Kon, W., Tommelein, I.D., Saragih, G.F., Kasih, R.N., Coelho, R.V. (2025). The Hidden Lean: Lessons from Japan. In O. Seppänen, L. Koskela, & K. Murata (Eds.), *Proceedings of the 33rd Annual Conference of the International Group for Lean Construction* (IGLC33) (pp. 1345–1356). https://doi.org/10.24928/2025/0140

THE HIDDEN LEAN: LESSONS FROM JAPAN

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ABSTRACT

Lean Construction, rooted in the Toyota Production System, has revolutionized the global construction industry. However, its explicit adoption in Japan—the birthplace of Lean principles—has been surprisingly limited. This paper investigates the intersection of traditional Japanese management systems and Lean principles to uncover latent Lean principles within Japanese construction practices. By combining a systematic literature review and field observations, the research explores the cultural, historical, and industrial factors that have shaped Japan's approach to construction management. The study highlights unique aspects of Japanese management, including the *WA* culture of harmony, the *Monozukuri* and *Hitozukuri* spirit, and the membership-based employment system, which collectively foster a quality-centric environment aligned with Lean principles. Challenges such as labor shortages, workforce aging, and overwork culture are also examined alongside innovative initiatives like i-Construction. The findings aim to bridge the gap between Japanese management styles and the global LC philosophy, offering insights for enhancing Lean adoption worldwide.

KEYWORDS

Japanese Management, Monozukuri, Hitozukuri, WA culture, Kaizen

INTRODUCTION

Lean management, originally framed to describe the Toyota Production System (TPS), was formalized as Lean Production in the manufacturing sector (Womack et al., 1990). Its principles, focused on maximizing value and minimizing waste, were later applied to construction, giving rise to the field of Lean Construction (LC) (Koskela, 1992; Ballard et al., 2002; Koskela et al., 2002). This paper explores how Lean principles have been cultivated and embedded in Japan, examining their historical and cultural roots, how they have been reflected in the construction industry, and how they may shape this industry's future trajectory.

The Japanese construction industry presents a fascinating case to study the adoption of Lean practices. While Japanese construction practices have evolved differently from the traditional Lean philosophy, Lean principles are deeply rooted in Japan's management systems. By

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examining the Japanese management style, this research aims to uncover new insights that could accelerate the global adoption and evolution of LC practices and tools. Japan's reputation for a nourishing quality-focused environment and its traditional management approach, known as *Monozukuri* (loosely translated as "production") and *Hitozukuri* ("people development"), provide a unique lens through which Lean theory can be enriched.

Interestingly, despite its origins, Lean has gained less attention in Japan's construction industry (Inokuma et al. 2014; Shigaki et al. 2024). This paper delves into the reasons behind this phenomenon, exploring whether certain theories are already woven into the Japanese context or if other factors contribute to Lean's limited prevalence. It aims to bridge the gap between management principles in the Japanese construction industry and LC principles, identifying opportunities to integrate and enhance LC. This paper also highlights emerging management trends in Japanese construction, exploring how the industry is charting its own course without strictly adhering to LC principles. Through this exploration, this research aims to contribute to shaping the future trajectory of LC practices worldwide.

RESEARCH METHOD

Following Saunders et al. (2020), this study adopts an interpretivist research philosophy to explore the historical and cultural underpinnings of Lean principles in the Japanese construction industry. This approach emphasizes understanding the subjective meanings and cultural contexts that have shaped Lean practices within Japan.

The study primarily employs a systematic literature review to analyze these underpinnings, focusing on academic articles and government publications that elucidate the unique characteristics of Japanese management styles and their alignment with Lean principles. Specifically, studies examining Japan's distinctive management style, including implicit Lean principles, have been used to comprehensively analyze Lean's historical and cultural background. For insights into the future of the construction industry, key references include materials related to the Ministry of Land, Infrastructure, Transport, and Tourism's (MLIT) i-Construction initiative. In addition to the literature review, this study incorporates field observations to offer practical insights and comparative perspectives. Observations at Japanese construction sites draw from the author's professional experience, providing qualitative examples of how Lean principles manifest in practice. Comparative observations at U.S. construction sites, which are largely influenced by Western culture, highlight the uniqueness of Japanese management principles.

Figure 1 illustrates the scope of this paper highlighted by red boxes, which the authors of this paper added to the diagram created by Shigaki et al. (2024). As mentioned, this research explores the origins of Lean, it outlines the future trajectory of the Japanese construction industry, and finally, it proposes the future development of LC.

