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LEAN CONSTRUCTION ADOPTION IN INDONESIA AND AUSTRALIA: BASED ON TOE FRAMEWORK

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ABSTRACT

Lean construction (LC) has gained strong interest and is increasingly deployed in both Indonesia and Australia, two neighbouring countries with different development stages. While one is rapidly developing and the other is a developed country and has a relatively 'mature' construction industry, both face similar productivity challenges. This study uses the Technological, Organizational, and Environmental (TOE) framework to explore factors affecting Lean Construction adoption in both countries. Through multiple case studies of five companies from each country, the results reveal similar TOE factors, with notable differences, particularly in government roles in promoting LC. Overall, Australian firms took a slower, more isolated approach, while Indonesian firms had more interactions and collaborations with academics and professional bodies. This comparison is valuable in identifying converging factors and potential lessons for both countries. We remain hopeful that LC adoption will continue to thrive in the region and look forward to more research and industry case studies emerging.

KEYWORDS

Lean construction, Australia, Indonesia, TOE framework, actor, adoption

INTRODUCTION

Australia and Indonesia are neighboring countries with different systems and stages of economic development. Despite these differences, both countries' construction industries have made significant contributions to their national GDPs and face similar productivity challenges. Lean construction (LC) has gained traction in both countries' construction industries. The authors, representing LC peak bodies in both nations, have observed the development of LC in each country, which inspired this paper. Based on the TOE framework, this study aims to explore factors affecting LC adoption in both countries. The paper begins by reviewing IGLC papers to reflect on the LC development in both countries, using the TOE framework to explain the technical, organizational, and environmental factors associated with LC's growth in each context. TOE is a commonly used framework for understanding the technology deployments (Wang et al., 2010), but in certain contexts, lean construction itself can be perceived as a form of 'technology', as it comprises of methods and tools. As defined by Osabutey et al. (2014) such methods and tools are considered as process technologies, to deliver construction projects, and

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especially when the term lean construction 4.0 emerges (Hatoum & Nassereddine, 2022). Past studies have documented lean implementation in individual countries such as Colombia (Páez et al., 2013), India (Sreram & Thomas, 2023), and Australia (Chesworth et al., 2011), but comparisons among countries in terms of LC adoption were rare. This study is among the first attempts. The comparison reveals that while both countries share common factors, each also has unique aspects. This comparison is valuable for researchers in both nations, enabling mutual learning and offering insights for future development.

THE EARLY DAYS OF ADOPTION IN AUSTRALIA AND INDONESIA

We begin this section by outlining an overview of the construction industries in both countries. The construction industry in Australia accounts for 11% of the GDP (Master Builder Australia, 2024) which created 1.32 million jobs. According to Australian Bureau of Statistics (ABS, 2024), in 2022-23, the construction industry's total income was $568b, with expenses of $517b, resulting in an operating profit of $51b, with construction services[4] representing approximately two thirds of the total profit figure. The industry consists of 98.7% small businesses with less than 20 employees, with nearly 450,000 building and construction companies (Master Builder Australia, 2024). Interestingly, the industry frequently makes headlines due to various challenges, including labor shortages, quality issues (Paton-Cole & Aibinu, 2021), sluggish productivity (Nasirzadeh et al., 2022), and more recently, the collapse of builders (Schlesinger, 2024). Shockingly, nearly 3000 building companies broke in the last financial year 23-24. In Indonesia, the construction sector experienced rapid growth since 2011, driven by significant government investment in infrastructure, particularly from 2014 until the COVID-19 pandemic in 2020; more than 10% of the GDP. The development is promising but the industry is also struggled with poor labor skills, quality issues, and many others, which are persistent in Indonesia. At the macro level, the Indonesian construction market is competitive and fragmented, with both local and international players. In 2024, there were 190,677 contractors, with large entities making up 1%, medium entities 16.5%, and small entities 82.5%. Sixty percent of the top ten construction companies were foreign contractors, while the rest were state-owned. There are eight state-owned enterprises (SOEs). Despite facing financial and regulatory challenges like private firms, SOEs tend to innovate more in terms of quality. The government is expected to continue supporting the large state-owned construction companies. Indonesia's construction industry predominantly acts as a user or technology importer. This reliance on external technologies poses risks due to insufficient understanding. For example, BIM adoption in Indonesia led to data waste because it was used without a broader vision. A similar scenario may occur with LC if not properly managed (Abduh, 2025).

