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A REVIEW: PERFORMANCE MAPPING OF DESIGN–BID–BUILD AND DESIGN–BUILD IN GOVERNMENT PROJECTS BASED ON LEAN CONSTRUCTION

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Abstract

Government projects have a significant impact on public welfare and economic development, particularly in developing countries such as Indonesia. Under the prevailing regulations, government project delivery systems are generally categorized into two types: Design–Bid–Build (DBB) and Design–Build (DB). Achieving and improving the performance of government projects is essential to ensure contractual compliance and to serve as a model of best practices and lessons learned. This study aims to analyze the factors influencing the performance of government projects under both DBB and DB systems through a comprehensive literature review of prior studies. By employing an exploratory qualitative approach, this research identifies key factors as the main variables that should be considered in measuring government project performance for both delivery methods. The findings can be used to develop a Government Project Performance model for DBB and DB systems by project stakeholders as well as by academics who intend to further refine and expand this model in future research.

Keywords: Project Performance, DBB, DB, Government Project, Qualitative Method

Introduction

Government infrastructure projects play a strategic role.in supporting economic growth and public welfare, particularly in developing countries such as Indonesia. In 2025, infrastructure expenditure accounts for approximately 11–12% of the national budget, exceeding IDR 403 trillion (BPS, 2025). Such a substantial allocation requires that project implementation achieves optimal performance and complies with both technical and non-technical standards. This substantial budget allocation requires infrastructure projects to achieve optimal performance and comply with both technical and non-technical standards in order to deliver long-term benefits to society. The developed infrastructure is expected to attain its planned service life and meet key project performance indicators, including cost, quality, time, occupational health and safety, and environmental aspects (Elizar et al., 2017).

Traditionally, project performance has been evaluated using the iron triangle, which consists of cost, quality, and time (Atkinson, 1999). However, the increasing complexity of construction projects has expanded performance evaluation to include additional dimensions such as occupational health and safety, environmental sustainability, and stakeholder satisfaction. These additional indicators are particularly important in government projects, where accountability to public resources is essential (Choudhry, 2017; Elizar et al., 2017; Goftar et al., 2014; Mohammadi et al., 2018). The development of these performance indicators has become increasingly important in government projects, considering that such projects are funded by public resources whose utilization must be accountable to society.

Despite the development of various performance indicators, many government projects still experience inefficiencies and waste (Elizar et al., 2017). A study by Arviga et al. indicates that the level of waste in government projects in Indonesia remains relatively high (Bigwanto et al., 2024). A similar finding was reported by Alwi et al., who stated that waste in construction projects in Indonesia is generally caused by issues related to materials, design and documentation, labor, and weak project management practices. These conditions indicate that the current project management approaches have not yet been fully effective in controlling waste and improving overall project performance (Alwi et al., 2002). Previous studies indicate that material issues, design inconsistencies, labor productivity problems, and weak project management practices commonly cause such inefficiencies. These findings suggest that conventional project management approaches remain insufficient in ensuring optimal project performance.

In Indonesia, government construction projects are commonly delivered through two main systems: Design–Bid–Build (DBB) and Design–Build (DB), as regulated in Law No. 2 of 2017 concerning Construction Services. These delivery systems differ in terms of stakeholder involvement, contractual structure, and execution processes. Consequently, their performance outcomes may also differ, requiring a more specific and structured evaluation approach.

To address these challenges, Lean Construction has emerged as a relevant approach to improve project performance by minimizing waste and enhancing value generation. Lean principles emphasize continuous improvement, workflow stability, and collaborative planning throughout the project lifecycle. Therefore, integrating Lean Construction into performance evaluation provides a more process-oriented perspective compared to traditional outcome-based measurement.

However, previous studies tend to examine Lean Construction and project delivery systems separately. Limited research has systematically integrated lean-based performance indicators with differences between DBB and DB, particularly in government project contexts. This study aims to fill this gap by developing a structured performance mapping framework that combines Lean Construction principles with project delivery system characteristics.

In line with this policy, the Government, through Peraturan Menteri PUPR Nomor 12/PRT/M/2017, later updated by Permen PUPR Nomor 1 Tahun 2020, encourages the implementation of integrated design–build construction as an effort to enhance innovation, accelerate project delivery, and improve infrastructure quality (Adi et al., 2024). To ensure the successful implementation of this policy, project performance evaluation is required not only to focus on financial aspects but also to measure performance comprehensively throughout the project execution phase (Gantika et al., 2025).