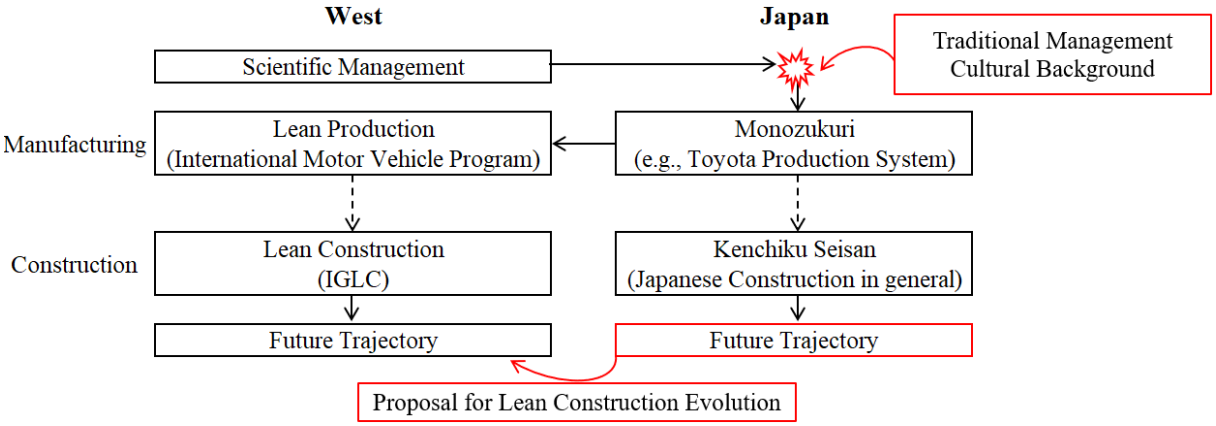

Figure 1: Research scope shown in red boxes. Figure adapted from Shigaki et al. (2024)

JAPAN AND LEAN CONSTRUCTION

To begin with, it is essential to explore why LC has not been widely recognized or adopted within the Japanese construction industry. Understanding this gap is crucial to the overall narrative of this study. Inokuma et al. (2014) identify key reasons behind this phenomenon. First, the TPS, which serves as the foundation for LC, has undergone continuous evolution, making it challenging to consistently define and apply its concepts within the construction sector. Second, many principles of LC are already and have been integrated into traditional Japanese construction practices, albeit without explicit recognition of Lean thinking. This has led to a widespread perception that LC is not present in Japanese construction. Shigaki et al. (2024) explore this paradoxical condition through an interview-based approach. One interviewee notes that LC is hardly recognized in Japan and highlights several factors limiting the LC principle's adoption: (1) the strong reliance on "tacit knowledge from the *Gemba*," which creates a gap between practitioners and researchers; (2) the perception that academic methods are too abstract for practical use; (3) the difficulty in translating concepts from the TPS to construction; (4) language barriers that have historically hindered access to LC principles while recent translation tools have helped mitigate this challenge.

Both Inokuma et al. (2014) and Shigaki et al. (2024) imply that some LC principles are already incorporated into the traditional construction management methods currently used in Japan. This incorporation makes it challenging to increase awareness of LC principles as a distinct concept. In fact, the term Lean may not be recognized as such; it was a term coined in the U.S. (Krafcik, 1988). Exploring how the construction environment inherently developed in Japan will provide a deeper understanding of LC principles. The following section delves into several factors that fostered the foundation of Japan as the birthplace of Lean practices.

TRADITIONAL AND CURRENT MANAGEMENT SYSTEMS IN JAPAN

BUILT-IN-QUALITY (SQC AND TQC)

In contemporary Japan, quality-focused management is predominant (Trevor, 1986, Hirao, 2022), and the construction industry is no exception. Also, as Taichi Ohno, known as the father of Lean, stated, "Total Quality Control (TQC) is the essence of TPS." (Fujimoto & Shimokawa, 1997). This deep connection between Japan's quality-oriented environment and Lean principles is evident in various aspects of its management culture.

Contemporary quality management in Japan traces back to the pre-war era (1900s to 1940s), when Japanese exports were labeled as "cheap and low-quality" due to a focus on mass production at low cost. However, as Japan transitioned post-World War II to a modern, quality-focused management style, this negative perception changed dramatically (Sugiyama, 2023). An iconic scene that captures this change in perception appears in the movie Back to the Future Part III. In the film, Doc, who lives in 1955, remarks, "No wonder this circuit failed… it says, 'Made in Japan.'" However, Marty, who comes from 1985, responds, "What do you mean, Doc? All the best stuff is made in Japan."

1950 marked a significant milestone for "Made in Japan" when W. Edwards Deming, an American statistician, was first invited to Japan to promote U.S.-style quality control methods. Initially invited to assist with the Japanese census, Deming gave lectures that laid the foundation of Statistical Quality Control (SQC). His philosophy emphasized that "quality is everyone's responsibility" and that "quality comes not from inspection but from the improvement of the production process" (Deming, 1982). Interestingly, while Deming's philosophy was not widely accepted in the U.S., it was warmly welcomed in Japan, sparking a transformation towards a quality-focused environment (Kitahara, 1988). With this philosophy, Japan learned to compete

with foreign countries. Aligning with SQC, companies started to refine/reshape this philosophy for Japanese society, and Quality Control Circles (QCCs) and 5S (sort, set in order, shine, standardize, sustain) were born; these are now framed as Japanese TQC. In the 1960s, although it was not explicitly recognized, TQC developed organically in Japan to secure quality. TQC is a comprehensive approach to quality management that emerged as Japanese industries sought to improve the global reputation of their products. Rooted in the principles of SQC introduced by Deming and others, TQC expanded these ideas to encompass every aspect of an organization. Toyota was not an exception. Toyota adopted SQC in the 1950s to improve product quality and transitioned to TQC in the 1960s. This shift strengthened practices like *Jidoka* (automation with a human touch) and *Kaizen* (continuous improvement), embedding quality into the production process. As a result, Toyota achieved significant improvements in production efficiency and customer satisfaction.