The Australian Construction Association (ACA, 2023) report highlighted Australia's productivity problem and stressed the need to improve construction efficiency. It defined productivity as "*doing more with less*", aligning with lean principles. The decline suggests that Australia has not fully adopted LC practices, though some lean principles may be used unknowingly. For example, Horman et al. (1997) documented a prominent Australian building firm - Jennings' case shows that lean principles, such as flow and just-in-time, were applied in Australian construction as early as the 1950s-70s, similar time as Toyota production system was developed. Production flow was emphasised to maintain production efficiency whilst meeting wider customer choices. More recently, in 2018, a major tier-one builder improved operational efficiency by "copying" the manufacturing production methods for high-rise apartments in Melbourne, cutting two months from construction time and reducing overtime

[4] Construction services is the largest subdivision of the Australia's construction industry, which groups businesses providing services largely to other construction businesses (commonly referred to as trades).

by 5% (Bleby, 2018). A more structured approach to LC in Australia emerged with the rebranding of Lean Construction ANZ (LCANZ), operating across various states, with the Victoria council being the most active. One of the authors chaired the Victoria council, which has been committed to promoting LC awareness through Communities of Practice (COPs) since 2022, where LC adoptions are explored and discussed across companies and organizations.

In Indonesia, LC has been introduced since 2005 but saw slow adoption, despite a 2015 government regulation and its revision in 2021. LC gained traction in 2019 when state-owned enterprises began implementing it, recognizing the need for improvement. Although still in early stages, LC implementation by SOEs should be shared with other contractors for effective adoption. Correct initial implementation is crucial for maintaining LC's reputation. Their lean journeys were mostly supported by academics and professionals through various interactions and collaborations. Few consultancy firms offer LC training and support. In 2024, IAMKRI[5], a professional association for lean construction, was established by 43 professionals from various sectors. In the past five years, SOEs have adopted various LC strategies with external help. Strengthening internal actors is crucial for initiation and development, requiring strong top management commitment and leadership. Involving external actors is also necessary to expand knowledge and validate implementation (Abduh, 2025).

Australia's early interest in lean is evident from hosting the IGLC three times (1997, 2000, 2015) and co-hosting IGLC32 in Auckland, New Zealand (2024) while IGLC has yet to be held in Indonesia. A search for publications in IGLC reveals 29 papers from Australia and 9 from Indonesia. Australian studies span a wide range of lean construction topics, from awareness (Chesworth et al., 2011), implementation challenges (Chesworth, 2015; Stevens, 2022) to LC deployment. From focusing on a specific tools and techniques, i.e. kaizen (Stevens & Thevissen, 2023), and more recently, digital lean innovations like digital LPS (Gao et al., 2024). In contrast, Indonesian studies have consistently focused on areas such as waste reduction (Aisyah et al., 2023), awareness (Abduh & Roza, 2006), and more recently adoption issues (Aisyah & Putra, 2024) hoping to sustaining the LC adoption and practice. Notably, one paper (Alwi et al., 2002), titled *Non-Value-Adding Activities: A Comparative Study of Indonesian and Australian Construction Projects,* made the first attempt to compare the two countries. Such comparative study gave an idea that there are different concerns of waste between developing and developed country (Alwi et al., 2002).

