

REVEALING LEAN-ALIGNED PRACTICES IN INDONESIAN SMALL CONTRACTORS: A PRELIMINARY STUDY

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ABSTRACT

Indonesia's construction industry is dominated by small contractors, whose operations are inefficient due to limited resources. While Lean Construction offers a solution to enhance performance, small contractors show reluctance to adopt it, as they perceive it as a new technology and complicated. However, little is known about whether Lean principles may already be present in their practices. This preliminary study addresses that gap by examining whether small contractors may implement Lean-aligned practices as internal organizational innovations. Data were gathered using an exploratory mixed-methods approach, including surveys, interviews, and site visits with 20 small contractors in Jakarta and Bandung. The analysis examined the nine types of waste, the production system, and the production processes. Observed practices were categorized into Lean-aligned (reflecting Lean principles) and non-aligned (conventional, standard, but suboptimal). The findings suggest that while most practices remain reactive, some contractors already exhibit Lean-aligned practices informally, such as collaborative planning, learning, and variability management. These results indicate that Lean principles may develop organically in a small contractor environment. Although preliminary, the findings could contribute to the Lean Construction literature by promoting Lean-aligned practices as internal organizational innovations. Moreover, future research could address regional and cultural variations of small contractors in Indonesia.

KEYWORDS

Continuous improvement, PDCA, production system, variability, waste.

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INTRODUCTION

Indonesia's construction industry is mainly comprised of small contractors, who account for 79.6% of the nation's 199,006 registered builders (BPS, 2025). These firms are labor-intensive and manage their operations informally, as is common for other small contractors, especially in developing countries (Barrett & Sexton, 2006; Ranadewa et al., 2018). Small enterprises, in general, struggled to invest in new project management methods because of their limited size and resources (Achanga et al., 2006; Sexton et al., 2006). The performance of a nation's construction industry depends not only on large contractors but also on the outcomes of projects managed by small contractors (Dobre, 2016). Therefore, inefficiencies in small contractors' operations can impair the overall performance of the construction industry. However, finding effective ways to address them remains a challenge.

Lean Construction offers a theoretical and practical framework for reducing inefficiencies and has been widely adopted by large firms globally (Engebø et al., 2017). However, small contractors face challenges in implementing Lean due to limited support, resources, and organizational capacity (Avelar et al., 2019; Ranadewa et al., 2018; Yadav et al., 2018). Adopting Lean is not merely applying Lean methods or tools, but it also needs a transformation in organizational behavior and work culture (Kallassy & Hamzeh, 2021; Pakdil & Leonard, 2015). Previous studies in the manufacturing and construction sectors indicated that Lean adoption in small and medium-sized enterprises (SMEs) relied on alignment with existing processes and internal organizational capabilities (Achanga et al., 2006; Ankomah et al., 2018).

Several studies have examined Lean adoption in SMEs, but most focus on implementing Lean methods and tools. (Ankomah et al., 2018; Etges et al., 2012; Osabutey et al., 2014). However, there is still a lack of studies investigating whether Lean principles are already informally present in small contractors' operations, particularly in developing countries such as Indonesia. This research aims to fill that gap by examining Lean principles as internal organizational innovation rather than externally imposed intervention. Research by Owais & Matkó (2026) supports this view, noting that implicit Lean practices—those not explicitly labeled—can represent Lean principles and act as a form of internal organizational innovation, as defined by Barrett et al. (2008).

This study is the preliminary phase of a two-year research project. It used exploratory mixed methods: online surveys, interviews, and site visits, involving 20 small contractors in Jakarta and Bandung. The study investigates whether Lean principles, such as continuous improvement, pull scheduling, and waste reduction, are already portrayed in small contractors' production systems and processes. It also identifies the types and sources of waste in their operations. Moreover, based on the findings, the study tries to classify the observed practices into either Lean-aligned or non-aligned.

The remaining part of this paper is structured as follows: a literature review on Lean Construction and SMEs; the research methodology; the results of this preliminary study; the discussion; and the conclusions.

LITERATURE REVIEW

LEAN AS AN INNOVATION FOR SMEs

Large construction enterprises and SMEs, including small contractors, differ in organizational structure, resource availability, project scale, and innovation capacity (Dobre, 2016). To be competitive in the market, SMEs must adapt and succeed by adopting new knowledge and innovation (Sexton et al., 2006). Research by Barrett & Sexton (2006), through qualitative case studies of small construction firms in the UK, found that innovation in SMEs is usually owner-led and incremental, influenced by limited resources and practical experience; SMEs often innovate to survive and satisfy clients rather than to grow. This behavior, to some extent,

reflects the Lean principle of maximizing value, as SMEs aim to improve service quality, reduce costs, or accelerate delivery; however, it may, conversely, compromise efforts to minimize waste. Therefore, small contractors need to adopt Lean principles comprehensively. Here, Lean Construction is regarded as an innovation in process technologies for delivering construction projects (Zelenko & Maxwell, 2024).