Although it was not explicitly recognized at that time, this quality-focused approach, rooted in SQC and TQC, became pervasive across industries in Japan. Under Deming's philosophy, quality control was framed as a collective responsibility involving everyone in an organization. While this approach was not broadly adopted in the West, it resonated deeply in Japan and took root. The following section explores the cultural and organizational factors that allowed this concept to flourish in Japan.

WA Culture

The concept of WA (*和*) is deeply rooted in Japanese culture and emphasizes harmony, collaboration, and collective responsibility within a group or society. Historically, WA has been integral to fostering unity and cooperation, encouraging individuals to prioritize the group's well-being over personal interests.

O-Young (1983) highlights that quality control in Japan thrives because of the harmonious relationship between producers and consumers. He notes that producers, being consumers themselves, work diligently to eliminate defects, ensuring trust and confidence in their products. This unique deep-seated pursuit of harmony (WA) extends beyond interpersonal relationships to include respect for tools, machines, and even industrial robots, reflecting a holistic approach to harmony in all aspects of production and management.

Three Religions

In Japan, a unique characteristic is the interweaving of multiple religions, creating a distinct cultural foundation. Three religions—Zen Buddhism, Confucianism, and Shintoism—are thought to have interacted with one another, contributing to the activation of quality improvement initiatives and advancements in quality management. Saha (1994) analyzes their influence on the Japanese society as follows. Zen Buddhism emphasizes the unity of body and mind, valuing direct experience and the pursuit of perfection through focus and self-discipline. This has instilled in the Japanese a deep appreciation for precision and mastery, which has become a cornerstone in manufacturing and process management. Confucianism underscores the importance of education, hierarchical order, and collective harmony, fostering a workplace culture of cooperation and shared responsibility that supports widespread participation in quality improvement activities. Shintoism, with its reverence for nature and all things, instils respect for tools, materials, and the environment. This perspective promotes careful handling of equipment and a commitment to accuracy and meticulousness in craftsmanship. Together, these religious values have merged to form a foundation that supports Japan's unique approach to quality improvement and management.

Employment System

Traditionally, Japanese society has adopted a membership-based employment system that is different from a job-based employment system. Doi (2022) highlights a key distinction between

job-based and membership-based employment systems. In the job-based employment system, prevalent in Western countries, tasks are predefined, and people are matched to them rigidly. Conversely, in a membership-based employment system, typical in Japan, the connection between people and tasks is managed flexibly, allowing for dynamic adjustments to align people with varying roles over time.

Figure 2 represents the difference between job- and membership-based employment systems. The membership-based system in Japan reflects a cultural focus on optimizing the whole rather than individual components, a perspective that coincidentally aligns with systems thinking, which opposes "divide-and-conquer" approaches (Senge, 1990). In the membership-based system, workers need to overlap each task and consider the whole project, which aligns with Deming's philosophy fitting into the management policy of Japanese organizations as workers cannot be committed to only their own scope of work. As an example, visits to construction sites in both Japan and the U.S. allowed the authors to see how the differences between these systems are reflected in construction practices. In the U.S., roles and responsibilities are clearly defined, with explicit task assignments. Safety is managed by safety managers, quality by quality control managers, the project by project managers, and field operations by field engineers. Each role operates within a well-defined scope, fostering specialization and clarity. In Japan, individuals manage a broader range of roles and responsibilities and are expected to consider tasks beyond their immediate scope, including related departments and adjacent workflows. The first author's experience in Japan included training to oversee five key areas: schedule, cost, quality, safety, and environment. This holistic approach emphasized comprehensive oversight rather than specialization.

