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EXPLORATION OF LEAN CONSTRUCTION IN JAPAN AND ITS PARADOXICAL STANCE

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ABSTRACT

Japanese construction, appraised for its high quality and production efficiency, holds virtues that Lean advocates have long admired in the Toyota Production System. However, Japanese building construction academia and industry organizations have remained disconnected from the mainstream IGLC community until recently. Therefore, its current state is insufficiently understood overseas. This study has employed a literature review, including resources in English and Japanese languages, and gathered first-hand testimonials to shed light on such a gap. This paper identified practices and routines from Japanese construction sites that could be incorporated into the Lean Construction repertoire, and identified points from which Japan could learn, such as the role of dynamic ecosystems in the birth and expansion of the Lean Construction movement and the presence of heavy-weight champions who nurtured conduit leaders. Japanese constructors have aspired to pull their engineering strength to the next level and combine it with innovative management practices, including incorporating good ones learned from overseas. That is where the role of Lean resides. Lean may help fill the gap of converting tacit knowledge into structured knowledge, increasing transparency, smoothing the transmission of know-how, creating more efficient project deliveries, and turning itself into a more attractive business.

KEYWORDS

Lean Construction, Japan, Theory, Toyota Production System, Ecosystem.

INTRODUCTION

The 1990s provided a fertile ground for rethinking construction engineering and management from the perspectives of technology, processes, and people (Tzortzopoulos et al., 2020). It was when (Western) construction started to apprehend quality management as in manufacturing. Improvements observed in the automotive sector have not been a product of a radical technology change but the result of the application of a new production philosophy, which was the generalization of partial approaches such as JIT and TQM (Alarcón, 1996). The seminal report *Application of the New Production Philosophy to Construction* (Koskela, 1992) led to the reconceptualization of production theory and practice in construction, which has matured over 30 years to a large extent around the International Group for Lean Construction (IGLC).

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Lean Construction is the counterpart to Lean Production evolved in the context of construction. Lean Production is a generalization of the Toyota Production System (TPS), which is successfully applied in diverse business scenes. However, in Japan, the birthplace of the TPS, the conceptualization of Lean, in general, has been less evident. Iwao (2021) identifies a "conceptualization weakness" related to its high-context culture. Consequently, outstanding management techniques have been conceptualized in other countries and brought back to Japan later. Nonaka and Takeuchi (2019) praise the role of practical wisdom (phronesis) in continuous innovation but emphasize the necessity of both informal and formal interactions to convey the essential meaning of strategies in action. Japanese construction has arguably succeeded without formalized Lean, but there is room for improvement by adopting the "old-new" approach.

When it comes to the construction sector in Japan, it is intriguing that signs of applications of Just-in-Time (JIT), Total Quality Control (TQC), Concurrent Engineering (CE), and Value Engineering (VE) existed since the 1970 and 1980s. They have been little explored, perhaps due to the language barrier. For example, Tamura (2009) cited Taylor's influence in the incorporation of good practices from manufacturing, while Furusaka (2009) and Matsumura (2010) mentioned TQM and VE as innovations that transformed the construction gemba with tools and mindset. Still, there was no clear demonstration of how Lean Construction works at Japanese construction gemba and in white-collar offices, whether it exists in the first place.

Despite the "feel" that something tacit exists, there was no evidence in the "open" literature.

> *Many people are interested in the Japanese state of Lean Construction because Lean Construction has been born out from the Toyota Production System. Although I have been studying and introducing Lean Construction for some years, even now people who know the term "Lean Construction" seem to be less than 50 in number inside Japan (Dr. Inokuma to the Lean Construction Blog, 2017).*

Motived by the unprecedented exchange between Japan and the IGLC community in recent years and the approaching IGLC 2025 scheduled to take place in Osaka and Kyoto, this study aims to revisit the origins of the Lean Construction movement and discuss the paradoxical stance of the Japanese building industry, providing a historical background and reflections aspiring to trigger future exchange opportunities for mutual evolution.

RESEARCH METHOD

This study has employed an interpretivist research philosophy, holding a relativist ontological position, lying closer to a subjective epistemology and a constructivist axiology, according to the classification suggested by Saunders et al. (2009). It is exploratory and aims to shed light on the paradox that has kept the Lean Construction community apart from the Japanese construction academia and industrial societies (and vice-versa), even though a critical source of inspiration came from their manufacturing counterparts.