It was reported that Lean principles are already present in SMEs' construction practices under various names or terms. For example, resource constraints lead SMEs in Sri Lanka to reduce waste, such as excess inventory and idle workers during construction (Ranadewa et al., 2018). Clients' demands for quality have motivated small contractors to prevent defects and rework (Barrett & Sexton, 2006). Additionally, SMEs' flat organizational structures can make decision-making and problem-solving more efficient and effective by supporting Lean principles of employee empowerment and quick feedback (Barrett & Sexton, 2006). However, a main challenge for SMEs is systematically documenting innovation, because true innovation occurs only when on-site problem-solving is documented and reused for future reference, becoming a standard part of the organization's culture (Barrett et al., 2008).

These findings suggest that Lean principles may emerge organically within SMEs, even without formal Lean training or external interventions. This perspective supports the idea of Lean as an internal organizational innovation, shaped by the constraints and experiences of small contractors.

LEAN PRINCIPLES VS. LEAN METHODS OR TOOLS IN CONSTRUCTION

Lean Construction has been developed since 1992 and is documented in a vast body of literature. (Engebø et al., 2017). One way to understand and implement Lean Construction successfully is through the Lean Construction Pyramid, introduced by Do (2022), which distinguishes between Lean Construction philosophies, principles, methods, and tools. Lean principles, such as flow, pull, value, kaizen, and respect for individuals, can be applied in any organization, including the construction industry, affecting its operations and culture. Lean methods, often called Lean tools in other literature, put Lean principles into practice, including the Last Planner System (LPS), 5S (Seiri, Seiton, Seiso, Seiketsu, and Shitsuke), Kanban, and the A3 Report. However, the success of their implementation depends on a proper understanding of Lean philosophies and principles (Ballard & Howell, 1998; Pažek, 2021, Do, 2022).

As stated by Zelenko & Maxwell (2024), previous research in the International Group for Lean Construction (IGLC) literature emphasized the importance of Lean principles as the foundation for effective implementation of Lean methods and tools. For example, the implementation of LPS may be reduced to a scheduling task without a genuine focus on reliability and a culture of learning (Ballard, 2000). Furthermore, 5S may involve only cleaning a construction site, without promoting continuous efforts to identify and eliminate waste (Salem et al., 2005). It can be said that implementing Lean methods or tools alone does not ensure the adoption of Lean principles (Etges et al., 2012). Furthermore, in fostering a Lean culture, the organization must uphold the principle of respect for individuals (Erazo-Rondinel et al., 2024).

The distinction between Lean principles and methods is important for understanding how small contractors may already be practicing Lean principles informally, even if they have not adopted formal Lean methods.

LEAN ADOPTION RESEARCH FOR SMEs IN DEVELOPING COUNTRIES

Kull et al. (2014) suggested that the national context is important to address when implementing Lean in the manufacturing industry, since it relates to the culture of the nation. Lean implementation was reported to perform better in collectivist cultures than in individualistic countries; developing countries tend to be more collectivist than developed countries (Hofstede, 2001). Aligning lean practices with employee culture can enhance lean implementation results

by preventing conflicts (Yarbrough & Aljabr, 2021). Additionally, it is recommended to evaluate the organization's cultural infrastructure before implementing Lean (Pakdil & Leonard, 2015), since culture is potent in stabilizing an organization and shaping its performance and effectiveness in the long run. In addition, SMEs, especially in developing countries, tend to have more collectivist organizational cultures than larger firms (Dobre, 2016).

Research also indicates that small contractors and manufacturers in developing countries face similar challenges when adopting Lean practices and tend to follow a comparable improvement path. For instance, in Sri Lanka and India, the main obstacles are a lack of formal Lean training (Panizzolo et al., 2012; Ranadewa et al., 2018), a lack of resources, such as capital and limited personnel (Achanga et al., 2006; Matindana et al., 2025), and a lack of understanding of Lean principles, committed leadership, and a supportive work culture (Achanga et al., 2006; Ankomah et al., 2018). Cultural and organizational resistance can delay Lean implementation among small contractors in developing countries; therefore, leadership commitment, especially from top management or the business owner, is critical (Barrett & Sexton, 2006). Matindana et al. (2025) argued that early success through incremental Lean implementation is essential for SMEs to build confidence. External supports, such as those from industry associations, collaboration networks, and mentorship, are needed by SMEs (Huaman-Orosco et al., 2022; Panizzolo et al., 2012).

The challenges arise because Lean is perceived as an external innovation introduced into existing systems. These results highlight the need to consider local context and internal dynamics when implementing Lean. Few studies have examined the informal adoption of Lean principles by small contractors. This preliminary study aims to identify practices aligned with Lean principles, even if not formally labeled as such.