THE TOE FRAMEWORK

The TOE framework was developed in the last century. Originally it was used to understand the adoption of IT innovations. As it gains popularity, the TOE framework has become one of models understanding the adoption of technology. According to Tornatzky and Fleischer (1990), The TOE framework comprises of three contexts which enables the exploration of factors influencing the adoption of an innovation in a firm. These three contexts are technological context, organizational context, and environmental contexts (see Table 1). The **technological context** describes both the internal and external technologies relevant to the firm (Tornatzky and Fleischer, 1990). The technological attributes that can influence the decision to adopt the innovation itself or another emerging technology and its availability (Tornatzky and Fleischer, 1990). Pan and Pan's (2019) study is useful in clarifying technology characteristics which is drawn on Rogers' diffusion innovation theory. In this study, our intention was to position lean construction as an innovation that organizations adopt, rather than an existing technology that integrates with another system. The **organizational context** describes the organizational characteristics that can inhibit or facilitate the innovation adoption (Tornatzky and Fleischer,

[5] IAMKRI standards for Ikatan Ahli Manajemen Konstruksi Ramping Indonesia, translated (in English) as The Indonesian Professional Society in Lean Construction Management.

1990). This includes several descriptive measures: Firm size, the centralization, formalisation, and complexity of its managerial structure, the number of slack resources available internally, and communication processes. **The environmental context** refers to the environmental characteristics in which an organization conducts its business.

Table 1: The context of Technological Innovation

TOE framework	Breakdown elements
Technology	• Relative advantage – degree of benefits provided by LC • Compatibility – perceived consistency of the innovation with the existing practices, for example, is LC compatible with the existing project management and control? • Complexity – perceived difficulties in understanding and using the innovation. • Trialability – kick off with a pilot project
Organisation	• Top management leadership behaviour • Managerial structure – complexity, formalisation, and centralisation • Communication process – role of informal internal linking agents, such as champions • Firm size – large companies have more resources to invest in new technologies. • Slack – organisational resources are fungible, in that they can be taken from one area and moved to another. Thus, firm may decide to reorient its priorities, taking resources away from an existing activity and applying it to an innovative one. Thus, slack can be created for organisation. Firm may simply wait to see how things play out before making a commitment when lack of information about specific technology, or observing key players' move.
External Task Environment	• Industry characteristics and market structure – • Competitive pressure is noted. • Customer-supplier relationship – dominant customers (say government agency) can dictate technology use by the firm that serve them. • Market uncertainty – face a great deal of cyclic instability. • Technology support infrastructure – bring new technology depends on labour costs, skills of the available labour force, and access to suppliers of technology-related services. • Government regulation - The regulatory environment including policies and standards form the institutional pressure. Often known as top-down pressure that enables the adoption of innovations.

Source: Adopted from Tornatzky and Fleischer (1990, pp.153).

RESEARCH METHOD

Case study is a widely used research method in lean construction. A search for "case study" on IGLC.net yields nearly 500 papers, though most are based on a single case study. This study leverages the authors' network and engagement with local Lean Construction peak bodies facilitating access to multiple cases. This study adopts multiple case studies as its primary research method which consists of five case companies from each country. These case companies are masked as IC1-IC5 for Indonesia, and AC1-AC5 for Australia (see Tables 2 and 3). We used convenient sampling, selecting companies involved in lean community practices or other lean construction engagements in both countries. It is worth noting that given the low lean maturity in both countries, the number of participating companies is very limited. We organized workshops and seminars on lean construction, where companies shared their lean journey. Additionally, we visited projects implementing lean methods to observe real-world applications.

Table 2: Profiles of case companies from Australia

	Case companies In Australia				
No.	AC1	AC2	AC3	AC4	AC5
Nature of business	Private	Private	Private	Private	Private
Tiers	Tier-2	Tier-1	Unknown	Tier-1	Tier-1
Sectors	Civil	Civil	Building	Civil/Building	Building

Note: AC stands for Australian contractors. AC5 collapsed in 2019.

Table 3: Profiles of case companies from Indonesia

	Case companies in Indonesia				
No.	IC1	IC2	IC3	IC4	IC5
Nature of business	SOE-Public	SOE	SOE-Public	SOE-Public	SOE-Public
Tiers	Large	Large	Large	Large	Large
Sectors	Civ./Build.	Civ./Build.	Ind./Civ./Building	Civ./Build.	Ind./Civ./Build.

Note: IC stands for Indonesian contractors.

Data collection primarily involved direct interactions with key personnel from each case company, during discussions, workshops, and webinars. Guided by the TOE framework, the questions and observations focused on the three TOE categories to identify factors influencing LC deployment in both countries and enable a comparative analysis.