Quantitative tertiary data were collected from the IGLC proceedings. Qualitative secondary data were attained through a bibliographic review, including untranslated materials. Primary data were obtained through semi-structured interviews. The targets were three experienced engineers from a major Japanese General Contractor, hereinafter (J_n), and Western academics (co-authors to this paper) with a long track record in Lean Construction, hereinafter (W). Participants included: (J_1) Senior Chief Researcher from the R&D (32 years of experience), (J_2) BIM Lead from the Construction Division (21 years of experience), and (J_3) General Manager of Planning & Administration from the Construction Division (33 years of experience).

The approach was inspired by the "catch-ball" game, whose concept has been employed in organizational contexts, conveying the idea of an iterative dialogue, in this case, by correspondence. The specific questions can be followed along with the testimonials, which provide first-hand impressions based on empirical background. The expression "*nama no koe*" (literally *raw voice*) refers to the collection of heartfelt experiences. The discussed topics have long been the object of curiosity in this field and disclose hitherto little-known faces of history.

HISTORICAL BACKGROUND AND CURRENT SITUATION

The origins of the Japanese-style management are not uncontroversial. It is believed that Scientific Management principles met the post-war technocratic rationality of the *Sangyō Gōrika* movement to set the foundations for Japanese manufacturing (*Monozukuri*) as a "revised Taylorite" model (Tsutsui, 1998). Monozukuri practices emerged from unrelated improvements whose underlying principles that led to success were hazy in their inception.

In the realm of building production (*Kenchiku Seisan*), innovations were not understood as "Lean" efforts. Instead, they were likely the product of consecutive kaizens until becoming "ordinary" routine practices. Despite the skepticism toward accepting methods employed in manufacturing, there was a sense of admiration regarding the outstanding performance of TPS. TQC (later renamed to TQM) policies were how those ideas penetrated construction sites, suggesting activities and tools associated with Lean Production without calling them Lean.

To provide a concrete example, Takenaka Corporation has promoted Total Quality Control (TQC) efforts since 1976 and won the Deming Prize in 1979. The following passage conveys the context and spirit of that period (free translation from the original text in Japanese):

> *My father [Ren'ichi Takenaka] began exploring more fundamental business improvements and turned his attention to the automotive industry, where TQC was already advancing. With the guidance of Hino Motors, he came to know the name of Prof. Tetsuichi Asaka (Professor Emeritus at The University of Tokyo and a pioneering leader of TQC). We immediately requested Prof. Asaka's guidance, but he initially declined to accept. However, driven by our determination to ensure the continuation of the Takenaka's family business, we persisted and finally obtained his approval on the third attempt. This happened in 1976. Prof. Asaka had a policy of guiding one company per industry, and our company was chosen for guidance in the construction industry. By the way, in the automotive industry, Toyota Motor Corporation received his guidance. In the electric power industry, it was Kansai Electric Power Company (Toichi Takenaka in Kigyō sonzai kachi no sōzō: Hinshitsu keiei, Takenaka Corporation, TQM Promotion Department, 2022, p.26).*

Endeavors based on a similar philosophy antecede the creation of the IGLC. Nevertheless, the Japanese academia did not devise a formal theory of Lean Production for construction. As a result, Lean-like applications were and, arguably, continue to be essentially tacit.

Recently, prominent former UTokyo Prof. Fujimoto (Economics) collaborated with Prof. Yashiro (Architecture) to "theorize" building production through the lenses of Monozukuri. The joint research resulted in the untranslated book *Kenchiku Monozukuri-ron* (Fujimoto et al., 2015). Intriguingly, it did not mention Lean Construction's TFV theory. Also, there is no report of firms intentionally reformulating their production systems into formal Lean inspired by it.

Fig. 1 illustrates the transmission routes across the movements, including the obstructed but existing path from TPS to Japanese construction and the gap with the formal Lean Construction.