METHODOLOGY

RESEARCH DESIGN

The study employed an exploratory mixed-methods approach, combining quantitative and qualitative methods; this approach is suitable for exploring organizational behaviors in real-world settings, such as the operational practices of small contractors (Creswell & Clark, 2017; Fellows & Liu, 2021). While the study shares the same characteristics with a case study, such as the use of multiple data sources and a focus on small contractors in Jakarta and Bandung, it is not formally classified as a case study (Yin, 2017). Since this study is a preliminary phase of a two-year research project, future phases will involve broader data collection across additional regions in Indonesia.

This study used purposive sampling to select 20 small contractors in Jakarta and Bandung through existing networks. The selected contractors have been involved in various project types: building construction, civil engineering, infrastructure, mechanical, electrical, and plumbing (MEP), and interior. Most respondents were key decision-makers, including owners, directors, and project managers. Of 20 contractors, 17 completed the online survey, while 11 were involved in interviews and site visits, including 3 who did not respond to the survey but agreed to participate in a site visit and interview.

ANALYTICAL FRAMEWORKS

Three analytical frameworks were used to guide data collection and analysis:

- **Nine types of waste.** The nine types of waste are: waiting, overproduction, inventory, transportation, overprocessing, motion, defects, non-utilized talent, and making-do (Koskela et al., 2013; Sarhan et al., 2017). This framework was used to identify waste in contractor operations, particularly in their production system and processes.

- **Production system.** The five levers of the Project Production Management (PPM) framework were used to assess how contractors manage production systems: product design, process design, variability, inventory, and capacity (Prado & Tommelein, 2023; Zabelle, 2024). The PPM framework is intended to maximize value and to minimize waste. In this study, the PPM's five levers were used to examine whether Lean principles are embedded in production systems.
- **Production process.** The Plan-Do-Check-Act (PDCA) cycle was used to assess how contractors plan, execute, monitor, and improve their processes. This PDCA cycle is related to continuous improvement practices (Do, 2022; Zadeh et al., 2025). In this study, it was used to identify Lean-aligned practices in operational processes.

DATA COLLECTION AND ANALYSIS

At the beginning of the study, a literature review was performed on how small contractors adopt innovation, how Lean principles are applied in SMEs across the manufacturing and construction sectors, and the analytical frameworks. The results of this literature review contributed to the development of data collection instruments and analytical techniques.

Three data collection methods were employed: an online survey, interviews, and site visits. Each method had a specific purpose and was analyzed using appropriate techniques (Creswell & Clark, 2017), as summarized in Table 1.

Table 1: Data collection and analysis

Method	Number of respondents	Purpose	Number of questions	Average duration (minutes)	Data analysis
Online Survey	17	To gather quantitative data on production systems and processes	68	31	Descriptive statistics (Fellows & Liu, 2021)
Interview	11	To explore types and sources of waste, and understand practices in depth	84	87	Thematic analysis (Silverman, 2021)
Site Visit	11	To observe actual practices and validate survey and interview responses			Triangulation (Creswell & Clark, 2017; Yin, 2017)

The online survey collected data on production systems (based on the five PPM levers) and production processes (based on the PDCA cycle). Respondents answered 68 questions in total: 43 on production systems and 25 on production processes, taking an average of 31 minutes. 17 responses were analyzed using descriptive statistics to identify patterns and frequencies of the practices. Screenshots of the online survey (in Indonesian) are provided in Figure 1 to sample the questions related to the production system, production process, and type of waste.

Interviews with 11 contractors explored the types and sources of waste and verified the online responses. The interview protocol covers 84 questions: 68 from the online survey and 16 new questions on waste. Site visits were conducted alongside interviews involving direct observations of on-site practices, such as site layout, planning & control system, logistics, labor, materials, and communication, and review of project documents, such as contract, drawing,

specifications, and schedule. Thematic analysis was used to identify recurring themes and classify practices as either Lean-aligned or non-aligned, supported by online responses. Figure 2 provides a screenshot of the interview's transcript and the results of the observations (in Indonesian) as an example of thematic coding. Observations were used to triangulate survey and interview findings.

Perencanaan dan Input
Pada bagian pertama ini, kami ingin memahami bagaimana Bapak/Ibu melakukan persiapan awal sebelum dan saat memulai sebuah proyek konstruksi. Pertanyaan-pertanyaan berikut bertujuan untuk menggali pemahaman konseptual, praktik pengendalian, serta cara Bapak/Ibu merencanakan berbagai input atau sumber daya utama (seperti material, tenaga kerja, peralatan, dan informasi/metode kerja) yang krusial untuk kelancaran proyek. **Pada section ini terdapat 2 jenis pertanyaan, yaitu pertanyaan yang dapat diisi lebih dari 1 opsi jawaban (standar oleh pilihan opsi yang berbentuk persegi) dan pertanyaan yang hanya dapat diisi 1 opsi jawaban (standar oleh pilihan opsi yang berbentuk lingkaran).**

7. UMUM
Apakah anda melakukan perencanaan awal sebelum memulai konstruksi? *

☐ Ya, selalu melakukan perencanaan yang sangat detail

☐ Ya, selalu melakukan perencanaan umum (garis besar)