Current practice shows that the evaluation of government project performance is still predominantly based on financial approaches conducted at the end of the project (Wahyudi, 2024). This approach has not been able to comprehensively identify the factors causing low project performance during the execution process. The development of a performance model based on Lean Construction is expected to provide deeper insight into the root causes of project performance issues, enabling more precise and sustainable improvements. However, the development of such a performance model may vary depending on the project delivery system used in government projects.

In response to these issues, the Lean Construction approach has emerged as a method to improve construction project performance by reducing waste and increasing value creation. Lean construction emphasizes a work culture oriented toward high productivity and low waste at every stage of project execution (Sarhan et al., 2017). Projects with high productivity levels and low waste are believed to provide long-term benefits and support the sustainability of construction projects. Therefore, performance measurement based on Lean Construction is essential to ensure that these principles are effectively implemented and deliver tangible impacts on the performance of government projects (Huovila & Koskela, 2014).

One of the tools within the Last Planner System (LPS) that is widely used to improve the reliability of project planning and execution is the Percent Plan Complete (PPC) metric. LPS enables the development of more technical and operational performance indicators for measuring project performance (Alarcon et al., 2016; De |a Garza & Leong, 2000; Tommelein, 2015; Hatmoko et al., 2018). Performance measurement based on the Last Planner System (LPS) is capable of identifying the root causes of low project performance in greater detail, enabling projects to implement corrective actions to recover delays and improve overall performance.

Research on Lean Construction has been widely conducted, particularly on international projects, with a focus on the level of implementation, barriers to adoption, and the benefits of lean construction on project performance (Alarcon et al., 2016; Lauren Pinch, 2005; Thais da C L Alves, 2018; Zhang & Chen, 2016). However, most of these studies have not linked the implementation of Lean Construction with differences in project delivery systems, particularly in government projects. On the other hand, several studies indicate that the Design–Build system tends to have advantages over Design–Bid–Build in terms of project performance (Chen et al., 2015; El Asmar et al., 2016; Hale et al., 2009; Katar, 2019; Park & Kwak, 2017). However, studies that develop a government project performance model by comparing Design–Build and Design–Bid–Build based on Lean Construction remain very limited, particularly in the context of projects in Indonesia.

There are several project delivery systems used in the construction industry, with DBB and DB being the most common. The differences between these systems are related to the number of contractual relationships with project stakeholders and the timing of stakeholder involvement. Recent studies have also identified patterns in contract payment provisions and stakeholder selection criteria commonly applied within each project delivery system. (Franz et al., 2020; Adi & Ni'am, 2012; Asmar et al., 2013; Sari et al., 2023; Sari et al., 2023)

Although previous studies have examined Lean Construction, Design–Build, and Design–Bid–Build separately, the existing review literature shows several important limitations. First, most review articles focus on the implementation level, barriers, and benefits of lean construction without systematically linking lean performance indicators to specific project delivery systems (Koskela, 2000; Womack & Jones, 1996). Second, comparative analyses between DBB and DB are generally limited to traditional performance metrics such as cost, time, and quality, and rarely incorporate lean-based operational indicators such as workflow reliability, planning stability, and waste reduction (Formoso et al., 2002; Love et al., 2011). Third, within the context of government projects—particularly in Indonesia—there is still a lack of structured literature reviews that map project performance dimensions across different delivery systems using a lean construction perspective. As a result, there is no comprehensive conceptual framework that explains how lean-based performance indicators may differ between DBB and DB throughout the project life cycle (Ballard & Howell, 2003; Hopp & Spearman, 2008).

This study seeks to address these gaps by providing a structured literature review that integrates Lean Construction principles with project delivery system characteristics. The main contribution of this article is the development of a performance mapping framework that identifies and classifies key performance indicators for Design–Bid–Build and Design–Build based on lean construction concepts (Womack & Jones, 1996). In addition, this study highlights the differences in performance measurement approaches between the two delivery systems and identifies research gaps that provide opportunities for future empirical and model-based studies, particularly in the context of government infrastructure projects (Sacks et al., 2010).

