Transforming the Construction Sector through Lean Management Practices: A Case of Turkey's Construction Sector

Shurouq Mosad[1] and Mehmet Savsar[2]

[1]*Üsküdar University, Institute of Sciences, Engineering Management Program, Istanbul, Turkey*
Email: mshourouq@gmail.com

[2]*Üsküdar University, Faculty of Engineering & Natural Sciences, Industrial Engineering Department, Istanbul, Turkey. Email:*
msavsar@gmail.com

ATIF/REFERENCE: Mosad, S. & Savsar, M. (2025). Transforming the Construction Sector through Lean Management Practices: A Case of Turkey's Construction Sector, *International Journal of Advanced Natural Sciences and Engineering Researches*, 9(6), 244-250.

*Abstract-*This study explores the application of Lean Construction principles to improve efficiency and reduce waste in Turkey's civil and highway construction projects. Based on a survey of 269 industry professionals, it examines the impact of five key Lean factors—Culture/People, Continuous Improvement, Customer Focus, Waste Elimination, and Standardization—on project performance. Statistical analysis revealed that standardization and waste elimination significantly enhance efficiency and cost control, while cultural and continuous improvement practices showed weaker influence. The findings contribute a localized Lean framework suited to the Turkish context and offer practical insights for improving infrastructure project outcomes.

Keywords: Lean Construction, Project Performance, Standardization, Waste Reduction, Infrastructure, Turkey.

I. INTRODUCTION

Turkey's construction sector plays a vital role in national development, contributing significantly to GDP growth and employment (Erol & Unal, 2015). In recent years, the sector has been at the heart of major infrastructure projects under national strategies like Vision 2023, which includes initiatives such as the Istanbul New Airport and Kanal Istanbul (Guide, 2025). These high-profile projects, while ambitious, often face recurring challenges such as delays, cost overruns, poor quality control, and environmental concerns. These issues reflect underlying inefficiencies in traditional construction practices and highlight the urgent need for improved project management methods (Yaldız, 2023).

Amid these challenges, Lean Construction has emerged as a promising approach to enhance productivity, minimize waste, and streamline operations in complex construction environments (Demirkesen & Tezel, 2022). Derived from Lean Manufacturing, Lean Construction shifts the focus toward delivering value, reducing non-essential activities, and optimizing resources across the entire construction process. Internationally, Lean

principles have demonstrated success in improving construction outcomes, but their application in Turkey remains limited and inconsistent. Cultural, operational, and institutional barriers have hindered widespread adoption, despite the pressing need for efficiency in large-scale public infrastructure projects (Eren, 2019).

This study investigates the applicability and impact of Lean Management practices in Turkey's civil and infrastructure construction sector, with a particular focus on highway projects. These projects are typically large in scale, involve multiple stakeholders, and are central to economic and urban development. However, they are also highly prone to inefficiencies due to outdated processes, poor coordination, and lack of standardized procedures. By examining key Lean components—such as standardization, waste elimination, continuous improvement, people-centered culture, and customer focus—this research aims to identify how these principles can contribute to better project outcomes in Turkey.

Data for this study were collected through a structured questionnaire administered to 269 professionals working in the Turkish construction industry. The responses were analyzed to determine the influence of Lean principles on project efficiency, cost control, waste reduction, and stakeholder satisfaction. The findings provide empirical evidence on the current state of Lean implementation, the barriers to its effective use, and the practical benefits it can offer when properly applied.

Through a careful review of literature, quantitative analysis, and contextual adaptation, this research contributes to developing a Lean framework that addresses the specific needs of the Turkish construction environment. The ultimate goal is to support the construction industry in Turkey in transitioning toward more efficient, sustainable, and value-driven practices, thereby enabling better delivery of critical infrastructure projects and enhancing the sector's long-term competitiveness.

Despite its critical importance to the national economy, the Turkish construction industry continues to suffer from persistent inefficiencies, including project delays, budget overruns, resource wastage, and inconsistent quality. These problems are particularly evident in large-scale civil and infrastructure projects, such as highways, where coordination among multiple stakeholders and complex logistical demands create frequent disruptions. Traditional construction management methods have proven insufficient in addressing these challenges, often resulting in missed deadlines, inflated costs, and diminished stakeholder confidence. While Lean Construction has been successfully adopted in other countries to improve productivity and reduce waste, its implementation in Turkey remains limited and poorly integrated into existing practices. Furthermore, current lean frameworks are not fully adapted to the unique cultural, economic, and operational conditions of the Turkish construction environment. Without a targeted approach, inefficiencies will continue to undermine project performance and waste valuable public and private investment. Addressing this gap requires a context-specific exploration of how Lean principles can be effectively applied within Turkey's infrastructure sector to enhance efficiency, reduce waste, and support sustainable construction outcomes.