☐ Kadang-kadang, tergantung skala proyek

☐ Jarang/Tidak melakukan, langsung eksekusi berdasarkan kontrak

☐ Lainnya

Praktik Sistem Produksi
Pada bagian ketiga ini, kami ingin menggali praktik 'pelaksanaan dan pengendalian' proyek Bapak/Ibu saat pekerjaan sedang berlangsung. Pertanyaan-pertanyaan ini bertujuan untuk memahami bagaimana Bapak/Ibu memantau progres (swait) pekerjaan, menjaga kualitas hasil, mengendalikan biaya agar sesuai anggaran serta praktik pelaporan dan evaluasi yang dilakukan selama proyek berjalan. **Pada section ini terdapat 2 jenis pertanyaan, yaitu pertanyaan yang dapat diisi lebih dari 1 opsi jawaban (standar oleh pilihan opsi yang berbentuk persegi) dan pertanyaan yang hanya dapat diisi 1 opsi jawaban (standar oleh pilihan opsi yang berbentuk lingkaran).**

56. Bagaimana cara utama Bapak/Ibu mengetahui progres harian di lapangan? *

☐ Saya (Pemilik) melihat sendiri ke lapangan setiap hari

☐ Menerima laporan lisan dari Mandor (sakit bertemu atau telepon)

☐ Mandor mengirimkan foto progres (misal: via WhatsApp)

☐ Mandor mengisi buku laporan harian

☐ Lainnya

Pemborosan Konstruksi
Pada bagian terakhir ini, kami ingin mengidentifikasi pemborosan-pemborosan konstruksi yang pernah dialami pada proyek Bapak/Ibu. Pertanyaan-pertanyaan ini bertujuan untuk mengetahui jenis pemborosan yang Bapak/Ibu alami dan penyebabnya. Pada pertanyaan-pertanyaan di bawah ini, Bapak/Ibu dapat memilih lebih dari 1 jawaban.

69. Apa yang menyebabkan pemborosan "Overproduction" dalam proyek Bapak/Ibu? *

☐ Overproduction adalah pemborosan akibat memproduksi barang lebih banyak dari yang dibutuhkan oleh proses selanjutnya.

☐ Kurangnya keahlian pekerja dalam memahami rencana volume pekerjaan sehingga jumlah yang diproduksi lebih banyak daripada kebutuhan

☐ Desain dan dokumentasi yang diberikan oleh konsultan/owner kurang sehingga tidak sesuai dengan kondisi aktual di lapangan

☐ Anahan kerja yang tidak jelas dari level manajemen pada perusahaan

☐ Budaya perusahaan yang selalu memproduksi lebih banyak daripada kebutuhan untuk jaga-jaga agar tidak terjadi kekurangan saat konstruksi

☐ Tidak pernah mengalami pemborosan tersebut

☐ Lainnya

Figure 1. Screenshots of question examples of the online survey (in Indonesian)