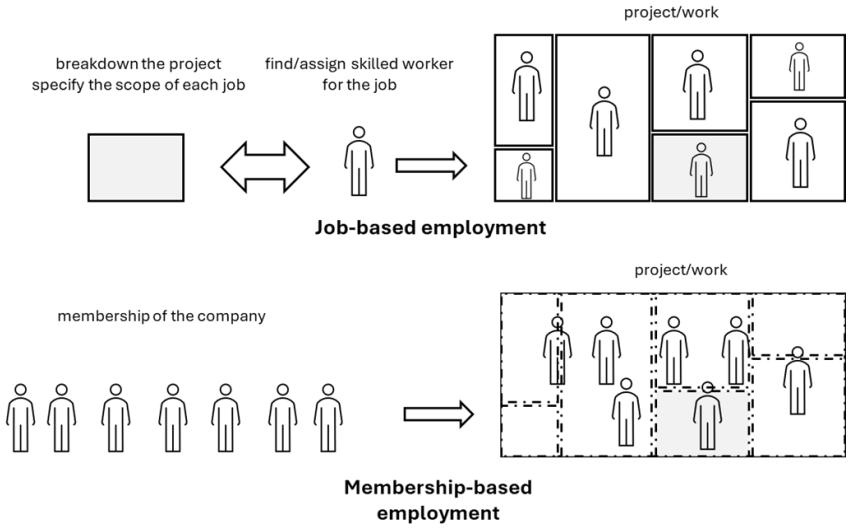

Figure 2: Comparison of Job-Based and Membership-Based Employment Systems

This membership-based employment system in Japan is believed to have aligned well with Deming's philosophy of total quality management, enabling significant improvements in quality. Furthermore, this system, which encourages a comprehensive understanding of processes beyond individual roles, makes it easier to identify issues across interconnected workflows. It is also considered to have greatly contributed to Kaizen, a key element of Lean, by fostering continuous improvement, as workers are encouraged to view systems holistically.

INHERENT CONTINUOUS IMPROVEMENT SYSTEM (KAIZEN)

Kaizen (*改善*), a Japanese term meaning "improvement," is a management philosophy emphasizing continuous, participatory, incremental, and cost-effective enhancements in areas such as quality, productivity, cost, delivery, safety, morale, and environment. Rooted in

Japanese industrial practices—particularly at Toyota—as well as broader Japanese cultural values, Kaizen fosters teamwork, creativity, and self-reliance, making it a cornerstone of Lean thinking worldwide.

While Kaizen is widely regarded as an integral component of Lean practices, its application varies significantly across regions. Otsuka et al. (2018) highlight that Japanese-style Kaizen and Western-style Kaizen differ due to variations in industrial climates and corporate cultures. These differences are shaped by how companies and workers interact within each system.

At the outset, it is crucial to recognize that the effectiveness of Kaizen depends on the industrial and corporate contexts in which it is applied. For instance, Japanese Total Quality Management (TQM) practices, which emerged in a highly collaborative industrial climate, did not align seamlessly with Western countries' faster-paced and individualistic corporate culture, especially in the U.S. (Otsuka et al., 2018). This led to the evolution of Western-style Kaizen, emphasizing top-down management and quicker outcomes, compared to the more collective and incremental Japanese approach. In the U.S., the dynamic labor market and shorter employment tenures have shaped a preference for top-down management. Executives often focus on rapid breakthroughs, relying on standardized, ready-made approaches such as Six Sigma, developed by Bill Smith at Motorola in 1986 (Montgomery & Woodall, 2008). By contrast, Japanese-style Kaizen is built on bottom-up contributions, with workers actively participating in QCCs and developing custom-made solutions tailored to specific problems (Otsuka et al., 2018). This system is supported by a cultural emphasis on lifelong employment (one of the features of membership-based employment), which fosters loyalty and trust between workers and management. While both approaches aim to improve processes, Japanese Kaizen prioritizes adaptability and customization over standardization.

Heavy Focus on Gemba

As mentioned, Japanese-style Kaizen focuses on bottom-up approaches, emphasizing the importance on Gemba. This is also a feature of Japanese-style management, which was studied in the 1980s to analyze the rapid development in Japan at that time. Suzuki (2000) states that Japanese style management is characterized by four primary features: group-centric management, stability-oriented management, home-like consciousness management, and field (Gemba)-oriented flexible management. Field (Gemba)-oriented management encourages continuous improvement (Kaizen) through the collective efforts of first-hand employees, fostering an environment where knowledge from the field is actively utilized for decision-making and problem-solving. Practices associated with this approach include the implementation of 5S activities, company-wide quality management initiatives like TQC and QCCs, and the application of JIT production systems to minimize waste and maximize productivity (Tezuka & Koyama, 2021). In other words, regardless of concepts like Lean or TPS, Japan has long had a cultural inclination toward emphasizing the importance of Gemba. This focus on the actual workplace is deeply rooted in Japanese management practices, where companies, regardless of industry, prioritize on-site engagement and production activities. This tradition underscores the belief that being physically present in the field and understanding the realities of the workplace is essential for effective management and continuous improvement.

RESPECT FOR PEOPLE

Until now, the discussion has focused on tangible aspects of Lean practices, such as quality management and Kaizen. A foundational concept lies at the center of these practices, emphasizing the importance of Respect for People. Deeply rooted in Japanese manufacturing culture, this principle is tied to the Monozukuri spirit, which values not only craftsmanship but also the individuals behind it. This section explores how the spirit emerged and how it has been passed down and integrated into current practices. Even though respect for people is one of the core concepts in Lean and LC philosophy, there is limited research on it (Erazo-Rondinel et al.,

2024). Actually, the Monozukuri spirit and its attitude toward people lies at the very core of Lean thinking.