Accordingly, the objectives of this review article are: (i) to map the performance of DBB and DB project delivery systems based on lean construction through a systematic literature review; and (ii) to identify gaps in the existing literature and propose directions for future research.

Research Methods

Methodology

This study focuses on three main domains, namely lean construction performance indicators, the characteristics of Design–Bid–Build and Design–Build delivery systems, and performance measurement in government or infrastructure projects. The overall research framework is visualized in Figure 2.

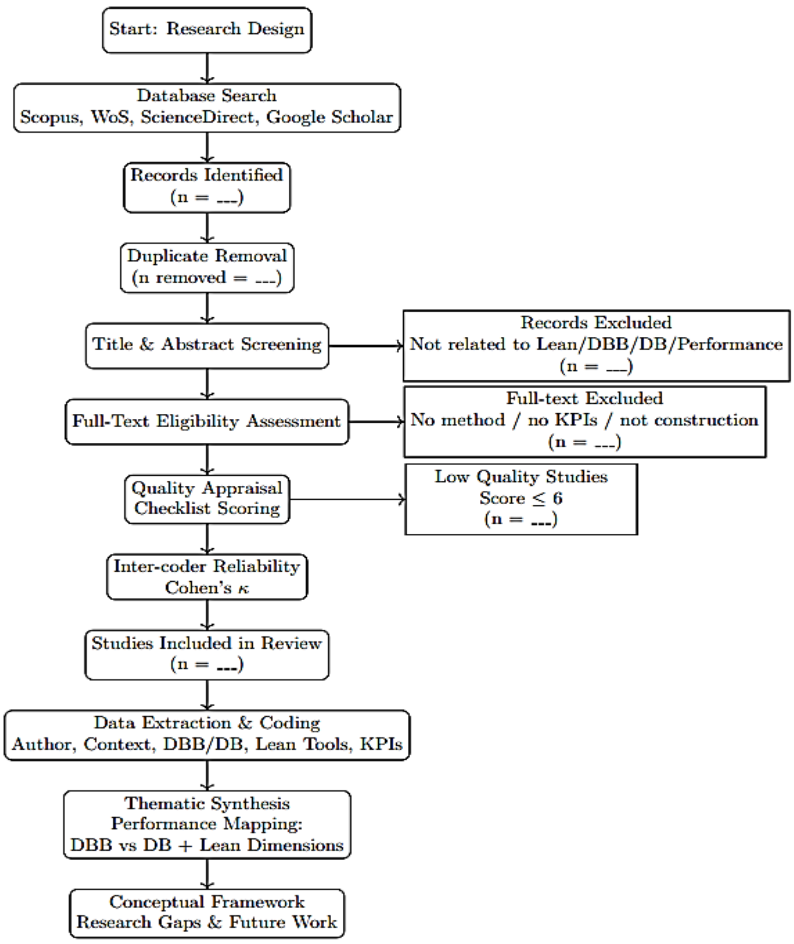

Figure 2. Research framework

Research Design

A qualitative–exploratory review design was employed to identify, classify, and synthesize performance indicators reported in previous studies. This approach was selected because the objective of the study is to develop a conceptual performance mapping rather than to conduct a statistical meta-analysis. The review focuses on three main domains:

1. lean construction performance indicators,
2. characteristics of DBB and DB delivery systems, and
3. performance measurement in government or infrastructure projects

Literature Search Strategy

Relevant publications were collected from major scientific databases, including Scopus, Web of Science, ScienceDirect, and Google Scholar. The search covered journal articles, conference papers, and selected high-quality reports published between 2000 and 2024 to capture the development of lean construction and project delivery systems.

The search strings combined keywords related to:

1. "lean construction",
2. "Last Planner System",
3. "project performance",
4. "design–bid–build",
5. "design–build", and
6. "government or infrastructure projects"

Boolean operators (AND, OR) were used to refine the search and ensure comprehensive coverage.

Inclusion and Exclusion Criteria

To ensure the relevance and quality of the reviewed studies, the following criteria were applied:

1. The inclusion criteria consist of peer-reviewed journal articles and reputable conference papers that discuss lean construction performance indicators or Last Planner System metrics, compare DBB and DB performance, and are related to construction or infrastructure projects.
2. Meanwhile, the exclusion criteria include studies that do not provide a clear methodological description, are not directly related to project performance or delivery systems, or are identified as duplicate records across databases.Exclusion criteria:
   a. studies without clear methodological description,
   b. publications not directly related to project performance or delivery systems,
   c. duplicated records across databases.

