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Lean Management Implementation to Improve Productivity and Efficiency in Electrical Construction Projects: A Case Study at Bozer Construction Unipessoal LDA, Timor Leste

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ABSTRACT

This study aims to evaluate the implementation of Lean Management principles and their impact on productivity and efficiency in electrical construction projects, focusing on a case study at Bozer Construction Unipessoal LDA in Timor Leste.The research employs a qualitative descriptive method using a single embedded case study design. Data were collected through semi-structured interviews with key project staff, direct field observations, and analysis of internal project documentation.The study found that Lean tools—specifically Just-In-Time (JIT), Kaizen, and Total Quality Management (TQM)—significantly contributed to minimizing waste, improving scheduling accuracy, and enhancing workforce coordination. However, challenges were encountered, including limited knowledge of Lean concepts, cultural resistance to bottom-up improvement processes, and logistical barriers in maintaining timely material delivery.Despite constraints, the adoption of Lean strategies yielded measurable performance improvements: reduced project delays, enhanced material efficiency, and improved quality control. This case illustrates that Lean Management can be adapted effectively even in resource-constrained, post-conflict settings like Timor Leste.This study contributes to the limited empirical literature on Lean Construction in Southeast Asia, offering practical insights for similar developing country contexts. It demonstrates that local adaptation and incremental implementation of Lean principles can lead to substantial gains in project delivery performance.

Keywords*: Lean Construction, Electrical Infrastructure, Productivity, Developing Countries, TQM, Kaizen, JIT.*

INTRODUCTION

Infrastructure development plays a vital role in national economic growth, especially in developing countries. Among various sectors, electrical construction is essential for providing access to energy, supporting industrial activities, and improving public welfare. However, in many developing nations, including Timor Leste, infrastructure projects are often plagued by delays, inefficiency, and cost overruns. This situation has created a pressing need to adopt innovative project management approaches to improve efficiency and productivity.

Timor Leste, a young post-conflict country, is still developing its foundational infrastructure. Local construction companies, such as Bozer Construction Unipessoal LDA, are instrumental in implementing electrical development projects, particularly electricity distribution in underserved areas. However, these companies face serious operational inefficiencies owing to fragmented work processes, limited skilled human resources, weak planning, and logistical challenges. These conditions create significant gaps between the planning and implementation of project execution.

Lean Management has emerged as a potential solution to address these issues. Originally developed in the manufacturing sector, lean has been adapted across industries, including construction, to eliminate waste, optimize processes, and enhance value creation. Lean Construction emphasizes continuous improvement, team involvement, and efficient resource utilization. Although its implementation in advanced economies is widely documented, there is limited empirical research on how lean can be applied in resource-constrained developing nations.

This research, therefore, aims to evaluate the application of Lean Management principles in electrical construction projects managed by Bozer Construction. It examines how lean strategies are integrated into project workflows, what challenges are encountered during implementation, and what measurable impacts are observed in terms of project efficiency and productivity. By focusing on a real case in Timor Leste, this

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study contributes to the limited but growing body of literature on Lean Construction in emerging economies.

LITERATURE REVIEW

Concept of Lean Management in Construction

Lean Management is a strategic philosophy aimed at eliminating waste and maximizing value in all aspects of the process. Womack and Jones (1996) outlined five key principles of lean: specifying value, mapping the value stream, creating flow, establishing pull, and seeking perfection. When applied to the construction sector, these principles seek to improve workflow efficiency, minimize idle time, and align resource utilization with project goals.

Koskela (2000) extended the lean philosophy to the construction sector by proposing the transformation-flow-value (TFV) theory. The transformation component focuses on converting inputs into outputs; the flow component addresses the smooth and uninterrupted movement of resources; and the value component ensures that the outputs meet stakeholder expectations. Lean Construction integrates planning, control, and continuous feedback loops to enhance operational performance.