THE FINDINGS

The findings in Tables 4 and 5 outline the technological, organizational, and external contexts in which the case companies from both countries attempted LC. Technologically, both countries are adopting common LC techniques and have seen their benefits. Organisationally, organisational support and additional resources are essential. In Indonesia, director-level support for LC adoption is evident, with construction firms benefiting from both internal and external guidance. Interestingly, trained PM in Indonesia often starts LC trial with pilot projects, while Australia typically relies on internal lean champions. Externally, the government plays a major role in Indonesia, but not in Australia. Detailed findings are summarised as follows.

TOE FACTORS FROM AUSTRALIA CASE COMPANIES

- **Technological context:** Table 4 shows that only a few lean construction practices, such as LPS, VSM, and just-in-time, have been adopted by Australian case companies. Despite limited adoptions, the benefits were still impressive. AC3's director stated, "*We will implement this daily activity briefing (an element of LPS) fully in other projects*." AC1 and AC2 participated in a government alliance project emphasising "*continuous improvement*", adopting LC tools that improved performance. AC1's innovation manager, a strong advocate for LPS, noted fewer calls happened to superintendents due to improved plan reliability.
- **Organizational context**: Most Australian case companies are tier 1 contractors, except AC3, a young but innovative firm. Company size appears to influence LC adoption. While none explicitly mentioned slack resources, their commitment and setups suggest extra resources were allocated, such as hiring innovation and continuous improvement managers (as seen in AC1 and AC2), engaged external consultants for LC implementation (AC3 and AC5).
- **External environment:** Among the five case companies, AC1, AC2, and AC4 are key players in the civil sector, which fluctuates with government budgets. Lean adoption in AC1 and AC3 occurred during the Victorian government's Big Build initiative. Although AC1, AC2, and AC4 are competitors, alliance programs and continuous improvement

initiatives required them to share best practices. Further, no regulations mandate lean implementation, although peak bodies such as ACA had lobbied government about the construction industry's declined productivity challenges.

TOE FACTORS FROM INDONESIA CASE COMPANIES

Based on Table 5, as supported by Abduh (2025), there were three active SOEs and then perceived as leader in LC adoption and implementation (IC2, IC3, and IC5), while there were another two SOEs less active and then can be categorized as learning companies (IC1 and IC4). Based on TOE framework, the adoption of LC by five SOEs is described as follows:

- **Technological context:** LPS was the most popular and implemented LC method, while the second was Visual Management (VM), followed by Waste Management (WM). Other methods and tools implemented by case companies were VSM, 5S, and A3. These methods and tools were tried out mostly by case companies in building projects, while they have also attempted to implement LC in civil and industrial plant/EPCs projects. However, the case companies of IC2, IC3, and IC5 implemented more methods than IC2 and IC4. To support implementation, case companies developed various support systems, such as procedures, software, integration of lean and BIM, trainings, assessments, roadmaps, and LC-related events. Many early LPS implementations were conducted on ongoing projects to address current issues, leading to less effective outcomes. Later, LPS was planned at the start of projects, but many case companies still implemented it voluntarily or as a pilot project, depending on the project team's willingness and capabilities.
- **Organizational context**: All Indonesian case companies are large contractors, and therefore, for the adoption of LC to be effective, there should be a formal, systemic and significant commitment from the companies. The adoption may be initially started by an actor (LC champion), but supporting from top level management is a must. It seems that the higher the support is coming from, the more effective the adoption of LC (IC2, IC3, and IC5). Nonetheless, supports from HCM director was effective to encourage the case companies' employees to start a new path of professional career by adopting LC. Furthermore, more active top-level management in supporting the adoption of LC, the adoption and implementation will be sustainable (IC2, IC3, and IC5).
- **External environment:** The lean journeys of case companies were supported by academics and professionals through interactions and collaborations. The Indonesian government's role in introducing LC was significant, given its lead in the construction industry. However, owner and partner demand remain low, so adoption relies on the awareness and needs of each company. Only IC3 began its lean journey due to partner demand in an EPC project, later expanding it companywide. Engagement with IAMKRI provided all case companies with proper knowledge and practices for confident LC implementation.