Study Selection Process

The study selection process followed a PRISMA-based approach to ensure transparency and replicability in identifying and screening the literature. The process consisted of four main stages: identification, screening, eligibility, and inclusion.

1. Identification
   The initial search across Scopus, Web of Science, ScienceDirect, and Google Scholar yielded 'n' records. Additional studies were identified through backward and forward citation tracking, resulting in 'n' additional records. All records were exported to a reference management tool, and 'n' duplicates were removed.
2. Screening
   The remaining 'n' records were screened based on titles and abstracts to assess their relevance to main domain. Studies that were clearly unrelated to construction, did not address

performance indicators, or did not involve project delivery systems were excluded at this stage.

3. Eligibility
   Full-text assessments were conducted on 'n' articles to evaluate methodological clarity, relevance to lean performance indicators, and applicability to DBB or DB contexts. Articles that lacked sufficient methodological detail, were not peer-reviewed, or did not provide measurable performance indicators were excluded.
4. Inclusion
   A total of 'n' studies met all inclusion criteria and were included in the final qualitative synthesis. These studies were then analyzed to extract performance indicators, lean construction practices (including Last Planner System metrics), and characteristics of DBB and DB delivery systems.

Data Extraction and Coding

A structured data extraction form was developed to record key information from each selected study, including:

1. author and year,
2. project type and context,
3. delivery system (DBB or DB),
4. lean construction tools or principles applied,
5. performance indicators used, and
6. key findings related to project performance

The extracted data were then coded and grouped into thematic categories, such as traditional performance indicators (cost, time, quality), lean-based indicators (workflow reliability, PPC, waste reduction), and stakeholder-related indicators.

Research Variable Selection

The selection of research variables was grounded in both theoretical considerations and evidence from prior studies. Variables X1 to X6 represent the major dimensions of project performance that are consistently discussed in construction management and Lean Construction literature. Cost (X1), quality (X2), and time (X3) were selected because they constitute the traditional "iron triangle" of project performance (Atkinson, 1999). Occupational health and safety (X4) and environmental performance (X5) were included to reflect broader sustainability and operational requirements that are increasingly emphasized in government infrastructure projects (Choudhry, 2017; Mohammadi et al., 2018). Organizational culture (X6), represented by the AKHLAK values adopted in Indonesian state-owned enterprises, was incorporated as an enabling factor that supports collaboration, commitment, and continuous improvement within Lean Construction implementation.

The dependent variable, project performance (Y), was defined as the overall achievement of project objectives in accordance with contractual requirements and stakeholder expectations. This variable was selected because it serves as the ultimate outcome influenced by the operational and managerial factors represented by X1 to X6.

The identification of these variables was carried out through a structured literature review process. Each article included in the review was examined to identify performance dimensions, Lean Construction practices, and project delivery characteristics that were repeatedly reported across studies. Variables and indicators that appeared consistently in multiple peer-reviewed publications and were considered relevant to the Indonesian government project context were retained. Indicators that were highly context-specific, rarely discussed, or difficult to operationalize were excluded. This approach ensured that the selected variables were theoretically justified, empirically supported, and practically relevant for developing a conceptual model of government project performance in Design–Bid–Build and Design–Build systems.

Data Synthesis and Performance Mapping

The synthesis was conducted using a thematic analysis approach. Performance indicators identified from the literature were classified and mapped according to:
1. project delivery system (DBB vs DB), and
2. lean construction dimensions

This mapping process enabled the identification of similarities, differences, and gaps in performance measurement between the two delivery systems. The results are presented in the form of conceptual tables and a performance mapping framework to support future model development.

Research Results and Discussion

PRISMA-Style Literature Screening

The literature review followed a PRISMA-style flow to ensure transparency and replicability. The identification stage yielded 126 records from Scopus, ScienceDirect, and Google Scholar using keywords related to project delivery system, design–bid–build, design–build, lean construction, Last Planner System, and project performance. After removing 34 duplicates, 92 records were screened based on title and abstract.