No	Aspek yang diamati	Perencanaan & Penjadwalan	Pengendalian Material	Koordinasi Tim	Keselamatan Kerja	Alur Kerja (workflow)	Dokumentasi & Administrasi	Pengelaaan tenaga kerja	Pengendalian kualitas	Penggunaan alat dan peralatan
1 PT1	Temuan Lapangan	Tidak ada jadwal mingguan; pekerjaan berjalan berdasarkan instruksi harian mandor.	Pembelian material dilakukan oleh pemilik; penggunaan material memprioritaskan stok gudang; perkiraan kebutuhan material dilakukan sendiri oleh pemilik.	Koordinasi informal tanpa rapat rutin; dipimpin oleh pemilik yang terjadi kekeliruan ringin di koordinir.	Tidak ada APD khusus; sering rutin; dipimpin oleh pemilik yang terjadi kekeliruan ringin di workshop.	Urutan kerja tidak diatur.	Gambar kerja model sudah menggunakan 3D model; tidak ada catatan kerja harian/mingguan.	Tidak ada pembagian kerja secara khusus.	Pemeriksaan kualitas secara visual; tidak ada standar.	Pemakaian alat tidak diatur khusus.
	Bukti/Contoh Konkret	Tidak ada kertas kerja jadwal, walaupun sederhana.	Tumpukan material di sekitar area kerja; pembelian material dilakukan pemilik.	Dilakukan jika ada proyek baru; jika ada pertanyaan terkait gambar kerja.	Kaki tegores material; mata mengalami iritasi.	Pengaturan urutan kerja dilakukan oleh tukang.	Gambar kerja disediakan pemilik; tidak ada pembukuan khusus; hanya menyediakan jika kerja berdasarkan jumlah pekerjaan yang ditangani.	Pembagian tenaga kerja diatur oleh tukang; pembagian beban pekerjaan yang ditangani.	Pemeriksaan dilakukan oleh tukang dan pemilik.	Penggunaan menunggu alat yang idle.
2 PT2	Temuan Lapangan	Penjadwalan disusun oleh manajemen kantor untuk mengendalikan target progres mingguan.	Menepikan sistem pengendalian dengan stok cadangan untuk berjangan dan intensif untuk mencegah kendala ketersediaan material hingga level pekerja.	Koordinasi dilakukan secara dini dengan stok cadangan untuk berjangan dan intensif untuk memastikan instruksi tersampaikan hingga level pekerja.	Prioritas tinggi pada aspek keselamatan melalui penyediaan alat perlengkapan standar.	Pembagian kerja berbasis area untuk menjaga efisiensi dan fokus kualitas.	Administrasi proyek terdokumentasi secara kronologis dan visual.	Manajemen tenaga kerja dilakukan secara mandiri oleh tim internal dengan spesialisasi tertentu.	Kualitas merupakan parameter utama keberhasilan proyek yang dipantau melalui acuan gambar memiliki kompetensi khusus.	Penggunaan peralatan melalui tim internal dengan spesialisasi tertentu.
	Bukti/Contoh Konkret	Penggunaan Kurva S berbasis Excel dan strategi lembur untuk mengejar keterlambatan target.	Pemesanan cat dilakukan di awal dengan spare beberapa guna menghindari perbedaan gradasi warna (belang) pada cat WhatsApp untuk laporan logistik.	Pertemuan koordinasi dilakukan Persediaan scaffolding, body tiga kali sehari (pagi, siang, sore) harmonis, APD, dan kotak PK yang disiapkan sebelum pekerjaan dimulai.	Pengerjaan interior (misal: kitchen set) diselesaikan per satu grup untuk satu ruangan hingga tuntas sebelum pindah area lain.	Laporan harian mencakup data cuaca, material terpakai, dan dokumentasi foto untuk setiap tugasnya diatur oleh mandor berdasarkan keahlian.	Memiliki sekitar 20 pekerja internal (sipil, pengecatan, scaffolding) yang pembagian tugasnya diatur oleh mandor berdasarkan keahlian.	Jika terjadi kesalahan kerja, dilakukan pengecekan ulang terhadap gambar desain yang telah dicetak untuk meminimalkan rework.	Penggunaan alat mesin hanya diberikan kepada pekerja terampil untuk menghindari kerusakan; distribusi material internal menggunakan troli roda.	
3 PT3	Temuan Lapangan	Penjadwalan menggunakan metode reverse scheduling untuk memenuhi batas waktu kontrak yang tetap (fixed).	Pengadaan material dilakukan sesuai kebutuhan di lapangan (Just-in-Time).	Hubungan koordinasi bersifat langsung antara manajemen proyek dan pelaksana teknis.	Kompetensi/K3 dipenuhi melalui seleksi tenaga kerja yang memiliki pengalaman teknis memadai.	Pelaksanaan pekerjaan mengikuti pola serial karena keterbatasan jumlah personel.	Optimisasi alat berat untuk mengatasi kendala transportasi material di dalam site.	Struktur tim menggunakan mandor yang memiliki otoritas dalam pengaturan tenaga kerja lapangan.	Pengendalian kualitas dilakukan secara pragmatis dan berbasis pengamatan visual.	Penggunaan excavator/backhoe berat untuk mempercepat logistik internal.
	Bukti/Contoh Konkret	Jadwal ditarik mundur dari target penyelesaian 24 Desember dengan rincian target galian harian sebesar 266 m³.	Pemesanan batu dan semen dilakukan H-2 berdasarkan informasi stok menipis dari mandor.	Instruksi operasional diberikan langsung oleh PM kepada mandor, diikuti evaluasi mingguan mengenai capaian target.	Rekrutmen surveyor dan diirer yang sudah siap pakai tanpa memerlukan pelatihan internal tambahan.	Pekerjaan dilakukan satu arah (berurutan), tidak dibagi menjadi beberapa grup paralel.	Penggunaan backhoe untuk bongkar pasir dan batu dari titik truk yang terbatas ke titik kerja.	Jumlah pekerja diatur secara spontan oleh mandor sesuai kebutuhan oleh mandor sesuai kebutuhan tahap pekerjaan (misal: penambahan orang saat pemasangan batu kali).	Pemeriksaan progres dilakukan secara visual melalui foto untuk melansir material pasir dan batu di lokasi yang sulit dan batu di lokasi yang sulit dan batu di lokasi yang sulit.	Penggunaan excavator/backhoe untuk melansir material pasir dan batu di lokasi yang sulit dan batu di lokasi yang sulit.
4 PT4	Temuan Lapangan	Perencanaan jadwal difokuskan pada pemenuhan durasi kontrak untuk meminimalkan waste yang signifikan sangat ketat.	Strategi pengadaan dilakukan dengan meminimalkan waste material finishing.	Sistem koordinasi satu pintu untuk internal akurasi instruksi kerja.	Terdapat kesenjangan antara perencanaan prosedur K3 secara formal dengan implementasi penggunaan APD di lokasi proyek.	Penugasan tim yang tetap pada satu unit kerja untuk menjaga konsistensi kualitas.	Prosedur administrasi perubahan kontrak dilakukan secara formal dan legal.	Mengedepankan fleksibilitas tenaga kerja internal untuk menjaga produktivitas.	Pengendalian mutu dilakukan melalui pengawasan langsung dan penetapan standar visual.	Memastikan ketersediaan alat melalui kepemilikan aset mandiri oleh perusahaan.
	Bukti/Contoh Konkret	Menambah sumber daya dan jam kerja (Senin-Minggu) untuk mengejar target 110 hari yang terpasang guna menghindari sisa berlebih.	Kebijakan "Kursen 80% Order" untuk grant; sisa 20% baru dipesan setelah opsname terpasang guna menghindari sisa berlebih.	Instruksi/Menajer Proyek (PM) hanya diberikan kepada mandor merencanakan penyediaan APD agar tidak terjadi instruksi ganda dan PKJ sejak awal, ditemukan kondisi lapangan di mana pekerja tidak dilengkapi dengan APD standar saat bekerja.	Melakukan manajemen satu tim menyelesaikan satu unit bangunan sampai tuntas agar hasil pengerjaan memiliki standar "seribuhan" yang sama.	Pengajuan Justifikasi Teknis (Jastek) dan Contract Change Order (CCO) resmi untuk setiap perubahan desain mayor.	Pekerja memiliki kemampuan multitasking; jika satu item kebutuhan habis, tenaga kerja langsung dialihkan ke pekerjaan sama lain (bocok-kemplang).	Penetapan target harian visual (misal: 10 m²/orang) dan inspeksi PM sebelum pelaporan masalah ke pemilik.	Perusahaan memiliki aset sendiri seperti mobil, scaffolding, dan alat ukur untuk menghindari hambatan akibat sewa alat eksternal.	