Table 4: Key factors from TOE framework from Australian companies

		AC1	AC2	AC3	AC4	AC5
Technological (T)	LC practices deployment	Digital LPS Driven by program alliance CI initiative	VSM and continuous improvement adopted Driven by program alliance CI initiative	A few key features of LPS used Triggered by one of the large clients	Self-developed LC capability training	JIT and 5S adopted
Organizational (O)	Top management support	Support from the innovation manager/CI manager level	Support from the innovation manager/CI manager level	Top management level	Supply chain manager	OHS director
	Managerial structure	No	No. but it has CI/change management function	No.	Yes. Lean and supply chain manager	No
	Communication process	LC champion	LC champion	External lean consultant	N.A.	Lean consultant on part-time basis
	Firm size/slack	2CI leads	CI leads	Planning manager is on board	300 LL staff trained	OHS team
Environmental (E)	Industry characteristics	Start with a trial, now across different arms of the company	The UK arm is doing well			
	Technology support	Lean consultant engaged	N.A	Lean consultant engaged Overseas benchmarking exercise	N.A.	N.A.
	Engaging professional body	Engaging LCANZ	Engaging LCANZ	Engaging LCANZ		Engaging LCANZ but disconnected
	Government regulation	Not applicable (N.A)	N.A.	N.A.	N.A.	N.A.

Table 5: Key factors from TOE framework from Indonesian companies

		IC1	IC2	IC3	IC4	IC5
Technological (T)	LC practices deployment	Modified LPS provided by LC team	Modified LPS, VSM, VM, 5S & BIM-Lean tools	Modified LPS, VSM, VM, 5S, Waste Register, BIM-Lean tools	Modified LPS & WM	Modified LPS, VM, WM, A3, BIM-Lean tools
Organizational (O)	Top management support	Support from the operational manager	Supported by HCM director	Supported by the president director	Supported by HCM director	Supported by HCM director
	Managerial structure	No, only ad-hoc LC team	No, only ad-hoc LC team	A function in the strategic and innovation division	No, only ad-hoc LC team	No, only ad-hoc LC team
	Communication process	External lean consultant	LC champion	LC champion	External lean consultant	LC champion
	Firm size/slack	PM trained, pilot	PM trained, pilot	PM trained, all projects	PM trained, pilot	PM trained, pilot
Environmental (E)	Industry characteristics	Start with a learning program, and then pilot projects by individuals	Initiated by an internal champion, leveraged to companywide adoption, and to the selected projects	Driven by partner and then leveraged to companywide adoption of every project	Started as companywide program, then implemented to pilot projects	Started as companywide program, then implemented to pilot projects
	Technology support	Academic and lean consultant engaged	Academic and lean consultant engaged	Academic and lean consultant engaged Overseas benchmarking exercise	Academic and lean consultant engaged	Academic and lean consultant engaged
	Engaging professional body	Engaging IAMKRI (active)	Engaging IAMKRI (active)	Engaging IAMKRI (active)	Engaging IAMKRI (passive)	Engaging IAMKRI (active)
	Government regulation	Yes	Yes	Yes	Yes	Yes

DISCUSSION

In the *technological* context, as noted in Tables 4 and 5, both countries adopt commonly known and "popular" LC methods, with LPS and VSM being the most prevalent. This may be influenced by external consultants' awareness and connections with academics. In Indonesia, modified LC methods were introduced to comply with local project administration procedures. However, this may create additional waste and discourage the use of these methods. In LPS implementation, the lack of foremen or subcontractor competence forced superintendents to take on extra tasks, potentially hindering reliable promises and effective LPS execution. In contrast, adjustments in Australia are fewer, as many LC methods are available in their original English form, which Australians can take advantage. For example, AC1 adopted a digital LPS platform from the U.S., and AC4 has business in the U.S, allowing them to implement LC methods with minimal adjustments. An exception is AC3, which adopted a small portion of LPS, known as daily activity briefing (DAB) as daily huddle, for a large American client in Australia, who "mandated" its implementation. These differences between Australia and Indonesia in the context of LC technology can also be attributed language and accessibility. Australia benefits from having LC methods available in their original English form, making it easier to adopt them with minimal adjustments. In contrast, Indonesia may need to modify these methods to fit local project administration procedures, which can create additional challenges; help of Indonesian's LC professional body - IAMKRI - in facilitating this issue is critical.