During the eligibility stage, a number of articles were excluded due to several reasons, including the absence of a government project context, lack of measurable performance indicators, limited relevance to lean construction or the Last Planner System, and purely conceptual contributions without empirical evidence.

A total of 35 full-text articles were assessed, of which 15 articles were excluded because they did not provide measurable indicators or did not distinguish DB and DBB. Finally, 20 articles were included in the qualitative synthesis and used to construct the performance indicator framework. This process ensures that the variables and indicators used in this study are grounded in validated empirical research and aligned with lean construction principles.

Mapping and Indicator Development

A mapping of previous studies was conducted to identify the dominant factors influencing government project performance within the lean construction perspective. The synthesis confirms that project performance is no longer evaluated solely using the iron triangle (cost–quality–time), but also includes K3, environmental aspects, and organizational culture, particularly in BUMN projects implementing AKHLAK values.

Table 1 shows that each variable is operationalized into measurable indicators reflecting LPS practices such as collaborative planning, routine evaluation, constraint removal, and commitment management. These indicators represent process-based performance measurement rather than end-of-project financial metrics, which is consistent with lean principles.

Table 1. Lean-Based Project Performance Indicators

Variable	Variable Code	Indicators	References
X1 (Cost)	X.1.1	Conducting consistent project socialization and target setting, with comprehensive evaluation implementation.	(Ajayi, 2016; Alwi et al., 2002; Elizar et al., 2017; Nikakhtar et al., 2015; Treloar et al., 2003
	X.1.2	Conducting project socialization and target evaluation to achieve a minimum	(Chai et al., 2013; De Boer et al., 2001; Verma & Pullman, 1998)

		of 100% Percent Plan Complete (PPC).	
	X.1.3	Conducting comprehensive project target evaluation, with routine meetings aimed at reviewing labor cost utilization.	(Ahbab, 2012; Garold Oberlender & Trost, n.d., 2001; Kaliba et al., 2009; Kim et al., 2008; Rahman et al., 2013; Sawan et al., 2018)
X2 (Quality)	X.2.1	Conducting project socialization and target setting, with formal evaluation of procurement activities.	Kaliba et al., 2009; T. Park et al., 2014a; Seddeeq et al., 2019
	X.2.2	Conducting project socialization and target setting, with formal evaluation of work targets and outcomes.	(Ajayi, 2016; Alwi et al., 2002b; Elizar et al., 2017; Nikakhtar et al., 2015; Treloar et al., 2003)
	X.2.3	Conducting consistent project socialization and target setting, with comprehensive evaluation implementation.	Ajayi, 2016; Ajayi & Oyedele, 2018; Alwi et al., 2002a; Elizar et al., 2017; Lauren Pinch, 2005; Letcher & Vallero, 2011
	X.2.4	Conducting coordination and collaborative design from the early stages of the project to prevent work variability.	Ajayi, 2016; Ajayi & Oyedele, 2018; Alwi et al., 2002a; Elizar et al., 2017; Lauren Pinch, 2005
X3 (Time)	X.3.1	Conducting project socialization and target setting, with formal evaluation of the S-curve.	(Ahbab, 2012; D. W. M. Chan & Kumaraswamy, 1997; Cvetković et al., 2018; Issa, 2013a; Kaming et al., 1997; Ramanathan & Narayanan, 2012; Seddeeq et al., 2019)
Variable	**Variable Code**	**Indicators**	**References**
	X.3.2	Conducting consistent project socialization and target setting, with comprehensive evaluation implementation.	(Ajayi, 2016; Alwi et al., 2002; Elizar et al., 2017; Lauren Pinch, 2005; Nikakhtar et al., 2015; Treloar et al., 2003)
	X.3.3	Conducting project socialization and target evaluation, where work outcomes have not yet met planning targets and schedule realization aligns with the established plan.	(Kaliba et al., 2009; Lui et al., 2004; Schatteman et al., 2008; Tallgren, 2018
X4 (Occupational Health and Safety)	X.4.1	Conducting consistent project safety socialization and target setting, with comprehensive evaluation implementation. Safety signage is available on site.	Alomari et al., 2018; Atombo et al., 2017; Awada et al., 2016; Bajjou, Chafi, & En-Nadi, 2017; Mohammadi et al., 2018
X5 (Environment)	X.5.1	Conducting socialization and demonstrating top management commitment to the use of environmentally friendly materials.	(Ajayi & Oyedele, 2018; Lauren Pinch, 2005)
	X.5.2	Conducting collaboration to prevent environmental damage, protect facilities, and mitigate potential vandalism or looting.	(Suryadi, Herwindiati, & Anondho, 2025; Suryadi, Herwindiati, Anondho, et al., 2025)