Figure 2: A screenshot of the interview's transcript and observations' results (in Indonesian)

RESULTS

NINE TYPES OF WASTE

Interviews with 11 contractors revealed that 7 of the 9 types of waste were experienced. Two types of waste that were not observed during interviews are overproduction and motion; this is likely due to the respondent's unfamiliarity with the terminology. This suggests that contractors may engage in these practices without recognizing them as waste. This supports the difficulty in translating Lean concepts to small contractors and suggests that the findings reflect only the most easily identified forms of waste. Further identification of waste by involving more respondents is needed in the future. Table 2 summarizes the seven types of waste identified, with examples from interview transcripts, and their sources, derived from thematic coding of interview data, survey responses, and site observations.

According to Table 2, waste types such as waiting, transportation, defects, and non-utilized talent were commonly found in small contractors' operations, with percentages of 81.8%, 90.9%, 63.6%, and 63.6%, respectively. Conversely, waste types like overprocessing and inventory were found less frequently during the interview, at 45.5% and 36.4%, respectively.

Additionally, making-do waste was the least reported, with only a few respondents (27.3%) mentioning it. These results do not necessarily indicate that contractors are free from the less-reported waste types; rather, they may reflect limited awareness of Lean waste terminology. The site visits that were conducted during the interview have confirmed the findings: contractors operate with minimal documentation, fragmented workflows, and owner-driven coordination.

Table 2: The seven identified types of waste

Waste (Frequency)	Example from Interview	Source of waste
Waiting (9/11 = 81.8%)	<i>"We waited up to 2 hours due to an overlapping vendor schedule."</i>	Poor coordination, limited space
Transportation (10/11 = 90.9%)	<i>"We had to carry materials manually due to muddy access roads."</i>	Poor site layout, reactive logistics.
Overprocessing (5/11 = 45.5%)	<i>"We work overtime to catch up on delayed physical work due to administrative deadlines."</i>	Overloaded system, lack of standard operating procedures (SOPs)
Inventory (4/11 = 36.4%)	<i>"Materials were delivered early and blocked circulation paths."</i>	Push system, limited storage, poor scheduling
Defects (7/11 = 63.6%)	<i>"We had to rework due to rushed work for administrative deadlines."</i>	Low skills, lack of standard instructions
Non-Utilized Talent (7/11 = 63.6%)	<i>"Our skilled workers were reassigned to cleaning when materials were late."</i>	Poor resource planning, supply delays
Making-do (3/11 = 27.3%)	<i>"We started work with verbal instructions; drawings came later."</i>	Incomplete info, informal communication

PRODUCTION SYSTEM

The responses from 17 contractors provided insight into their production systems, assessed using five levers of the PPM framework.