In the *organizational* context, an important factor is its internal politics and culture of organization of companies. In Australia, companies vary as they are private by nature. In Indonesia, they all are the same, SOEs and large, so the different between companies is small. However, the strategies used by the companies are different depending on the awareness of top management and the existence of champions. In terms of organizational structure, construction firms in Australia typically operate with a very "lean" structure at the project level. Lean leads or continuous improvement leads are rarely seen, except in the programme alliance model, where exceptional performance was demonstrated across metrics such as continuous improvement and innovation. In another words, in order to align the project goal, project teams are motivated to allocate extra resources, leading to the establishment of lean champions or CI leads. So, in this organizational context, the differences between Australia and Indonesia lay in company structure and culture that have different level of organizational flexibility and leanness in the first place.

In the environmental context: The role of government in Indonesia is needed, since Indonesia is still a developing country where private sectors are not mature yet. In Australia, there is no need for regulation to adopt best practices, as the industry is already mature; however, client requirements are crucial. As Rose and Manley (2012) reminded us that clients should be maximizing this opportunity and encouraging contractors to propose properly evaluated innovative options. In the cases of AC1, AC2, and AC4, the adoption of LC methods was driven by client pressure. Furthermore, the external actors such as academics, consultants, and associations are still needed. For academics, the role in Indonesia is more needed than in Australia, since the professional association is still new and not mature yet. As the implementation of LC progressing, more actors, internal and external, will merge to support further LC implementation as well as development in Indonesia. This is seen in countries like Columbia (Páez et al., 2013) and India (Sreram & Thomas, 2023) where construction firms first encounter LC through academics. The difference between Indonesia and Australia in the environmental context is due to the industry maturity and role of clients. Australia's construction industry is mature, reducing the need for government regulation to adopt best practices. In Indonesia, the developing private sector relies more on government support and external actors like academics and consultants. On the other hand, client requirements, in

Australia, drive the adoption of LC methods, while in Indonesia, the role of clients is less emphasized, and external support is more critical due to the immature professional association.

The discussion showed that in both countries, lean construction adoption is still at the method and tools level. The findings indicate both countries have a strong enthusiasm for implementing popular methods, such as Last planner system, and a few others but less popular lean practices and lean principles remain unexplored. Future research should map lean implementation not only at the tool and practice level but also at principle and method level similar to the early work of Chesworth et al. (2011) where the authors explored the presence, extent and awareness of lean construction principles within the Australian construction industry. We echoed Sreram and Thomas' (2023) conclusion that creating further awareness and marketing LC should attract more construction companies to adopt lean. Even at tool and practices level, Australian construction firms appear to adopt LC in a more textbook manner, as many of the lean consultants are from the manufacturing background. However, it is witnessed that the modification and adaptations of certain LC practices in Indonesia. The implication for Indonesian contractor is that they could benefit from benchmarking their adoption strategies against those in Australia or other more mature lean markets to identify areas for improvement. At the organisational level, the adoption of lean construction appears to follow a top-down approach in Indonesia, driven by strong leadership, while in Australia, it is more bottom-up, relying on grassroots willingness to adopt lean principles but the adoption process is slow. Both approaches have advantages and limitations, and an integrated approach combining strong leadership support with grassroots-driven experimentation may be more effective and worth recommending for both countries. This would require genuine commitment, not just rhetorical support, but tangible investments in resources, including financial support, to ensure successful lean implementation at the project level. Finally, external factors play a significant role. Governments should actively support the lean movement, as it is a proven methodology for improving productivity, a challenge both countries currently face. Public sector clients could mandate lean implementation in government projects, reinforcing its adoption. Additionally, Indonesia's collaboration between government, academia, and industry has been instrumental in driving lean construction adoption, whereas such collaboration remains limited in Australia. This highlights a critical gap that Australian stakeholders should address to strengthen lean construction implementation nationwide.