X6 (Organizational Culture)	X.6.1	Formally sharing vision and mission with all stakeholders to promote AKHLAK BUMN culture, including slogans and visual reminders.	(Lühr et al., 2022; Mao et al., 2017; michael Morcos, 2018; Rischmoller et al., 2018)
Y (Project Performance)	Y1	Achievement of project performance in accordance with contractual requirements.	(Atkinson Roger, 1999; Enshassi et al., 2016; Mesa et al., 2016; Mohammadi et al., 2018)

The mapping as shown in Table 1 above indicates that project performance in government construction is primarily driven by process reliability rather than solely by contractual compliance or technical capability. Each variable represents a control point within the lean production system, where variability, waste, and coordination failure can be reduced through structured planning and continuous evaluation.

Cost Performance (X1)

Cost performance is closely linked to workflow reliability, particularly through the achievement of Percent Plan Complete (PPC) and systematic labor cost monitoring. In the lean context, cost overruns are not viewed merely as financial deviations but as symptoms of upstream planning failures, such as unremoved constraints, unstable work packages, and rework. Routine target evaluation functions as a feedback mechanism that enables early detection of deviations and corrective action. This finding reinforces the principle that cost efficiency is an outcome of stable production flow rather than post-hoc budget control.

Quality Performance (X2)

Quality indicators emphasize early design coordination and formal procurement control, which are consistent with the lean concept of "build quality into the process." Early involvement of key stakeholders reduces design variability, minimizes RFIs and change orders, and prevents downstream defects. The literature also highlights that collaborative design reviews and standardized work evaluation improve first-time quality performance. This supports the argument that quality in lean projects is achieved through process integration, not inspection-based control.

Time Performance (X3)

Time performance received the highest emphasis due to its direct relationship with planning reliability and constraint management. Monitoring through S-curves and aligning planned versus actual schedules are traditional tools; however, within a lean framework, their effectiveness depends on the stability of weekly work plans and the removal of constraints before task execution. Delays in government projects are therefore interpreted as a manifestation of planning variability rather than solely resource shortages. Reliable work planning, as promoted by the Last Planner System, reduces schedule uncertainty and improves overall project flow.

Occupational Health and Safety (X4)

K3 indicators highlight safety socialization, visual management (signage), and continuous evaluation, which align with lean principles of transparency and standardized work. Safety performance is not treated as a compliance requirement but as an integral component of production reliability. A stable and well-planned workflow reduces unsafe conditions caused by congestion, rework, and time pressure. Thus, improved planning reliability contributes simultaneously to better safety outcomes.

Environmental Performance (X5)

Environmental performance is driven by top management commitment and collaborative control of site impacts, reflecting the lean objective of minimizing waste in materials, energy, and environmental resources. The use of environmentally friendly materials and preventive coordination to avoid damage to surrounding facilities indicates a shift from reactive mitigation to proactive environmental planning. This demonstrates that environmental performance can be embedded within production planning rather than treated as a separate sustainability initiative.

Organizational Culture – BUMN AKHLAK (X6)

The inclusion of AKHLAK culture as an enabling factor extends existing lean construction studies by incorporating organizational behavior and value alignment. The formal dissemination of shared values strengthens trust, communication, and commitment among stakeholders, which are critical for collaborative planning and reliable promise management. In lean systems, culture functions as the foundation for mutual accountability and continuous improvement. Therefore, AKHLAK values support the behavioral transformation required for effective LPS implementation in government-owned enterprises.

Lean Interpretation of Waste in Government Projects

The synthesis indicates that waste in government projects is predominantly caused by fragmented coordination, unstable planning, and limited process control, rather than purely technical limitations. This finding shifts the perspective from a product-oriented evaluation to a process-oriented diagnosis, where:

a. cost overruns stem from rework and variability,
b. schedule delays result from unreliable commitments and unresolved constraints,
c. quality defects arise from late stakeholder involvement, and
d. safety and environmental issues emerge from reactive management practices

Such patterns are characteristic of non-lean production systems where planning is centralized, communication is sequential, and feedback loops are weak. By contrast, lean construction promotes decentralized planning, collaborative decision-making, and continuous performance measurement, which directly address these root causes.