II. LITERATURE REVIEW

The concept of Lean originates from the manufacturing sector, particularly the Toyota Production System (TPS), which emphasized efficiency, waste elimination, and value creation through continuous improvement. Womack and Jones (2003) refined this thinking into five key principles: defining value from the customer's perspective, mapping the value stream, ensuring smooth process flow, establishing pull-based production, and striving for perfection. These principles were later adapted to the construction industry, resulting in what is known today as Lean Construction.

Lean Construction reorients traditional project delivery methods by emphasizing collaboration, transparency, and efficiency across all phases of construction. Koskela (1992) defined Lean Construction as a system that

integrates design and construction activities, aiming to deliver value while minimizing waste. Unlike conventional construction methods, which often prioritize individual contract performance, Lean focuses on optimizing the entire project lifecycle, including planning, design, procurement, and execution. Ballard and Howell (2003) contributed significantly to this transformation through the development of the Last Planner System (LPS), which improves workflow reliability and short-term planning.

Numerous studies across different countries have shown that Lean Construction practices result in reduced lead times, lower costs, improved safety, and higher quality. For example, Ogunbiyi et al. (2014) demonstrated that implementing Just-in-Time (JIT) delivery and LPS in the UK construction industry improved productivity by 20%. Similarly, Babalola et al. (2019) reported that Lean methods led to early project completion and cost savings in an Ohio-based project. These examples confirm that Lean Construction is effective in diverse project environments when properly executed. However, despite its proven benefits, Lean adoption in Turkey remains underdeveloped. Studies by Tezel and Nielsen (2013) highlight cultural resistance, fragmented supply chains, and lack of leadership commitment as significant barriers. Most Turkish firms still rely on traditional methods characterized by reactive planning, redundant tasks, and poor waste control. Furthermore, Lean tools such as Value Stream Mapping (VSM), 5S, and Kaizen are not widely institutionalized in Turkish projects, limiting their impact.

In the Turkish context, literature also points out that standardization and stakeholder alignment are critical success factors. Yıldırım et al. (2022) emphasized the role of work standard sheets and prefabrication in improving planning and minimizing on-site uncertainties. Moreover, the application of Key Performance Indicators (KPIs) driven by customer requirements is found to be essential for performance tracking and continuous improvement.

While Western models of Lean Construction offer a solid foundation, they cannot be directly transplanted into the Turkish industry without adaptation. The local construction environment presents unique challenges such as frequent economic fluctuations, inconsistent project governance, and varying levels of workforce skill. Therefore, there is a clear research gap in developing a culturally and operationally relevant Lean framework tailored to the needs of Turkish infrastructure projects.

III. METHODOLOGY

This study employed a quantitative research methodology to examine the implementation and impact of Lean Construction practices in the Turkish construction industry, with a specific focus on civil and highway infrastructure projects. The objective was to empirically assess how various Lean principles influence project efficiency, cost control, and waste reduction in the local context.

A structured survey questionnaire was developed based on extensive literature and expert inputs. The survey instrument was designed to capture respondent perceptions across five core Lean dimensions: Culture/People, Continuous Improvement, Customer Focus, Waste Elimination, and Standardization. Each dimension was operationalized using multiple items measured on a 5-point Likert scale ranging from "Strongly Disagree" to "Strongly Agree."

The target population consisted of professionals working in Turkey's construction industry, including engineers, project managers, contractors, consultants, and other stakeholders involved in infrastructure projects. A total of 269 valid responses were collected from diverse regions in Turkey, representing various organizational types and project roles. Purposive sampling was used to ensure that participants had practical knowledge of construction practices and project management. The data collection process adhered to ethical research standards. Participation was voluntary, and respondents were assured of anonymity and

confidentiality. Before data collection, the survey was pilot-tested to ensure clarity and relevance, and minor revisions were made to improve wording and layout.

