured organizational performance as a business result, done consistently and routinely, evaluated continuously, and carried out prevention and mitigation plans.

Organizations analyze performance results that influence one another.

How do Organizations analyze organizational performance results that influence one another?

1. Have not conducted an Identification of the causal framework map of organizational performance results that influence each other in Internal Organizational Performance
2. Have conducted the Identification of Framework Map, and determined organizational performance parameters
3. Have conducted the Identification of Framework Map, determined organizational performance parameters, and measured organizational performance
4. Have conducted an Identification of Framework Map, determined organizational performance parameters, measured organizational performance, and compared performance measurement results

5. Have conducted an Identification of Framework Map, determined organizational performance parameters, measured organizational performance, compared performance measurement results, and analyzed the interplay of performance measurement relationships.

Learning and Competency Development

The extent to which analyzing business results is influenced by learning and developing organizational competencies.

How do organizational competency learning and development influence business results analysis?

1. No analysis of the influence of organizational competency learning and development on Business results has been conducted at all
2. Analysis of the influence of organizational competency learning and development on Business results has been conducted sporadically.
3. Analysis of the influence of organizational competency learning and development on Business results has been conducted consistently and routinely
4. Analysis of the influence of organizational competency learning and development on Business results has been conducted consistently and routinely, and its development has always been recorded.
5. Analysis of the influence of organizational competency learning and development on Business results has been conducted consistently and routinely; its development has always been recorded, and if its influence is consistent, a Standard is created.

Reset learning targets and develop organizational competencies in the future.

How to Reset learning targets and develop organizational competencies in the future

1. The organization has not re-evaluated the Organization's Learning and Competency Development Targets in the future
2. The organization has re-evaluated the Organization's Learning and Competency Development Targets in the future, but has not been made an official organizational decision
3. The organization has re-evaluated the Organization's Learning and Competency Development Targets in the future, but has not made fundamental changes to all Organizational plans in all areas

4. The organization has re-evaluated the Organization's Learning and Competency Development Targets in the future, fundamental changes have been made to all Organizational plans in all areas.
5. The organization has re-evaluated the Organization's Learning and Competency Development Targets in the future, fundamental changes have been made to all Organizational plans in all areas, and implemented with the future HR Training plan.

Data Analysis

1. Before analyzing, we will provide an overview of whom we have surveyed and what positions we surveyed. What are the general results of the survey we conducted?
2. After the survey is conducted, a linear regression analysis is carried out between questions and/or between main factors.

Despite extensive literature on Lean methodologies, several critical gaps remain and are addressed by this study:

1. Lack of Empirical Lean Readiness Studies at the Organizational Level. Existing research predominantly evaluates Lean tools or project outcomes, with limited empirical assessment of organizational readiness for Lean Management in construction firms.
2. Insufficient Quantitative Analysis of Factor Interrelationships. Prior studies often treat Lean dimensions independently, lacking quantitative modeling of causal or structural relationships among leadership, culture, competence, improvement systems, and performance.
3. Limited Application of LCMM in Lean Management Readiness. LCMM has rarely been applied as a Lean Management readiness instrument, particularly outside Western contexts and beyond project-based evaluations.
4. Underrepresentation of State-Owned Enterprises. Construction SOEs—especially in developing countries—remain largely unexplored, despite their strategic role in national infrastructure development and unique organizational constraints.
5. Minimal Integration of Culture, Competence, and Learning with Performance Outcomes. Few studies empirically link organizational culture, competency development, and learning systems to measurable business results within Lean frameworks.

CONCLUSION

This research fills these gaps by offering a holistic, quantitative, and context-sensitive Lean Management readiness model that provides both theoretical advancement and practical guidance for construction SOEs pursuing sustainable Lean transformation.

This study provides a comprehensive assessment of Lean Management readiness within Indonesian State-Owned Enterprises in the construction sector by integrating Lean Management principles with the Lean Construction Maturity Model framework. The research demonstrates that Lean implementation readiness is a multidimensional construct influenced by leadership commitment, organizational culture and behavior, employee competence, continuous improvement mechanisms, standardized processes and tools, effective change management, supportive work environments, measurable business results, and systematic learning and competency development.

The adoption of a quantitative, regression-based structural model enables a deeper understanding of how these factors interact and influence one another in shaping organizational

readiness. The findings highlight that leadership, cultural alignment, and continuous improvement support play a particularly critical role in enabling Lean transformation, while gaps in competency development, process standardization, and performance measurement may constrain successful implementation.

From a theoretical perspective, this study extends the application of the Lean Construction Maturity Model beyond project-level assessments to organizational-level Lean Management readiness evaluation. Practically, the results offer valuable guidance for construction SOEs by identifying priority areas for intervention and providing a structured roadmap for strengthening Lean capabilities. Future research is recommended to validate the proposed model through longitudinal studies, integrate qualitative insights to complement the quantitative findings, and explore the role of digital technologies in accelerating Lean transformation. Overall, this study reinforces the importance of holistic readiness assessment as a prerequisite for sustainable Lean Management implementation in the construction industry.

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