CONCLUSIONS

This study aimed to explore Lean Construction practices in Indonesia and Australia, as both countries are relatively active in raising LC awareness in the region. The TOE framework was used to examine the technological, organizational, and environmental factors influencing LC adoption. Overall, technological and organizational factors were similar, while government regulation differed, as expected due to the countries' distinct systems. Technologically, both countries are adopting common LC techniques with necessary modification and benefiting from them. Organizationally, leadership support and additional resources were essential, as observed in the case companies supporting LC adoption. Externally, the government plays a significant role in Indonesia but not in Australia. Overall, Australian firms took a slower, more isolated approach, while Indonesian firms had more interactions and collaborations with academics and professional bodies. To accelerate adoption, it's crucial to promote education and encourage the establishment of more consultants through professional associations like IAMKRI and LCANZ, which will help contractors facilitate LC adoption. A limitation of the study is that engagement with industry practitioners was influenced by the authors' industry connections, and the participating companies were large, making it difficult to generalize for the entire industry, especially since most construction firms in both countries are small. Future research could focus on more companies especially private and foreign companies in Indonesia and

smaller firms in Australia, or the entire supply chain to determine if LC methods are adopted more broadly in both countries. Nonetheless, this comparison is valuable in identifying converging factors and potential lessons for both countries. We remain hopeful that LC adoption will continue to thrive in the region and look forward to more research and industry case studies emerging.

REFERENCES

Abduh, M. (2025). Lean construction in developing countries: the case of Indonesia (in print). In G. Ofori (Ed.), *Research Companion to Advances in Construction in the Global South*. Edward Elgar Publishing.

Abduh, M., & Roza, H. A. (2006). Indonesian Contractors' Readiness Towards Lean Construction 14th Annual Conference of the International Group for Lean Construction, Santiago, Chile. https://iglcstorage.blob.core.windows.net/papers/attachment-29497b60-f822-4f52-b294-8acdb6257862.pdf.

ABS. (2024). *Tradies continue to lead the way in $568b Construction industry*. Australian Bureau of Statistics. Retrieved 18 January from https://www.abs.gov.au/articles/tradies-continue-lead-way-568b-construction-industry

ACA. (2023). *Nailing Construction Productivity - A blueprint for reform*. https://www.constructors.com.au/advocacy/reports/nailing-construction-productivity/

Aisyah, R. A., Gunawan, K., & Gazali, A. (2023). Lean Construction Through Waste Register Method: A Case Studies Project in Indonesia. Proceedings of the 31st Annual Conference of the International Group for Lean Construction (IGLC31) Lille, France. https://doi.org/10.24928/2023/0204

Aisyah, R. A., & Putra, P. (2024). Towards Sustainable Lean Construction in Indonesian Contractor: Effort & Learning From PT.PP (a Government-Controlled Construction & Investment Company). Proceedings of the 32nd Annual Conference of the International Group for Lean Construction (IGLC32), Auckland, New Zealand. https://doi.org/10.24928/2024/0169

Alwi, S., Hampson, K., & Mohamed, S. (2002). Non value-adding activities: a comparative study of Indonesian and Australian construction projects. 10th Annual Conference of the International Group for Lean Construction, Gramado, Brazil. https://iglcstorage.blob.core.windows.net/papers/attachment-42328794-07d0-4ecf-a28a-521c5f2bb193.pdf

Bleby, M. (2018). Turning construction on its side: Probuild cuts building time, labour costs. *The Australian Financial Review*. https://www.afr.com/property/turning-construction-on-its-side-probuild-cuts-building-time-labour-costs-20171227-h0aeuy

Chesworth, B. (2015). Misconceptions of lean: Why implementation fails. 23rd Annual Conference of the International Group for Lean Construction, Perth, Australia https://iglcstorage.blob.core.windows.net/papers/attachment-a0dad11e-8c01-4a2a-9c01-31fbac6f6588.pdf

Chesworth, B., London, K., & Gajendran, T. (2011). Lean Awareness in Australian Construction: Investigating the Extent of Lean Adoption across Australian Construction Sectors. 19th Annual conference of the International Group of Lean Construction, Lima, Peru. https://iglcstorage.blob.core.windows.net/papers/attachment-1cd4b981-1259-4229-988a-0b17bedc90a4.pdf.