Monozukuri

Monozukuri, meaning "making things" or "manufacturing" in English, is a term that has been used since at least the 9th century, originally referring to creating things related to agriculture. Over time, especially with industrialization, its meaning expanded to encompass industrial manufacturing, reflecting a broader and more modern interpretation (Kumagai & Niida, 2021). Beyond simply making things, it emphasizes the story behind the creation, respect for the maker, the pursuit of the highest level of mastery, and gratitude for the entire process. Generally, it is used for traditional handicrafts such as Japanese drums (Saabye et al., 2024), swords, and porcelain. Interestingly, the word Monozukuri evokes various associations in the minds of Japanese people, as shown by the ranking of frequently used words in a study by Kumagai & Niida (2021). The study identified the top ten most frequently occurring single-character nouns associated with Monozukuri, with *'人'* (people) ranking first, followed by *'手'* (hands), *'物'* (things), *'形'* (form), *'心'* (mind), and *'技'* (skill), among others. These words reflect the multifaceted nature of Monozukuri and its connection to craftsmanship, creativity, and human involvement.

According to Fujimoto (2015), Monozukuri represents not only manufacturing but a broader concept encompassing both design and production activities. His "broader definition of Monozukuri" describes it as "the economic activity aimed at simultaneously achieving 'customer satisfaction,' 'profitability,' and 'employment security' through the effective flow of high-quality designs" (Fujimoto, 2015). He also emphasizes that Monozukuri-Gemba is the core place, not generating things but values for society, and underscores that it can become a place for workers to grow and find meaning in life.

Hitozukuri

Hitozukuri, meaning "making people" or "people development" in English, is another critical term that enhances the philosophy of Monozukuri. In Japanese manufacturing culture, Hitozukuri is as important as Monozukuri, emphasizing the development of individuals who not only excel in their technical skills but also contribute to innovation, teamwork, and sustainable growth. Toyota regards Monozukuri as inseparable from Hitozukuri, highlighting that creating high-quality products requires cultivating skilled, motivated, and innovative people (Uchiyamada & Sakai, 2009). As mentioned, Monozukuri-Gemba is not merely a place for executing tasks but also serves as a vital space for nurturing and developing people. This perspective underscores the role of Gemba as more than just a production site—it is a learning environment where workers can refine their skills, gain new insights, and evolve into innovative contributors to the organization. This aligns with the philosophy of Kaizen, which emphasizes continuous improvement not only in processes but also in people. Moreover, Japan's membership-based employment system has played a critical role in realizing this long-term perspective. By focusing on stable, long-term employment relationships, organizations have been able to invest in the education and development of their workforce.

CURRENT JAPANESE CONSTRUCTION CHALLENGES AND INITIATIVES

As confirmed, the core principles of Lean are also present in Japan and have served as the foundation for its production activities and systems, including the construction industry. From this point onward, this paper summarizes how Japan's construction industry has been evolving in recent years, particularly in aspects related to LC, while maintaining its traditional

management style. This evolution is viewed from two perspectives: the challenges currently faced by the construction industry and the initiatives being undertaken to address them.

CHALLENGES

Karoshi

Karoshi, or "death from overwork," refers to fatalities caused by excessive working hours and work-related stress, including conditions such as heart attacks, strokes, and even suicides (Kanai, 2009). The term gained prominence in the 1980s, during Japan's economic boom, when cases of sudden death linked to long working hours began to surface, highlighting the severe physical and mental toll on workers (Hamaguchi, 2011).

As public awareness grew, driven by reports and lawsuits from victims' families, Karoshi became a symbol of Japan's excessive work culture. The government, recognizing the gravity of the issue, introduced the Karoshi Prevention Countermeasure Promotion Law in 2014, which aimed to address the root causes of overwork-related deaths by promoting workplace reforms and encouraging employers to reduce working hours. In addition to this law, the Work Style Reform Act (2018) was introduced to impose a clear cap on working hours. This Act aimed to reduce working hours and implement measures to improve work-life balance, thereby addressing the systemic issues contributing to an excessive work culture. With these regulatory frameworks, the construction industry, as well as other industries, needed to update their work ethics, which has resulted in a decrease in working hours. It is reported that the construction industry experienced a 3.7% working hours decline on average from 2018 to 2022 (MLIT, 2024).

Labor Population Decline and Workforce Aging

Japan's working-age population has been in a steady decline since peaking at 87.26 million in 1995, accounting for 69.5% of the total population. By October 2023, this figure had dropped to 73.95 million, 59.5% of the total population (MLIT, 2022b). The construction industry is no exception. MLIT (2022a) states that the number of workers in the construction industry has significantly declined from 6.85 million in 1997 to 4.79 million in 2022. Furthermore, 35.9% of the workforce is now aged 55 and older, while only 11.7% is under the age of 29, emphasizing the aging workforce and the critical challenge of transferring technical skills to younger generations. This situation is exacerbated due to the general perception that the construction industry is dirty, demanding, and dangerous, which limits the engagement of younger generations.