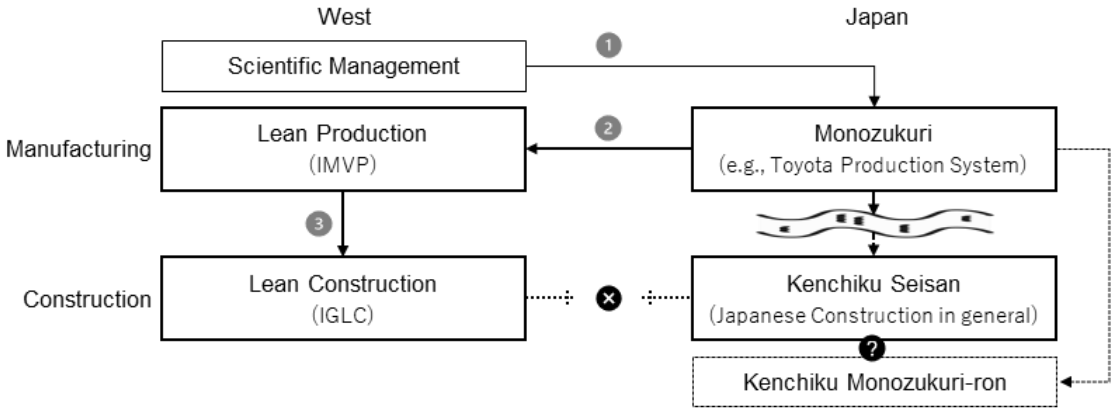

Figure 1: The path to Lean Construction and the disconnection with the Japanese construction

On the whole, Japanese construction has elements of Lean philosophy, introduced via TQC/TQM, but has not systematically deployed Lean Construction methods as in the West. In Japan, the initial focus was more on quality over production efficiency.

HOW DIFFERENT IS THE ORTHODOX JAPANESE APPROACH TO LEAN?

One of the few but most consistent studies on Lean Construction has been conducted by the Research Institute of Construction and Economy (RICE). Yamane et al. (2000) provided a concise yet comprehensive overview of the early days of Lean Construction, mentioning the Egan Report (1988) and research on TPS by European and American scholars as a strategy to overcome issues left unsolved by what the so-called Project Management (PM) methods were not able to do, particularly in terms of dealing with uncertainty and variability.

There was a sense that construction sites operated based on know-how accumulated over many years, and that would be the cornerstone for improving efficiency. They recognized that construction lagged behind manufacturing in many aspects of production systems and production management methods based on "theory". In a footnote, they cited the Ministry of Construction's "Construction Industry Technology Strategy (2000)", which stated that the country had not necessarily accumulated management skills compatible with the international community, so it was necessary to improve the sophistication of management approaches.

One of the interesting points discussed by Yamane et al. (2000) was the comparison between the Last Planner System (LPS) and the Japanese-style construction management. Since the main differences pointed out by that article could be outdated, the four points were checked against the field by authors who updated their descriptions with contemporary reflections.

1. **Lookahead Planning and its associated processes.**
The Lookahead Planning resembles the Japanese *Gekkan Keikaku* (monthly planning). However, the Lean Construction way not only derives "should" from the master plan but considers the "can", making explicit the necessary conditions in an iterative system reviewed weekly. In comparison, Japanese planning derives monthly and weekly work plans from the master plan and makes sub-processes adhere to them. However, there is no systematic procedure for constraint identification and elimination, which are carried organically.

2. **Last Planner and its associated processes.**
The Last Planner shares characteristics with the Japanese *Shūkan Keikaku* (weekly planning). The Lean way "shields" production by verifying work start conditions based on objective criteria. In comparison, the Japanese way also checks the readiness before moving a task from the monthly to the weekly work plan. The judgment, though, is heavily empirical and relies on tactic knowledge. The adherence to schedule is effective (partially due to its strict discipline) but not necessarily efficient since there is no systematic variability measurement.

3. **PPC metrics and progress lines.**
The PPC is a quantitative indicator of the process plan's "quality" or "reliability". It grounds the determination of investigations of the causes of planning failures and poor adherence. By comparison, Japanese sites draw *Shinchoku-sen* (progress line) on process charts that resemble the Line of Balance, updating them weekly and monthly. However, such a practice evaluates the results quantitatively but does not provide a notion of the production system's "goodness" in terms of "healthy work allocation" and overall process reliability.

4. **Planning responsibility, collaborative kaizen studies, and daily huddles.**
By definition, the LPS promotes the empowerment of frontline workers by engaging them in co-creating the Lookahead and Commitment plans. In Japanese sites, active discussions are held with the foremen regularly in meetings equivalent to "daily huddles" to consider improvements to the production system. In the *Chōrei* (morning assemblies), the communication is mostly direct from the main contractor to the workers. But, in the so-called

"11:30 meetings" for progress and safety management alignment, foremen positively engage with operational decisions and fine-tune countermeasures to arising issues. Still, in most cases, the staff of the main contractor elaborates the process plans in the site office.

THE PARADOXICAL GAP WITH THE LEAN CONSTRUCTION COMMUNITY

Japanese building production took advantage of specific management ideas successfully implemented in manufacturing but never called itself Lean Construction. Despite sharing operational characteristics, its development occurred independently. On the other hand, Lean Construction embodied pre-digested conceptualizations from Lean Production and not directly from Japanese construction sites. Therefore, casual similarities arise from latent ties in their shared sources of inspiration rather than being the product of active exchange and collaboration.