Implications for DBB and DB Delivery Systems

Measurement When interpreted within the context of project delivery systems, these factors reveal that process integration is the critical differentiator between DB and DBB performance. The discussion indicates that:

a. Design–Build (DB) enables earlier contractor involvement, facilitating collaborative planning and faster constraint resolution. This improves PPC and reduces schedule variability.
b. Design–Bid–Build (DBB) tends to have fragmented coordination, leading to higher rework risk, design changes, and lower planning reliability

Within the lean framework, DB projects show stronger alignment with LPS principles because of integrated teams and single-point responsibility. DBB projects require additional partnering mechanisms to achieve similar performance levels.

This finding supports previous studies but extends them by showing that the performance gap between DB and DBB is primarily driven by process reliability and lean implementation, not only contractual structure. However, the findings also suggest that DBB performance can be improved if lean mechanisms—such as collaborative planning sessions, shared performance targets, and structured weekly work planning—are formally introduced. This indicates that the performance gap between the two systems is not solely structural but also behavioral and process-driven.

From a theoretical perspective, the results reinforce the shift from the traditional iron triangle toward a lean production-based performance model, where process indicators mediate the relationship between project delivery systems and performance outcomes. The integration of organizational culture as an enabling variable contributes to the development of a more holistic performance framework for public sector construction.

Practically, the findings imply that government project evaluation systems should:

1. adopt process-based KPIs such as PPC, constraint removal rate, and planning reliability,
2. institutionalize the Last Planner System as a standard planning tool, and
3. align organizational culture (AKHLAK) with collaborative lean practices

Such measures would allow performance to be monitored continuously throughout the project life cycle rather than only at project completion.

Conclusion

This study confirms that the performance evaluation of government infrastructure projects is not determined solely by contractual mechanisms or technical specifications, but primarily by the reliability of production planning and process control implemented through the Last Planner System (LPS). The mapping results demonstrate that cost performance is an outcome of stable workflow, reflected in consistent PPC achievement, routine target evaluation, and systematic labor cost monitoring. When work packages are well-prepared and constraints are removed in advance, rework and idle time are reduced, leading to more efficient cost formation.

Quality performance is driven by early design coordination, formal procurement control, and structured evaluation of work results. These practices embed quality within the production process and reduce downstream defects, RFIs, and change orders. Time performance emerges as the most sensitive factor, as schedule deviations in government projects are largely caused by planning variability rather than resource shortages. Reliable weekly planning, supported by S-curve monitoring and alignment between planned and actual progress, significantly improves schedule stability and overall project flow.

Safety (K3) performance is strengthened through safety socialization, visual management, and continuous evaluation, indicating that safe operations are closely linked to well-planned and stable workflows. Environmental performance depends on top management commitment and collaborative control of site impacts, showing that sustainability outcomes can be integrated into production planning rather than treated as a separate compliance activity. In addition, the AKHLAK culture within BUMN organizations functions as an enabling factor that promotes trust, communication, and mutual accountability, which are essential for collaborative planning and reliable promise management.

The findings indicate that project performance in government construction is primarily influenced by process reliability rather than solely by contractual compliance or technical capability. Each performance variable represents a control point within the lean production system, where variability, waste, and coordination failure can be minimized through structured planning and continuous evaluation.

Cost performance is strongly associated with workflow reliability, particularly through the achievement of Percent Plan Complete (PPC) and systematic monitoring of labor costs. Within a lean perspective, cost overruns are not merely financial deviations but reflect upstream planning failures, such as unresolved constraints and unstable work packages.

Quality performance is enhanced through early design coordination and structured procurement processes. These practices reduce design variability and prevent downstream defects, thereby improving first-time quality performance.

Time performance is closely related to planning stability. Delays are primarily caused by planning variability rather than resource limitations. Therefore, reliable work planning supported by the Last Planner System significantly improves schedule performance.

Overall, these findings highlight that improving project performance requires a shift from outcome-based evaluation toward process-based performance management.

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