Gao, S., Chan, T. K., & Hendy, P. (2024). Digital Last Planner System Implementation: Critical Successful Factors Proceedings of the 32nd Annual Conference of the International Group for Lean Construction (IGLC32), Auckland, New Zealand. https://doi.org/10.24928/2024/0227

Hatoum, M. B., & Nassereddine, H. (2022). Proposing a House of Lean Construction 4.0. In *Lean Construction 4.0* (pp. 50-67). Routledge. https://doi.org/10.1201/9781003150930

Horman, M., Kenley, R., & Jennings, V. (1997). A lean approach to construction: an historical case study. 5th Annual Conference of the International Group for Lean Construction, Gold Coast. https://iglcstorage.blob.core.windows.net/papers/attachment-a859c5f5-18fe-41a2-b2d9-c66f07c40bd0.pdf.

Master Builder Australia. (2024). *Building and Construction Industry Snapshot*. Retrieved 14 January from https://masterbuilders.com.au/wp-content/uploads/2024/05/Industry-snapshot_May-2024.pdf

Nasirzadeh, F., Rostamnezhad, M., Carmichael, D. G., Khosravi, A., & Aisbett, B. (2022). Labour productivity in Australian building construction projects: a roadmap for improvement. *International Journal of Construction Management*, *22*(11), 2079-2088. https://doi.org/doi.org/10.1080/15623599.2020.1765286

Osabutey, E. L. C., Williams, K., & Debrah, Y. A. (2014). The potential for technology and knowledge transfers between foreign and local firms: A study of the construction industry in Ghana. *Journal of world business*, *49*(4), 560-571. https://doi.org/10.1016/j.jwb.2013.12.009

Páez, H., Vargas, H., & Ramírez, L. (2013). Lean construction philosophy difussion: The colombian case. 21st Annual Conference of the International Group for Lean Construction, Fortaleza, Brazil. https://iglcstorage.blob.core.windows.net/papers/attachment-d4c1c3f6-4842-41b3-ac19-74c7cd262149.pdf.

Pan, M., & Pan, W. (2019). Determinants of adoption of robotics in precast concrete production for buildings. *Journal of Management in Engineering*, *35*(5), 05019007. https://doi.org/10.1061/(ASCE)ME.1943-5479.0000706

Paton-Cole, V. P., & Aibinu, A. A. (2021). Construction defects and disputes in low-rise residential buildings. *Journal of legal affairs and dispute resolution in engineering and construction*, *13*(1), 05020016. https://doi.org/10.1061/(ASCE)LA.1943-4170.000043

Schlesinger, L. (2024). Nearly 3000 building companies go broke in a year. *The Australian Financial Review*. https://www.afr.com/property/commercial/nearly-3000-building-companies-go-broke-in-a-year-20240701-p5jq86

Sreram, P. K., & Thomas, A. (2023). Teaching and Training Efforts of Academia and Industry Towards Lean Construction in India. Proceedings of the 31st Annual Conference of the International Group for Lean Construction (IGLC31), Lille, France. https://doi.org/10.24928/2023/0199

Stevens, M. (2022). Superior contractor performance: a barrier to lean construction adoption in Australia. Proc. 30th Annual Conference of the International Group for Lean Construction (IGLC30), Edmonton, Canada. https://doi.org/10.24928/2022/0157

Stevens, M., & Thevissen, F. (2023). A Kaizen Event Enabled by System Engineering in an Infrastructure Project. Proceedings of the 31st Annual Conference of the International Group for Lean Construction (IGLC31), Lille, France. https://doi.org/10.24928/2023/0113

Tornatzky, L. G., & Fleischer, M. (1990). *Processes of Technological Innovation*. Lexington Books.

Wang, Y.-M., Wang, Y.-S., & Yang, Y.-F. (2010). Understanding the determinants of RFID adoption in the manufacturing industry. *Technological Forecasting and Social Change*, *77*(5), 803-815. https://doi.org/10.1016/j.techfore.2010.03.006