Lean Construction has employed Japanese vocabulary to convey specific ideas, positioning them as holding a different meaning from the customary (i.e., embedding the new philosophy). As elucidated by the text mining conducted by Shigaki et al. (2021), many words that became popular because of the TPS have been utilized without translation at construction sites. The continuity over the years suggests that such a lexicon has become part of the daily vocabulary. They are now an intrinsic part of management systems. Nonetheless, there was no mention of terminology exclusive to construction. The most cited authors are Ohno (1988) and Shingo (1985), with no significant quotes from Japanese architecture or civil engineering academics.

Fig. 2 shows that the tokens "Japan" and "Toyota" appeared the most to contextualize the source of inspiration, followed by specific principles, methods, and tools in IGLC papers.

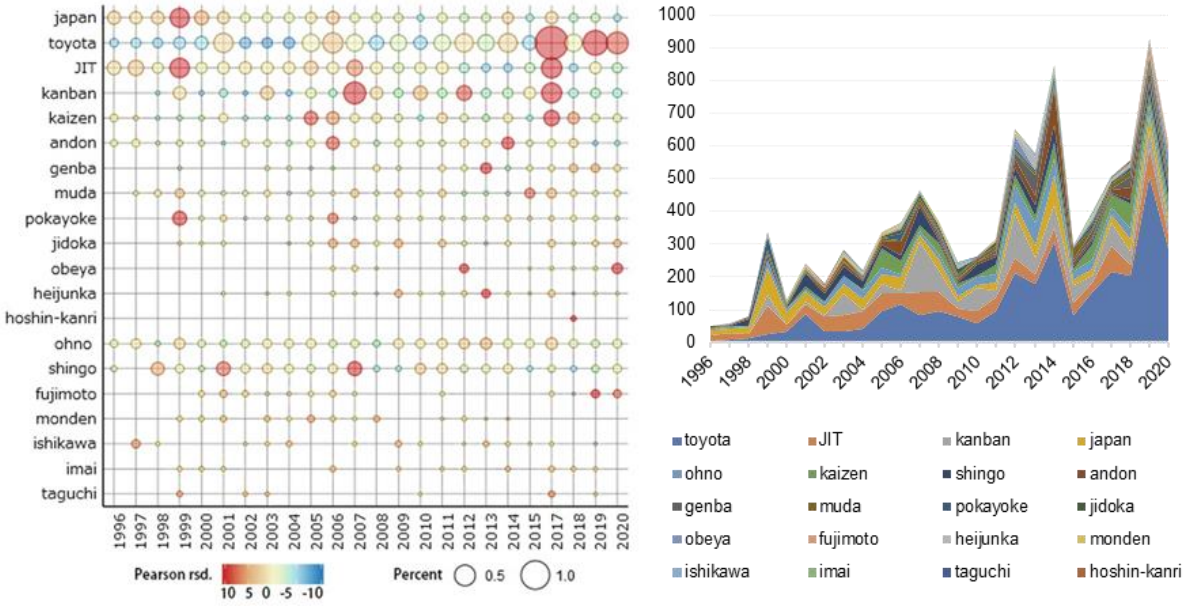

Figure 2: Japan-related keywords in IGLC conference papers (1996-2020) (Source: Shigaki et al. 2021)

The increasing number of participants in the IGLC conferences suggests that the topic is not exhausted. Adaptive in nature, Lean has merged with trending topics to respond to pressing issues such as contracting systems, digital transformation, sustainability, and well-being. It has also broadened its coverage to include more regions across the globe. However, the Japanese participation has been modest, disproportional to its expected position as the source of the TPS.

As for publications in the IGLC, considering the first authors, Japan stands at the 26th position among 50 countries, with only nine papers accounting for 0,42% of all articles (2004, 2005, 2006, 2014, 2017, 2018, 3x in 2023). Three of those papers were presented at the IGLC Conference in Lille, along with two industry day presentations, a record high engagement.

Historically, the countries that hosted more IGLC conferences have the most publications, even though it is difficult to conjecture about the industry-wide level of awareness and organization of their Lean Construction ecosystems. For instance, the US hosted the IGLC six times and is accountable for 21.7% of IGLC papers (affiliations of the first author), followed by Brazil (3x and 14.2%) and the UK (3x and 11.0%). As Osaka and Kyoto will host the IGLC 2025, one can expect growth in the exchange between Japan and the IGLC community.