- **Product design:** 6 contractors (35.3%) observed having detailed technical drawings and standardized specifications. While 11 contractors (64.7%) still relied on verbal instructions, which could lead to miscommunication and rework.
- **Process design:** 7 contractors (41.2%) reported implementing production planning collaboratively. While 9 contractors (52.9%) still used top-down planning, 1 respondent (5.9%) reported continuing to use a reactive approach, prioritizing speed over planning.
- **Variability:** 6 contractors (35.3%) found adopting learning practices to manage variability, using a feedback loop. While 8 respondents (47.1%) still managed variability reactively, without structured planning or a learning mechanism, 3 contractors (17.6%) deployed buffers, such as a time buffer at the end of the schedule, temporary storage, and slack of helper for masonry work.
- **Capacity:** 11 contractors (64.7%) used historical data and resource allocation strategies, while the other 6 (35.3%) relied on intuition or last-minute outsourcing.
- **Inventory:** 11 contractors (64.7%) used cash flow-based buffering strategies. 5 (29.4%) used informal methods such as verbal orders and reactive stock management. Only 1 contractor (5.9%) used just-in-time procurement to reduce on-site inventory.

Small contractors' weaknesses in product and process design are evident from the findings and align with many of the waste observed during the interview, such as waiting, transportation, defects, and rework. Moreover, small contractors addressed variability reactively, which may lead to waiting and non-utilized talent. While some contractors demonstrated flexibility in managing capacity and inventory, this may reflect necessity rather than strategic planning, given the limited resources and supply chain constraints typical of small contractors. The

sources of the seven types of waste identified during the interview highlighted weaknesses in their production systems. Site visits confirmed these patterns, revealing informal, reactive operations, minimal documentation, and owner-led coordination.

PRODUCTION PROCESS

Survey responses from 17 contractors revealed the respondents' production processes using the PDCA cycle as follows:

- **Plan (P):** 7 of 17 contractors (41.2%) still used informal planning methods, such as setting weekly targets without detailed schedules. The remaining 10 contractors (58.8%) used more systematic planning, including Gantt charts, S-curves, and spreadsheets.
- **Do (D):** 14 contractors (82.4%) have implemented structured execution by delivering instructions through foremen or supervisors. While the remaining 3 (17.6%) still relied on direct, unstructured verbal instructions. However, none of the respondents had formal written SOPs.
- **Check (C):** 14 contractors (82.4%) observed using informal digital tools (e.g., WhatsApp) for real-time monitoring, while the rest relied on verbal updates. Moreover, 16 respondents (94.1%) solved problems reactively by adding labor or extending work hours. Only 1 (5.9%) used a root cause analysis by visiting the site and reviewing documents, without blaming the labor.
- **Act (A):** 6 contractors (35.3%) still relied on tacit knowledge to be applied to future projects. Another 6 (35.3%) have documented lessons learned and used them for improvement. The remaining 5 contractors (29.4%) already archived project data, but unfortunately, they did not use it for learning.

The results of this PDCA cycle indicate an imbalance in the maturity of small contractors' production processes. Although contractors seem to perform better during the "Do" and "Check" stages, these practices are informal and lack structure, e.g., no SOPs and weak feedback mechanisms. In contrast, the "Plan" and "Act" stages are less developed, indicating that small contractors tend to address problems with short-term solutions rather than focusing on long-term improvements. This imbalance affects how efficiently small contractors execute and monitor their tasks. Interviews and site visits also confirmed that coordination is typically handled via WhatsApp, and small contractors rely on verbal instructions rather than formal procedures.

DISCUSSION

LEAN-ALIGNED PRACTICES

Based on the findings of this preliminary study, the observed practices can be further categorized into two groups: Lean-aligned and non-aligned practices. Lean-aligned practices are defined as those that reflect Lean principles, even if not formally labelled as such. On the other hand, non-aligned practices are defined as conventional practices that are suboptimal since they can contribute to the generation of the seven types of waste, as mentioned by Koskela et al. (2013) and Sarhan et al. (2017). However, its categorization should be interpreted as indicative rather than definitive, since this study is in a preliminary phase with its limited sample.

Most observed practices were categorized as non-aligned, resulting in seven types of waste identified during the interview. It was found that small contractors mainly relied on informal, reactive, and unstructured production systems. They have no SOPs, communicate mostly verbally, and rarely use formal planning and control tools; these practices fall short of the recommended industry's best practices. Some of the observed practices showed improvements in structure but remained characterized by top-down planning, limited team involvement, poor

inventory management, and reactive problem-solving; all of which are typical of conventional practices. However, some contractors reported having demonstrated Lean-aligned practices, suggesting that Lean principles have been embedded within small contractors. This offers an encouraging perspective for further development of Lean adoption among small contractors.