To analyze the data, descriptive statistics were used to understand respondent demographics and the frequency of Lean practice adoption. Inferential statistical techniques, including correlation and multiple regression analysis, were then applied to examine the relationships between Lean practices and project outcomes such as timeliness, budget control, and quality.

The dependent variable in the study was project performance, while the independent variables were the five Lean constructs. Hypotheses were formulated to test the significance of each construct's influence on overall project success. Reliability analysis was conducted using Cronbach's alpha to ensure internal consistency of the survey items, with all constructs exceeding the acceptable threshold ($\alpha > 0.7$).

This methodological approach enabled a structured and data-driven examination of Lean Construction's effectiveness in Turkey. The findings offer empirical support for the development of a context-specific Lean framework tailored to the challenges and opportunities of Turkish infrastructure development.

IV.   RESULTS and KEY FINDINGS

This chapter presents the results of the quantitative analysis conducted on the data collected from 269 construction professionals in Turkey. The study aimed to assess the influence of Lean Construction principles—Culture/People, Continuous Improvement, Customer Focus, Waste Elimination, and Standardization—on project performance, particularly within the highway and infrastructure sectors.

4.1.   Respondent Profile

The survey gathered demographic data to ensure diverse and representative responses. Key findings include:

- **Gender**: Majority male participants (approximately 86%).

- **Age Distribution**: Most respondents were aged between 26–45 years.

- **Educational Background**: Over 70% held a bachelor's or higher degree.

- **Professional Experience**: A significant portion had 5–15 years of experience in the construction sector, particularly in infrastructure projects.

4.2.   Descriptive Statistics

Descriptive analysis was conducted to understand the extent of Lean Construction practice adoption. The responses were measured using a 5-point Likert scale ranging from "Strongly Disagree" to "Strongly Agree." Among the five lean principles studied, standardization had the highest average score (mean ≈ 3.82), indicating that it is the most consistently applied Lean practice in the Turkish construction context. Waste elimination followed closely (mean ≈ 3.76), highlighting its perceived value in reducing costs and enhancing project efficiency. Customer focus and continuous improvement had mean scores of approximately 3.58 and 3.40 respectively, indicating moderate application. However, culture/people scored the lowest (mean ≈ 3.25), suggesting implementation challenges in fostering people-centered lean strategies.

4.3.   Correlation Analysis

To assess the relationships between Lean Construction practices and project performance, Pearson correlation analysis was performed. The analysis showed positive relationships between each of the lean dimensions and project success metrics such as efficiency, cost control, and timeliness. Standardization and waste elimination

had the strongest positive correlations with project performance, reinforcing their central role in lean implementation. Customer focus and continuous improvement also demonstrated moderate positive associations. Interestingly, culture/people, while conceptually vital, exhibited a weaker correlation with performance, indicating that people-centered strategies may not yet be effectively integrated into project workflows.

4.4.   Regression Analysis

Further, a multiple regression analysis was carried out to evaluate the predictive power of the five lean principles on overall project performance. The regression model was statistically significant ($p < 0.001$), with an adjusted R^2 of approximately 0.54, suggesting that more than half of the variation in project outcomes can be explained by the included lean variables. Among them, standardization emerged as the most influential predictor ($\beta = 0.376$, $p < 0.01$), followed by waste elimination ($\beta = 0.301$, $p < 0.01$). Customer focus also had a significant positive effect ($\beta = 0.198$, $p < 0.05$), while continuous improvement showed marginal significance ($\beta = 0.143$, $p = 0.052$). In contrast, culture/people were not statistically significant ($\beta = 0.082$, $p = 0.079$), suggesting that cultural or human factors have not been successfully leveraged to improve performance in most of the observed projects.

4.5.   Key Findings

From these results, several key findings emerged. Firstly, standardization—the practice of establishing clear procedures, guidelines, and work methods—was strongly associated with better project outcomes. Respondents reported that it helped reduce delays, prevent errors, and simplify coordination. Secondly, waste elimination played a crucial role in optimizing resource use and minimizing unnecessary activities. Techniques like prefabrication, Just-in-Time (JIT) delivery, and lean site management were particularly beneficial in this area. Thirdly, customer focus, which involves understanding and responding to client needs, contributed to better communication, fewer reworks, and higher satisfaction levels among stakeholders.