The first appearance was of a graduate student during his study abroad at Penn State (counted as US), whose research had no direct relation to Japanese construction (see Sakamoto et al., 2002). The first official record is from Prof. Yoshitaka Nakagawa, who said, at that time, that "only a few contractors and house building companies are introducing this Lean Construction system" (see Nakagawa & Shimizu, 2004; Nakagawa, 2005; Nakagawa, 2006).

Then, Dr. Akira Inokuma from the Japan Federation of Construction Management Engineers Association (JCM) published the intriguing "Absence in the Provenance." He stated that "ironically, dialogue on Lean Construction has been limited in Japan, and almost gives a perception that LC is not applied in Japanese construction projects" (Inokuma et al., 2014).

After that, Prof. Koichi Murata, with an industrial engineering background, collaborated with long-standing IGLC members based in the UK, establishing the first formal bridge with the IGLC community (see Murata et al., 2017; Murata et al., 2018; Murata, 2023). In the last conference, Prof. Kaori Nagai, with substantial experience in construction R&D, debuted at an IGLC conference (see Nagai et al., 2023). She coincidently belongs to the same University as the previous professor. Nevertheless, their encounter at the conference was serendipity.

The last publication was of an expat (counted as Japan) who had previously learned Lean Construction abroad but was affiliated with Japanese institutions. The transmission pattern was the opposite of the first one. With an "outside-inside" view, the authors identified tacit manifestations of the Lean philosophy in Japanese construction (see Shigaki & Yashiro, 2023).

Table 1 indicates the co-authorship patterns of the nine papers previously mentioned in terms of "Japanese x International" and "Industry x Academia" allocations.

Table 1: Collaboration patterns of IGLC papers from authors related to Japan (1996-2023)

Pub. Year	First Author	Japan. co-authors		Intl. co-authors		Co-author's affiliation
		Academia	Industry	Academia	Industry	
2004	YN	1	1	-	-	Mid-sized GC
2005	YN	1	-	-	-	-
2006	YN	1	-	-	-	-
2014	AI	-	5	-	-	Consultants
2017	KM	1	-	3	-	U. Huddersfield (UK)
2018	KM	1	-	3	-	U. Huddersfield (UK)
2023	KM	1	-	-	-	-
2023	KN	2	2	-	-	Nihon U, Mid-sized GC, Dev.
2023	JS	2	-	-	-	U. Tokyo

A search for "Lean Construction" in the J-Stage platform (https://www.jstage.jst.go.jp) will lead to only two papers (Nakagawa, 2005; Inokuma, 2014). Both are repeat authors from the IGLC articles shortlist. To explain Lean Construction to the local audience, they both referred to the TPS. The former mentions the Last Planner System as an approach that originated in construction. The latter does not mention specific methods but has the IGLC homepage in the bibliography. The oldest record, however, could only be found in a printed source: the

Proceedings of the 15th Kenchiku Seisan Symposium organized by the Architectural Institute of Japan (AIJ) by Prof. Jun Shiino who did not publish at the IGLC (see Shiino et al., 1999). That is the only paper with "Lean" in the title since 1985.

BRIDGING THE GAP: A CATCH-BALL DIALOGUE

HOW DID JAPANESE CONSTRUCTION INFLUENCE LEAN CONSTRUCTION?

The origin of Lean Construction dates to Lauri Koskela's visit to Stanford University in the early 1990s. Despite the well-known history involving Lauri Koskela, Glenn Ballard, and Gregory Howell, there is little discussion on the role weight of Japanese construction as a source of inspiration for the development of Lean Construction.

When asked about the triggers for interest in the TPS and the American pre-digested Lean Production, Koskela said:

> *For me, there was a specific, concrete trigger: A colleague asked whether we in construction have considered simplifying operations before automating them. I found that his question was inspired by Japanese experiences and started to look for the "new production philosophy" as embodied in the TPS.*

In the preface of his doctoral thesis, Koskela (2000) acknowledged a Japanese person affiliated with a leading house manufacturing company who contributed with a case study. However, such interaction does not seem to have significantly influenced the theorization of Lean Construction. When asked about the exchange with the Japanese person, he said:

> *Such interactions played only a minor role. I had been in Japan earlier for an extended period and had made readings in Japanese culture, but I do not think these experiences were much discussed in the 1992 report.*

WHEN AND HOW DID THE JAPANESE LEARN ABOUT LEAN CONSTRUCTION?

Even among the few people acquainted with Lean Construction, the learning routes and the degree of awareness can be diverse. The testimonials below confirm such a scenario.