Tools and Techniques of Lean

Several tools are central to Lean Construction, including:

- Just-in-time (JIT): This dnsures timely delivery of materials and equipment to minimize inventory waste (Shingo, 1989).
- Kaizen: Continuous improvement through small, incremental changes initiated by front-line workers (Imai, 1986).
- Total Quality Management (TQM) integrates quality control into every stage of construction to reduce rework and enhance client satisfaction (Oakland, 2014).

Empirical Research in Developing Countries

While Lean Construction has been implemented in various countries, developing regions face unique challenges, such as low technological adoption, inadequate training, fragmented supply chains, and top-down management culture. Studies by Fauzi (2023) and Anggraeni and Setiawan (2021) show that despite these constraints, leaning can lead to productivity gains if adapted contextually.

Research Gap and Contribution

Although several studies have analyzed Lean Construction in countries like Indonesia, India, and Brazil, empirical research on small post-conflict nations, such as Timor Leste, is scarce. This study addresses this gap by offering case-based insight into how Lean Management can be implemented in local firms operating under severe logistical and institutional constraints.

METHODOLOGY

Research Design

This study adopted a qualitative descriptive approach, using a single embedded case study design. The objective of this study is to provide a comprehensive understanding of how Lean Management principles are implemented under real-world project conditions at Bozer Construction.

Research Setting and Participants

The research was conducted at the Bozer Construction University LDA, focusing on projects in the electrical distribution sector. The participants included 14 individuals from various roles: project managers, engineers, site supervisors, procurement officers, and quality control personnel.

Data Collection Methods

Data were collected using three primary techniques:

- Semi-structured Interviews: These conducted with key informants to gather insights into the practical implementation of the lean principles.
- Field Observations: Researcher visited multiple project sites to observe the work processes, team meetings, and material flows.
- Document Analysis: Internal documents, such as project timelines, inventory logs, and quality control checklists, were reviewed to validate the interview data.

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Data Analysis

All the collected data were coded and categorized thematically. Themes were aligned with the lean tools (JIT, Kaizen, TQM) and analyzed in terms of their impact on project efficiency and productivity. Data triangulation was used to enhance the credibility of findings.

Ethical Considerations

Participants were informed of the research objectives and provided informed consent. The anonymity and confidentiality of participant responses were maintained throughout the study.

RESEARCH RESULTS AND DISCUSSION

Overview of Lean Implementation at Bozer Construction

Bozer Construction Unipessoal LDA, a contractor in Timor Leste, faced repeated challenges related to inefficiency, resource wastage, and scheduling inconsistencies in its electrical infrastructure projects. In response, the company initiated Lean Management practices in 2022 for several key projects in the electricity distribution sector. The implementation emphasized three core lean strategies: Just in Time (JIT), Kaizen, and Total Quality Management (TQM).

Field observations supported by semi-structured interviews and company documentation revealed that lean tools were selectively adapted to Bozer's project context. For example, material deliveries were aligned with site progress to minimize on-site stockpiling, morning coordination meetings were held to identify bottlenecks, and SOPs were revised to enhance consistency.

Table 1. Summary of Lean Strategy Application in Bozer Construction Projects

Lean Tool	Observed Practice	Impact on Site Performance
JIT	Material deliveries scheduled based on task progress	Decreased clutter and minimized storage time
Kaizen	Daily briefings for team feedback and improvement	Increased participation and process visibility
TQM	Internal checklists and process audits	Improved quality consistency and reduced rework

Measured Results and Efficiency Gains

The implementation of Lean practices at Bozer yielded the following measurable outcomes:

- Material Waste Reduction: A 20% decline in unused or surplus materials compared with baseline projects (based on site inventory logs).
- Workforce Efficiency: Team idle time during installations dropped by approximately 15% based on daily activity logs and field supervisor interviews.
- Project Delivery: A 10-day reduction in average project duration over three pilot projects.
- Quality Improvements: Non-conformance incidents dropped from 12 per project to seven on average (internal audit reports, 2023).