INITIATIVES

Productivity Improvement

As said in the Challenges section, improving productivity in the Japanese construction industry is not merely a corporate initiative but a socio-economic mission. Due to a declining workforce and newly established working-hour restrictions in Japan, tasks that once had adequate time and manpower must now be completed under stricter time constraints and with fewer resources. Reacting to this situation, MLIT, in 2016, launched the "i-Construction" initiative. This initiative, spanning a decade (2016–2025), aims to boost productivity in the construction industry by 20% through innovations and new technologies like drone-based surveying and 3D data integration across the entire construction process, at least for public projects. Alongside these advancements, the initiative seeks to reshape the industry's image, making it more appealing with promises of higher income, better work-life balance, and a fulfilling work environment, ultimately addressing labor shortages and driving innovation (MLIT, n.d.). In 2020, to accelerate this movement further, MLIT decided to mandate the utilization of new technologies on the bidders for the following projects. As of 2022, it is reported that in

comparison with 2015 when the initiative was not introduced, productivity improved by 21% (MLIT, 2023).

An example of integrating new technologies with traditional Kaizen practices can be seen in the work conducted by Toyota Frontier Research Center. To address labor shortages and aging challenges while improving construction productivity, the center developed a Construction Simulator. Sakai et al. (2024) reported that the researchers employed a simulator with 3D computer graphics to accurately replicate the work site and simulate planned construction activities. This innovative tool enabled a detailed analysis of inefficiencies (*Muda*) and the assessment of worker fatigue during various tasks. Based on these insights, the team identified optimal solutions and implemented them in the field. For example, the simulator revealed that the mortar transportation task was particularly labor-intensive. In response, the team introduced carts for mortar transportation, significantly reducing worker fatigue and enhancing efficiency. What makes this approach particularly interesting is its emphasis on addressing workers' physical burdens alongside productivity improvements. It serves as a compelling example of not only tackling existing and future challenges overviewed through productivity enhancements but also ensuring thoughtful consideration for the workers who are essential to sustaining these improvements.

DISCUSSION

Up to this point, the analysis has focused on how Lean principles originated and flourished in Japan, supported by its cultural and social environment. From here, the discussion shifts to exploring how Japan, as the birthplace of Lean, can contribute to the LC community globally.

HEAVY FOCUS ON PEOPLE AND GEMBA

As this paper has outlined, the development of Lean principles in Japan was significantly influenced by the cultural and social context of the country. The adoption of SQC during Japan's post-war recovery served as the foundation for what eventually evolved into Lean methodologies. However, this transformation was not the result of a top-down imposition by companies like Toyota alone. Instead, it was deeply rooted in the dedication of workers on the ground who continuously sought improvements and maintained a strong Gemba-focused mindset. This grassroots, bottom-up approach, inherent in Japanese management practices, played a critical role in shaping what the world now recognizes as Lean. Lean framing occurred primarily when Western countries sought to adapt and implement Lean in their own contexts. This framing process often resulted in a more formalized structure to suit Western industrial climates.

Berroir et al. (2015) note that a bottom-up approach to the implementation of LC proves to be the most practical. The effectiveness of LC practices does not emerge solely from top management directives but from the continuous, meticulous activities conducted at the ground level. This aligns closely with Japanese-style Kaizen, where incremental, field-driven improvements create the conditions for sustainable success.

LC is often seen as a set of tools or frameworks, but its true strength lies in fostering a workplace where frontline workers can engage in continuous improvement. While tools provide structure for top management, the core of LC is creating an environment that encourages problem-solving, collaboration, and innovation at the Gemba. By valuing and empowering workers, organizations can ensure LC remains impactful across diverse contexts.

TECHNOLOGY INTEGRATION FOR PEOPLE

The unique challenges faced by Japan, including labor shortages and an aging workforce, have accelerated the adoption of advanced technologies in the construction industry. Initiatives such as "i-Construction" exemplify the effective integration of technology into construction

practices, with a focus on enhancing productivity while maintaining a human-centered approach. In contrast to the top-down models prevalent in Western contexts, Japan's methodology prioritizes the specific needs of workers and the workplace. This balanced integration of technological innovation and a Gemba-centric focus presents a valuable model for advancing LC practices.

CONCLUSIONS

This study has explored the intersection between LC principles and traditional Japanese management practices, highlighting their inherent alignment through concepts such as WA culture, Monozukuri, Hitozukuri, and the membership-based employment system. While Lean has gained global recognition as a structured philosophy or methodology, many of its principles are already implicitly embedded within Japanese construction practices. Japan's dual focus on maintaining traditional values and adapting to modern challenges, as seen in initiatives like i-Construction, demonstrates how innovation and technology can complement a human-centered approach. Additionally, this study underscores the unique factors behind Japan's emphasis on Gemba and continuous improvement, offering deeper insights into how these culturally rooted practices can refine LC principles globally.