> ***[J1]*** *In Japanese construction, scientific management methods, such as TQC, were introduced in the 1970s. By the time I joined the company in 1992, they had become well-established and are still in use. Around 1993, the collapse of the bubble economy made corporate competition fierce. In 1995, I began researching production systems that could significantly reduce costs and improve productivity. Then, I started paying attention to TPS and learning about it from books, including materials by Fujimoto-san. I remember hearing the term "Lean" around that time. However, I did not pay much attention to Lean Construction research when considering ways of applying Toyota's methods. It was around 2009 when I learned about the Last Planner. I got very interested in it and started paying attention to Lean Construction.*
>
> ***[J2]*** *Coming from the construction site, I started working in software development three years ago (2021) and became interested in Agile. I wondered if this methodology could be applied in construction and began researching examples. It was when I came across the term "Lean Construction". About a year and a half ago (2022), when visiting a hospital project in Norway that utilized a workflow with certain BIM tools, the director of that software vendor taught me that Lean Construction concepts had been employed there.*
>
> ***[J3]*** *I'm not very familiar with it in the first place. I have a vague understanding that Lean Production has derived from TPS, which focuses on improving bottleneck processes.*

WHY HAS THERE BEEN LESS INTEREST IN LEAN CONSTRUCTION IN JAPAN?

The less interest reflects the low level of awareness, partially due to the language barrier and the difference between high-context and low-context cultures compared to the West.

> ***[J1]*** *Lean Construction is hardly known in Japan. However, just because there is less interest in Lean Construction, it does not mean that the Japanese construction industry is lagging behind in production methods (don't get me wrong). There are several possible reasons why Lean Construction has not received attention. (1) There is a tendency to value "tacit knowledge from the gemba", which has led to a gap in awareness between practitioners and researchers; (2) It is assumed that production methods that have been studied are somewhat difficult to understand and may not be suitable for practice use (if you can't*

engage practitioners in the field, no matter how good the method is, it will die without evolving); (3) There were attempts to learn directly from the TPS, but the translation from manufacturing to construction has not been successful; (4) English has been a barrier, so translation tools in recent years have been a great help.

***[J₂]** Many people just do not know the word. Additionally, there is a bias that since architecture involves creating one-of-a-kind products, it would not be possible to apply manufacturing processes directly. Consequently, only a few individuals are inclined to study the TPS. Also, Japanese people don't frequently search for information in English, so they do not come across information related to Lean Construction.*

***[J₃]** In Japan, production improvement efforts started with the Zero Defects movement, followed by QC activities, TQC, and then TQM. This approach was adopted not only in construction but in all industries. In post-war years, "Made in Japan" was synonymous with poor quality. As a national policy response, quality management began to gain importance. Organizations such as JUSE (Union of Japanese Scientists and Engineers) held QC conferences for all industries, and these activities continue to this day. However, the concept of Lean did not resonate in this country.*

WHY HAS IT BEEN HARD TO COLLABORATE WITH JAPAN SO FAR?

As part of the catch-ball process, the authors of this paper identified several difficulties in establishing deeper connections with Japan and pointed out some directions, summarized below.

***[W]** Understanding the research, business, and cultural context of construction in Japan has proven to be challenging. We need more "conduits" like the professors who already attend the IGLC conferences. There is also this language barrier, as only a few works have been published in English. We also need more research projects with set targets and budgets for collaborations with Japan. It is difficult to obtain funds, at least in the UK, focusing on Lean Construction from traditional research funders. Japanese business organizations could be more active in that regard. Due to the lack of engagement of Japan with the global Lean Construction community until now, Japan is seen as a "no Lean Construction zone" by many.*

WHAT COULD JAPANESE CONSTRUCTION LEARN FROM LEAN CONSTRUCTION?

Towards the wrap-up, the Japanese players reflected on the opportunities to take the good parts of the Lean Construction to further improve their so far tacit approach.

***[J₁]** By learning sophisticated "philosophy" and "methods" that are easy to understand for practitioners and putting them into practice. Lean Construction could be used to make explicit what is done implicitly.*

***[J₂]** Key aspects: (1) Respect for people: It is critical to have conduct guidelines for practicing it. In Japan, there is a tendency to appraise value delivery through self-sacrifice, which has hindered the ability to respect individuals. The concept of "humility", which is admired by foreigners, may intersect with this issue. (2) Logification and verbalization: Japan has struggled with formalizing and articulating systems. The ability to turn tacit knowledge into explicit knowledge is an urgent social matter. (3) Simplifying building structures and working with margins: In Japan, there is also a tendency to favor processes with "no gaps" or minimal downtime. Adopting a mindset that allows buffers could enable smoother processes and more flexibility. (4) Roles: Setting new roles with unique skills, such as coaching and facilitation, have become necessary to implement Lean. Practical examples from overseas could provide valuable insights.*

***[J₃]** I want to learn the concepts and examples of Lean Construction held overseas first. As of now, I cannot provide any definitive insights as I am not well-versed in this area.*

Finally, the authors of this paper provide their perspective on this matter.