On the other hand, continuous improvement practices were present but inconsistently applied. While many participants acknowledged its value, they cited a lack of training, structured frameworks, and follow-through as obstacles to regular implementation. Finally, the weakest performing principle, culture/people, highlighted a gap in organizational development. Despite Lean theory emphasizing the importance of empowering workers and fostering a collaborative environment, many Turkish construction firms appear to struggle with adopting people-centered strategies effectively. This may be due to hierarchical project structures, limited lean awareness, or resistance to cultural change.

In conclusion, the findings confirm that Lean Construction principles, particularly standardization and waste elimination, significantly enhance project performance in the Turkish infrastructure sector. However, for Lean to be fully effective, greater efforts are needed to embed continuous improvement and culture-driven practices within organizational systems. These insights provide a foundation for developing a localized lean framework tailored to the operational realities of Turkey's construction environment.

V.   CONCLUSIONS

This study set out to examine the effectiveness of Lean Construction principles in improving the performance of infrastructure projects in Turkey, with a focus on the civil and highway construction sectors. By analyzing data collected from 269 professionals in the Turkish construction industry, the research provides valuable insights into how Lean practices are currently understood, implemented, and perceived within the local context.

The findings highlight that standardization and waste elimination are the most influential Lean principles driving positive project outcomes. These practices were associated with improved resource utilization, fewer delays, better quality control, and overall cost efficiency. Customer focus also demonstrated a moderate positive impact, emphasizing the importance of aligning construction processes with end-user requirements. On the other hand, continuous improvement and culture/people factors were found to be less impactful, primarily due to organizational resistance, limited training, and a lack of strategic integration.

This research contributes to the broader literature by offering a contextualized understanding of Lean Construction in an emerging economy. It underscores the need for a localized approach to Lean implementation that considers the specific challenges faced by Turkish construction firms, such as cultural dynamics, management styles, and project complexity.

To realize the full benefits of Lean Construction, it is essential for organizations to go beyond tool adoption and foster a cultural shift toward collaboration, continuous learning, and proactive problem-solving. The study recommends that policymakers and industry leaders invest in training programs, pilot projects, and performance monitoring systems to facilitate broader Lean adoption.

In conclusion, Lean Construction offers a practical and impactful pathway for improving infrastructure project outcomes in Turkey. By strategically applying Lean principles, particularly standardization and waste elimination, the construction sector can significantly enhance its efficiency, sustainability, and competitiveness in the long term.

REFERENCES

Babalola, O., Ibem, E. O., & Ezema, I. C. (2019). Implementation of lean practices in the construction industry: A systematic. *Building and environment*, *148*, 34-43.

Ballard, G., & Howell, G. (2003). Lean project management. *Building Research & Information*, *31*(2), 119-133.

Demirkesen, S., & Tezel, A. (2022). Investigating major challenges for industry 4.0 adoption among construction companies. *Engineering, Construction and Architectural Management*, *29*(3), 1470-1503.

Eren, F. (2019). Top government hands-on megaproject management: the case of Istanbul's grand airport. *International Journal of Managing Projects in Business*, *12*(3), 666-693.

Erol, I., & Unal, U. (2015). Role of construction sector in economic growth: New evidence from Turkey.

Guide, G. P. (2025). Turkey Residential Real Estate Market Analysis 2025.
Koskela, L. (1992). *Application of the new production philosophy to construction* (Vol. 72, No. 39, pp. 0724-30017). Stanford: Stanford University.

Ogunbiyi, O., Goulding, J. S., & Oladapo, A. (2014). An empirical study of the impact of lean construction techniques on sustainable construction in the UK. *Construction innovation*, *14*(1), 88-107.

Tezel, A., & Nielsen, Y. (2013). Lean construction conformance among construction contractors in Turkey. *Journal of management in engineering*, *29*(3), 236-250.
Womack, J. P., & Jones, D. T. (2003). Banish waste and create wealth in your corporation. *Recuperado de http://www. kvimis. co. in/sites/kvimis. co. in/files/ebook_attachments/James*, *56*.

Yaldız, F. (2023). The Political Vision of the Organization of Turkic States: an Analysis of the Turkic World Vision 2040. *Eurasian Research Journal*, *5*(2), 61-79.

Yıldırım, N., Gultekin, D., Tilkici, D., & Ay, D. (2022). An institutional system proposal for advanced occupational safety and labor standards in the Turkish construction industry. *International journal of environmental research and public health*, *19*(22), 15113.