While these discussions provide valuable insights into the contributions of Japan's Lean principles to the global LC community, it is essential to recognize several limitations to this analysis. These limitations must be addressed to ensure a comprehensive understanding and applicability across diverse contexts.

The discussion of LC practices presented in this paper must also consider their potential darker aspects. Green (1999) highlights that much of the literature on LC tends to emphasize its positive outcomes while downplaying or ignoring the negative implications. Lean is often portrayed as universally beneficial, a perspective that has contributed to its widespread adoption. However, this idealized view may obscure the potential misuse of lean practices that may result in labor exploitation, excessive control enforced by employers, and unintended social costs.

As discussed in this paper, Japan's unique cultural and management practices have been instrumental in shaping LC methodologies. However, these same cultural norms have also raised significant social challenges, such as Karoshi and labor exploitation, particularly in industries such as construction where long hours and high stress are prevalent. While Lean and LC principles emphasize efficiency and teamwork, they can inadvertently exacerbate these problems by increasing work demands without addressing worker well-being.

Moreover, the differences between Japan's membership-based employment system and the job-based employment systems prevalent in Western cultures highlight another limitation. In Japan, flexible role assignments allow for holistic management but may also blur boundaries and heighten pressure to perform tasks outside one's defined scope. In contrast, the Western emphasis on clearly defined job descriptions may clash with the integrated and dynamic approach advocated by LC, leading to cultural and operational resistance.

By bridging Japanese management traditions and the global LC methodologies, this research provides insights for enhancing the application of Lean across diverse contexts. Future studies should examine how these principles can be tailored to different cultural and industrial settings to enhance their impact.

ACKNOWLEDGMENTS

Development of the ideas presented in this paper was supported in part by gifts made to the Project Production Systems Laboratory (P2SL). All support is gratefully acknowledged. Any opinions, findings, conclusions, or recommendations expressed in this paper are those of the authors and do not necessarily reflect those of contributors to P2SL.

REFERENCES

Ballard, G., Tommelein, I., Koskela, L., & Howell, G. (2002). Lean construction tools and techniques. In R. Best & G. de Valence (Eds.), *Design and construction: Building in value* (pp. 227-255). Butterworth-Heinemann.

Berroir, F., Harbouche, L., & Boton, C. (2015). Top down vs. bottom up approaches regarding the implementation of lean construction through a French case study. In *Proc. 23rd Ann. Conf. Int. Group for Lean Construction (IGLC 23),* 73-82. Perth, Australia.

Deming, W. E. (1982). *Out of the crisis*. MIT Press.

Doi, T. (2022). Two employment systems and education. *Chukyo Law Journal*, *66*(2), 45-67. Retrieved Dec. 29, 2024, from chukyo-u.repo.nii.ac.jp/record/18786/files/106350570101doi-chukyo-u.pdf

Erazo-Rondinel, A. A., Rivera-Nalvarte, C. C., Villar-Vasquez, J. A., Melgar-Morales, M. A., & Giménez, Z. (2024). Respect for people and lean construction: Good practices, benefits, and barriers. In *Proc. 32nd Ann. Conf. Int. Group for Lean Construction (IGLC 32),* 1207-1218. Lima, Peru. doi.org/10.24928/2024/0191

Fujimoto, T. (2015). The concept of monozukuri workplaces in empirical social sciences. *Keieigaku Ronshu, 85*, 17-24. doi.org/10.24472/abjaba.85.0_17

Fujimoto, T & Shimokawa, K. (1997). An interview with Taiichi Ohno, *CIRJE J-Series 97-J-4*, CIRJE, Faculty of Economics, University of Tokyo.

Green, S. D. (1999). The dark side of lean construction: Exploitation and ideology. In *Proc. 7th Ann. Conf. Int. Group for Lean Construction (IGLC 7),* 21-32. Berkeley, CA.

Hamaguchi, K. (2011). *Employment and labor law in Japan*. Nikkei Publishing.

Hirao, T. (2022). Intellectual proficiency as a study of skills. *The Japanese Journal of Human Resource Management, 23*(1)*,* 9-15. doi.org/10.24703/jshrm.23.1_9

Inokuma, A., Aoki, M., Shimura, M., Nagayama, D., & Koizumi, C. (2014). Absence in the provenance? Lean construction and its applicability in Japan. In *Proc. 22nd Ann. Conf. Int. Group for Lean Construction (IGLC 22),* 15-26, Oslo, Norway.

Kanai, A. (2009). "Karoshi (work to death)" in Japan: Causes, statistics, and prevention. *Journal of Business Ethics, 84*(Suppl. 2), 209-216. doi.org/10.1007/s10551-008-9701-8

Kitahara, T. (1988). SQC → TQC → TQM. *Economic Studies*, *54*(3), 1-30. doi.org/10.15017/4491687

Koskela, L. (1992). *Application of the new production philosophy to construction* (Technical Report No. 72). Center for Integrated Facility Engineering, Stanford University.