***[W]** Japanese construction is well-known for completing projects to a high standard and adhering strictly to the schedule, which may require employing additional resources, working extended hours, or investing in more technologies. To avoid overburden (muri), the Western construction industry has been focusing on health, safety, and well-being. These aspects could be transferred into the Japanese approach. Besides, Lean Construction techniques, such as the Last Planner System, Takt Planning, and Location-Based Planning could be of interest to Japan. Lean design and engineering (beyond construction) could also be new for the Japanese context. Above all, we need to go to the gemba and see what we can offer.*

WHAT COULD THE LEAN CONSTRUCTION MOVEMENT LEARN FROM THE CURRENT JAPANESE CONSTRUCTION MANAGEMENT METHODOLOGIES?

The answer is more about put light on what exists but has not been revealed thus far.

> ***[J$_1$]*** *Lean Construction could add new methods, such as sound planning and execution resulting from the excellent cooperation between main and subcontractors, by (re-)interpreting Japanese Kenchiku Seisan.*
>
> ***[J$_2$]*** *Key aspects: (1) Management techniques such as "shisa-koshō (literally pointing and calling)" and the daily meetings. (2) The highly organized site operation routine for quality, safety, and hygiene management in close cooperation with the subcontractor' foremen. (3) While it may not necessarily be considered a positive aspect, Japanese companies can complete construction work quickly. On the other hand, it might require a significant number of workers and extended working hours before its completion.*
>
> ***[J$_3$]*** *Overseas companies tend to be more litigious and have documentation excesses as a defensive management approach. Consequently, the cost of construction guarantees from insurance companies is significantly. By offering "full turnkey" solutions, Japanese General Contractors take comprehensive control and spend less with those kinds of issues. Additionally, General Contractors have advanced in construction technology development, providing solutions such as "composite construction methods (fukugōka kōhō)" and "reverse construction methods (sakauchi kōhō)" that I have not heard about out there. However, due to fundamental cultural differences, it is challenging to make direct comparisons.*

Like in the prior question, the authors provide their perspective on this matter too.

> ***[W]*** *Japan seems to have implemented innovative management practices, drawing inspiration directly from the source, that is, the Toyota Production System. Rather than simply adopting techniques from a toolbox, Japanese-style management returns to the fundamental concepts that underpin these practices. Many overseas organizations, however, implement different tools without considering fundamental concepts, which can affect results. By prioritizing a deep understanding of the underlying theory and principles, overseas organizations may be able to develop a more holistic approach. Also, new management techniques from Japan can be added to the Lean Construction arsenal. Recently, for instance, a large design consultancy company in the UK introduced ji-kōtei kanketsu, which became very successful.*

DISCUSSION: LESSONS FROM ABROAD

There are two main lessons from which Japan could take advantage when organizing itself regarding Lean Construction's future directions. (1) The role of dynamic ecosystems in the birth and expansion of the Lean Construction movement; and (2) The presence of heavy-weight champions who actively developed "conduits" leaders. The importance of the Californian ecosystem can be recognized in the intertwined biographies of exponents of this subject.

The "*Festschrift honouring Dr. Glenn Ballard*" (see Koskela et al., 2022) reports the story of a "maker at heart" who gained first-hand experience as a field worker on-site and then broke through to managerial positions and gradually transitioned from industry to academia. His collaboration with Gregory Howell, Lauri Koskela, and Iris Tommelein gave him access to widen his connections and enable enriching exchanges with construction companies, industry organizations, and Universities, where he met field workers, executives, notable professors, and students, each contributing to the development and maturation of innovative ideas.

This part of the history is also found in the inspiring first-person narrative of Iris Tommelein in her "*Journey Toward Lean Construction*" storytelling (see Tommelein, 2015). Colleagues from multidisciplinary backgrounds, encouragements to "go to the gemba" as an academic, the transit between lively Universities, the field experience in a Sabbatical, and the establishment and direction of a dynamic research laboratory (PS2L) with strong ties with the industry were contributing factors to enriching the path of a champion that transmitted the knowledge to talented students who have helped conduct the paradigm shift in the AEC industry.