The observed Lean-aligned practices by small contractors include:

- **Collaborative planning:** About 41.2% of contractors involved foremen or site supervisors in planning and scheduling decisions. This reflects the Lean principles of respect for people by empowering the field workers (Ballard, 2000; Barrett & Sexton, 2006)
- **Learning:** Around 35.3% of contractors implemented some form of documentation and feedback loops to learn from project outcomes. This practice aligns with *kaizen*, the principle of continuous improvement (Ballard, 2000; Womack & Jones, 1997).
- **Variability management:** A small minority of contractors (17.6%) reported using buffers (e.g., time or inventory) for managing variability. This practice aligns with TFS theory and the effort to reduce variability using buffers (Koskela, 1992; Tommelein, 2020)
- **Analytical problem solving:** Only one contractor (5.9%) mentioned root-cause analysis to support problem solving. This approach to problem-solving is consistent with Lean's emphasis on tackling issues at their source (Ballard & Howell, 1998).
- **Just-in-time:** Also, only one contractor (5.9%) mentioned a just-in-time approach to material procurement to minimize on-site inventory. This practice reflects the pull principle when ordering materials based on actual need (Tommelein & Li, 1999).

Among small contractors, fewer than 50% reported using the five identified Lean-aligned practices, with two of these practices used by only a minority of respondents (5.9%). Collaborative planning, variability management, and just-in-time practices were observed using the PPM framework, intended to promote flow and reduce waste. In addition, learning and problem-solving practices were identified through the PDCA cycle as part of continuous improvement activities.

Despite limited Lean adoption, it was observed that Lean-aligned practices emerged organically and informally in small contractors; this illustrates that innovation can arise internally within organizations. This also aligns with prior studies suggesting that small contractors often exhibit Lean-like behaviors in response to resource constraints, such as reduced idle labor and avoided overstocking (Panizzolo et al., 2012; Ranadewa et al., 2018). Yadav et al. (2018) identified continuous improvement, just-in-time, and active participation in management as the most important leanness factors in SMEs.

These observed Lean-aligned practices could serve as the foundation for Lean adoption among small contractors. However, more efforts are needed to encourage other small contractors to adopt the observed Lean-aligned practices.

LIMITATIONS

This preliminary study has several limitations:

1. **Limited sample size and scope.** The study involved a small number of respondents selected using purposive sampling and was limited to Jakarta and Bandung. The findings do not represent the full diversity of small contractor practices across Indonesia.
2. **Qualitative interpretation.** The assessment of practices as Lean-aligned and non-aligned was based on qualitative interpretation and therefore still requires validation.

3. **Terminology understanding.** Some Lean terminology, such as types of waste (overproduction or motion), may not have been fully understood by respondents, potentially leading to underreporting.
4. **Lack of performance outcome data.** The study focused solely on identifying practices and did not collect quantitative data on project outcomes.
5. **Unexamined cultural and organizational factors.** This study has not yet used respondents' profiles in its analysis of the region or workers' cultural backgrounds.

FUTURE RESEARCH

Considering the above limitations, several directions for future research are recommended:

1. **Broader comparative studies.** Given Indonesia's diverse geography and culture, future studies should encompass a broader range of regions but in limited sectors. The sectors should be defined according to where most small contractors work, such as housing, building renovation, and road project rehabilitation. This approach can investigate how regional, cultural, and sectoral variations influence small contractors' practices, including Lean-aligned practices.
2. **Organizational and cultural readiness.** Additional research could examine the organizational and cultural factors within small contracting firms that facilitate the successful adoption of Lean Construction. This might involve exploring the impact of owner-led innovation, team autonomy, and trust development. This research relates to the regional coverage in the previously proposed topic; the regions should focus on those that are considered to have a dominant culture in Indonesia.
3. **Formalizing good internal practices.** When Lean-aligned practices are present in a small contractor, it is possible to explore formalizing the underlying Lean principles into a structured Lean method, which already exists. This approach allows the resulting Lean method to serve as an internal organizational innovation rather than an external one, with some adaptation.

CONCLUSION

This preliminary study, as part of a two-year research project, examined the presence of Lean-aligned practices among Indonesian small contractors. Using three analytical frameworks, i.e., the nine types of waste, PPM, and PDCA cycle, the study identified how informal, reactive, and unstructured production systems contribute to inefficiencies in small construction operations. The results of this study revealed that while most practices remain conventional or non-aligned, several Lean-aligned practices were observed. For example, 41.2% of contractors involved supervisors in planning, 35.3% utilized lessons learned, and 17.6% used buffers to manage variability. However, more advanced practices such as root-cause analysis and just-in-time procurement were reported by only 5.9% of respondents. Suggesting that Lean principles may already be informally embedded within small contractors provides a potential foundation for further Lean adoption among them.

Since the study was limited in sample size and geographical scope (Jakarta and Bandung), the findings should be interpreted with caution. The assessment of practices was based on qualitative interpretation and, therefore, needs to be validated with performance data or expert review. Nonetheless, the study could contribute to the Lean Construction literature by introducing the concept of Lean-aligned practices as an internally driven innovation shaped by an organization's constraints and experience rather than external intervention. Future research will expand the regions and selected sectors, examine the organizational and cultural aspects of Lean-aligned practices, and explore how Lean-aligned practices can be formalized into Lean methods tailored to small contractors.

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