Koskela, L., Howell, G., Ballard, G., & Tommelein, I. (2002). The foundations of lean construction. In R. Best & G. de Valence (Eds.), *Design and construction: Building in value* (pp. 211-226). Butterworth-Heinemann.

Krafcik, J. F. (1988). Triumph of the lean production system. *MIT Sloan Management Review*, 30(1), 41.

Kumagai, Y., & Niida, M. (2021). A study on the meaning and the function of the word "Monozukuri". *Journal of Technological Science Research, 38*(3), 1-10. doi.org/10.20580/jptsci.38.3_1

MLIT. (2022a). The construction industry's current condition and challenges. *Annual Report on Construction, 2022 Edition.* Ministry of Land, Infrastructure, Transport and Tourism. Retrieved December 30, 2024, from www.mlit.go.jp/policy/shingikai/content/001610913.pdf

MLIT. (2022b, March 29). *Transition of working population and worker number.* Ministry of Land, Infrastructure, Transport and Tourism. Retrieved December 30, 2024, from www.mlit.go.jp/statistics/file000004/html/n1111000.html

MLIT. (2023). *Future development of i-Construction. i-Construction Strategy Report, 2023 Edition*. Ministry of Land, Infrastructure, Transport and Tourism. Retrieved December 30, 2024, from www.mlit.go.jp/tec/i-construction/pdf/02.9_kikaku_siryou2.pdf

MLIT. (2024, June). Work style reform in practice. Ministry of Land, Infrastructure, Transport and Tourism. Retrieved December 30, 2024, from jsite.mhlw.go.jp/saitama-roudoukyoku/content/contents/001867361.pdf

MLIT. (n.d.). *Promotion of i-Construction*. Ministry of Land, Infrastructure, Transport and Tourism. Retrieved December 30, 2024, from www.nilim.go.jp/lab/peg/img/file1737.pdf

Montgomery, D. C., & Woodall, W. H. (2008). An overview of Six Sigma. *International Statistical Review*, *76*(3), 329-346. www.jstor.org/stable/27919650

Otsuka, K., Jin, K., & Sonobe, T. (Eds.). (2018). *Applying the Kaizen in Africa: A new avenue for industrial development*. Retrieved December 28, 2024, from library.oapen.org/handle/20.500.12657/22933

O-Young, L. (1983). The culture of WA. *Japan Quarterly, 30*(1), 54. www.proquest.com/scholarly-journals/culture-wa/docview/1304281060/se-2

Saabye, H., Powell, D., & Hines, P. (2024). The microfoundations of lean leadership: Monozukuri, Hitozukuri, Kotozukuri. *Total Quality Management & Business Excellence, 35*(9-10), 998-1014. doi.org/10.1080/14783363.2024.2349806

Saha, A. (1994). Culture and the development of technology in Japan. *Technology in Society, 16*(2), 189-204. doi.org/10.1016/0160-791X(94)90030-2

Sakai, N., Ito, Y., Kawahara, D., Okuda, H., & Kanemaru. T. (2024). Development of a construction simulator. In *Proc. 6th Symposium on the Promotion of i-Construction* (Vol. 2024, pp. 49-52). doi.org/10.11532/kensetsumanagement.2024.0_49

Saunders, M. N. K., Lewis, P., & Thornhill, A. (2020). *Research methods for business students*. Pearson.

Senge, P. M. (1990). *The fifth discipline: the art and practice of the learning organization.* New York: Doubleday/Currency.

Shigaki, J. S.-I., Koskela, L., Tezel, A., & Pedo, B. (2024). Exploration of Lean Construction in Japan and its paradoxical stance. In *Proc. 32nd Ann. Conf. Int. Group for Lean Construction (IGLC 32)*, 1219-1231. doi.org/10.24928/2024/0193

Sugiyama, Y. (2023). A review of Japanese quality control: Three future perspectives. *Konan Business Review, 63*(3-4), 87-109. doi.org/10.14990/00004412

Suzuki, S. (2000). *The management of Japanese companies in Asia: On the results of questionnaire and field surveys*. Tax Management Association. <WHERE>?

Tezuka, K., & Koyama, A. (2021). Modern "Japanese-style management" theory (1). *Gakushuin University Economic Review*, *58*(2), 175-186, Retrieved December 26, 2024, glim-re.repo.nii.ac.jp/record/5070/files/keizaironsyu_58_2_175_186.pdf

Trevor, M. (1986). Quality control—Learning from the Japanese. *Long Range Planning, 19*(5), 46-53. doi.org/10.1016/0024-6301(86)90008-7

Uchiyamada, T., & Sakai, K. (2009). Monozukuri is Hitozukuri. *Journal of the Japan Society for Precision Engineering, 75*(5), 567-570. doi.org/10.2493/jjspe.75.567

Womack, J. P., Jones, D. T., & Roos, D. (1990). *The machine that changed the world: The story of lean production*. Rawson Associates.