Moving the focus to Scandinavia, Lohne et al. (2022) narrated the "*Emergence of Lean Construction in Norway*", which, as they said, was a phenomenon occurring within a setting that is generally advantageous but also following an effort carried out on several levels. The specificities of the Norwegian context included, for instance, the early experimentation by its largest contractor (Veidekke), the formal introduction of Lean Construction in the academic curriculum, and publication by authors from industry, universities, and research institutions. The appointment of Glenn Ballard as an adjunct professor at NTNU was also emphasized.

Going to a specific case, Elving (2022) narrated "*A Decade of Lessons Learned*" at Skanska Finland, pointing out what worked and what did not work in taking academic concepts to industry. The advice from Glenn Ballard was again highlighted. In the case of experimenting with the Last Planner System implementation, he emphasized the significance of industry-level approaches and technology platforms to logistics and supply development.

Clients and asset owners have also played an important role in the Lean Construction ecosystem. In the UK, for instance, National Highways' Lean Construction agenda has driven application in their supply chain (NH, 2020). In the US, Sutter Health has been a large client organization demanding Lean Construction application, recognized by the LCI for "moving the industry forward in embracing and implementing Lean tools on capital projects (LCI, n.d.)".

Regarding the heavy-weight champions, beyond his own contributions to the Lean Construction discipline through the TFV theory, Lauri Koskela also nurtured pupils who have made remarkable contributions. To name a few, Sergio Kemmer has been a successful consultant to a range of company sizes and regions. Bhargav Dave has led a startup whose core product emerged from PhD research. Daniel Forgues and Algan Tezel have contributed from an academic position while building ties with the industry. Indeed, some champions have industry backgrounds. Sven Bertelsen (Denmark) and Dean Reed (US) are notable examples who observed and participated in the evolution of the Lean Construction movement.

It is also worth noting the successful stories from South America, personified by Prof. Carlos Formoso (Brazil) and Prof. Luis Alarcón (Chile), who not only actively promoted the Lean Construction agenda, but also taught key figures who are now spread all over the world in both academia and industry. The Southern Hemisphere could be an inspiration to the East. As a limitation, this paper does not cover many other exponents deserving acknowledgment spread in various locations. Many more could also provide insights for advancing Lean in Japan.

During Japan's rapid economic growth period, in the second half of the last century, quality issues demanded innovative solutions. Such a context relates to the project ordering system in which General Contractors control the whole process and take massive responsibility. By then, instead of applying Lean as we know it today, the idea was to merely "build things that do not turn out into problems". Because of such strong customer orientation, it turned out that the physicality of buildings and the processes required to erect them became complicated.

In that context, the solutions created to tackle those challenges had an earnest technological emphasis, developing "hard technologies" to enable the so-much-aspired rationalized construction processes and other "soft" management goals. The *fukugōka kōhō* (Shigaki & Yashiro, 2023) and *sakauchi kōhō*, strategies not widespread overseas, are expressions of their unique engineering strength, which are partially the result of well-structured R&D Institutes and excellent in-house designers. That was chronologically before the emergence of the Lean Construction movement in the West and has since developed independently. The takeaway from those experiences was the attempt to create solutions that help organize the entire business in a way that benefits the owner. Such an attitude reflects the Japanese "culture of matching".

Intriguingly, Japan has developed Lean-ish ideas as part of quality management efforts but has not formalized Lean Construction as a platform for improvement in the delivery of projects. Studying from foreign examples, a proper curriculum in architectural and civil engineering education would possibly help accelerate the process of converting tacit knowledge into know-how that could be more easily transmitted to next-generation practitioners. Currently, the AIJ has no active committee to discuss Lean Construction. Neither has the influential *Nikkenren* (Japan Federation of Construction Contractors) a working group on this topic. The next IGLC could be a trigger to move forward.

CONCLUSION

The testimonials confirmed that Japanese construction has elements of Lean ingrained in routine practices. However, they have not been deployed as formal Lean Construction methods as known in the IGLC community. Through the preliminary but engaging dialogue between Lean theorizers and Japanese construction practitioners, the paradoxical gap between them has started to be filled. The continuity of such exchange could trigger innovations that bridge and eventually unite excellent partial solutions.

As a next step, Japanese constructors have aspired to pull their engineering strength to the next level and combine it with innovative management practices, including incorporating good ones learned from overseas. That is where the role of Lean resides. Lean may help fill the gap of converting tacit knowledge into structured knowledge, increasing transparency, smoothing the transmission of know-how to business partners (externally) and young employees (internally), creating more efficient project deliveries, and turning itself into a more attractive business. They aspire to nurture talented people who "generate maximum value by creating works that amaze", powered by individual ingenuity and collective rationality.

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