These results align with Koskela's (2000) theory of production flow, where improved coordination and flow stability directly contribute to better project performance.

Field Challenges and Contextual Constraints

Despite the positive outcomes, several challenges limited full optimization:

- Knowledge Gaps: Many workers lack basic knowledge of lean. As noted in the interviews, lean terms such as JIT and Kaizen were initially unfamiliar, and training had to be adapted.
- Logistical Limitations: JIT was difficult to sustain becaused of inconsistent material delivery times from local suppliers, exacerbated by poor infrastructure and limited vendor coordination.
- Cultural Resistance: The organizational structure remained top-down, which conflicted with Lean's emphasis on decentralized, team-led problem-solving. Workers were initially hesitant to voice suggestions, limiting the effectiveness of the early Kaizen circle.

These challenges echo the observations of Anggraeni and Setiawan (2021), who found that Lean Construction requires not only technical knowledge but also organizational culture shifts, especially in developing regions with rigid work hierarchies.

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Comparison with Existing Literature

Bozer's experience reflects the core principles found in global Lean Construction literature. The emphasis on reducing waste, engaging field-level employees, and ensuring quality aligns with Imai (1986), Oakland (2014), and Womack and Jones (1996), respectively. However, unlike studies in more developed countries (e.g., Shingo, 1989), Bozer faced barriers related to infrastructure and workforce preparedness.

Compared to Fauzi (2023), whose study in Indonesia revealed union-related resistance to lean adoption, Bozer encountered less organized labor resistance but more pronounced logistical and resource-related hurdles. This confirms that lean success factors must be tailored to the context, especially in post-conflict developing nations, such as Timor Leste.

Organizational Impact and Practical Contribution

The case of Bozer Construction illustrates that Lean Management can be implemented effectively in low-resource settings with incremental strategies. Key takeaways include:

- Early success in JIT and Kaizen boosts team morale and builds internal momentum.
- Simplified tools, such as visual progress boards and checklists, are appropriate for low-tech environments.
- Lean training must be continuous and adapted to local comprehension levels.

Bozer's approach offers a reference model for similarly sized firms in comparable contexts. This demonstrates that, even without sophisticated ERP systems or advanced analytics, lean principles can improve the outcomes of electrical construction projects.

Contribution to the Field of Lean Construction

This study adds new empirical evidence to the limited body of Lean Construction literature on underrepresented regions, specifically in Southeast Asia and post-conflict economies. It highlights the adaptive application of lean in real-world conditions and underscores the importance of contextual variables such as supply chain maturity and workforce readinessin shaping implementation success.

These insights can inform policymakers, construction managers, and international development partners aiming to improve infrastructure project delivery through lean strategies in developing contexts.

CONCLUSIONS, PROPOSALS, RECOMMENDATIONS

Conclusions

The research confirms that the implementation of Lean Management at Bozer Construction has led to tangible improvements in project efficiency, workforce productivity, and overall quality in electrical infrastructure development. Lean strategies, such as JIT, Kaizen, and TQM, when adapted to local conditions, proved effective even in a context with limited resources and institutional challenges.

Theoretical and Practical Contributions

This study validates Koskela's (2000) TFV theory in a developing country setting, confirming that flow and value optimization can enhance construction outcomes. It also expands the practical discourse on Lean Construction by providing contextual evidence from a post-conflict nation, emphasizing the role of incremental training, leadership engagement, and localized lean adaptation.

Recommendations

- Provide continuous and contextual Lean training for field workers and supervisors.
- Strengthen supplier partnerships to support JIT logistics.
- Institutionalize Kaizen groups to sustain a culture of continuous improvement.
- Develop simple digital tools for scheduling, inventory, and quality monitoring

Limitations and Future Research

This study is limited to a single firm and project type in the Timor Leste. Future research could compare lean implementation across multiple firms or explore quantitative analysis to measure performance outcomes more precisely. Longitudinal studies also have the potential to assess the long-term sustainability of lean practices in emerging economies.

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