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IMPACT OF PROJECT DELIVERY SYSTEM SELECTION ON VALUE GENERATION

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ABSTRACT

The Project Delivery System (PDS) selection is critical for the performance of construction projects because it directly influences costs, efficiency, and stakeholder satisfaction. Despite its importance, the proper PDS selection currently disregards identifying the most relevant contractual factors and their relationship with value generation. This study compares the characteristics and behavior of various PDS to address this issue. This paper uses a comparative literature analysis of four PDS models, i.e., Design Bid Build (DBB), Design-Build (DB), Construction Management at Risk (CM), and Integrated Project Delivery (IPD), to evaluate their contractual factors and performance. The literature evidences that IPD may outperform the other models, and despite the type of PDS deployed, the most frequently used contractual factors are cost, time, communication, quality, and change. It is concluded that fostering the use of collaboration and integration processes in the structure of the PDS drives performance improvement and, hence, value generation. Further research must consider analyzing the effect of emerging factors such as sustainability and digitalization.

KEYWORDS

Lean Construction, Project Delivery Systems, Contractual Factors, Collaboration, Value Generation

INTRODUCTION

The selection of a suitable Project Delivery System (PDS) is critical in both traditional and industrialized construction. It fosters cooperation, reduces conflicts, promotes innovation, improves risk management, and enhances project outcomes—key to success in complex projects. A PDS is defined as a business model that integrates and transforms resources to generate value for clients and stakeholders (Magretta, 2002), and consists of three main components: business terms, organizational structure, and management system (Cho et al., 2010). However, most selection tools still focus on traditional models, overlooking emerging

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factors such as sustainability, digitalization, and the specific needs of industrialized projects (Khan, 2023).

While methods like MCDM, Fuzzy TOPSIS, and Interval AHP offer structured approaches to PDS selection, they lack practical validation and do not fully address collaborative models such as IPD. These gaps call for a broader evaluation of PDS models that incorporates contractual and operational differences while integrating Lean Construction principles. This study aims to bridge the gap between theory and practice by exploring how PDS selection influences value generation in leaner, more efficient processes.

To address this, the study asks: How does PDS selection impact project value generation? The objectives are to:(1) Evaluate the state-of-the-art literature on PDS selection, (2) Compare PDS model performance, (3) Identify and assess key contractual factors, (4) Analyze PDS performance based on literature, (5) Conduct a comparative evaluation of PDS models.

LITERATURE REVIEW

The Lean Construction philosophy, adapted from Lean Manufacturing, focuses on reducing waste, improving collaboration, and maximizing value delivered to the client (Koskela, 1992; Howell, 1999). Selecting a PDS that reflects these principles is essential for project success. This study analyzes how contractual factors involved in PDS selection align with Lean Construction to reduce waste, generate value, and influence project performance.

PDS models vary in integration and collaboration levels. Figure 1 schematically compares four emblematic types: Design-Bid-Build (DBB) separates design and construction, creating coordination issues and placing risk on the client (Bastias & Molenaar, 2010). Construction Management at Risk (CM) involves early manager participation to improve cost and time control while reducing the client's exposure to overruns (Eastman, 2011; Inmoley, 2020). Design-Build (DB) unifies design and construction, enabling early changes and avoiding conflicts between contractors and consultants (Rahmani et al., 2017; Konchar & Sanvido, 1998). Integrated Project Delivery (IPD) promotes full integration through early collaboration and advanced technology, improving outcomes and reducing risks (El Asmar et al., 2013; Azhar, 2014; AIA, 2007). These models represent a continuum of collaboration and integration shaped by how their contractual components interact.

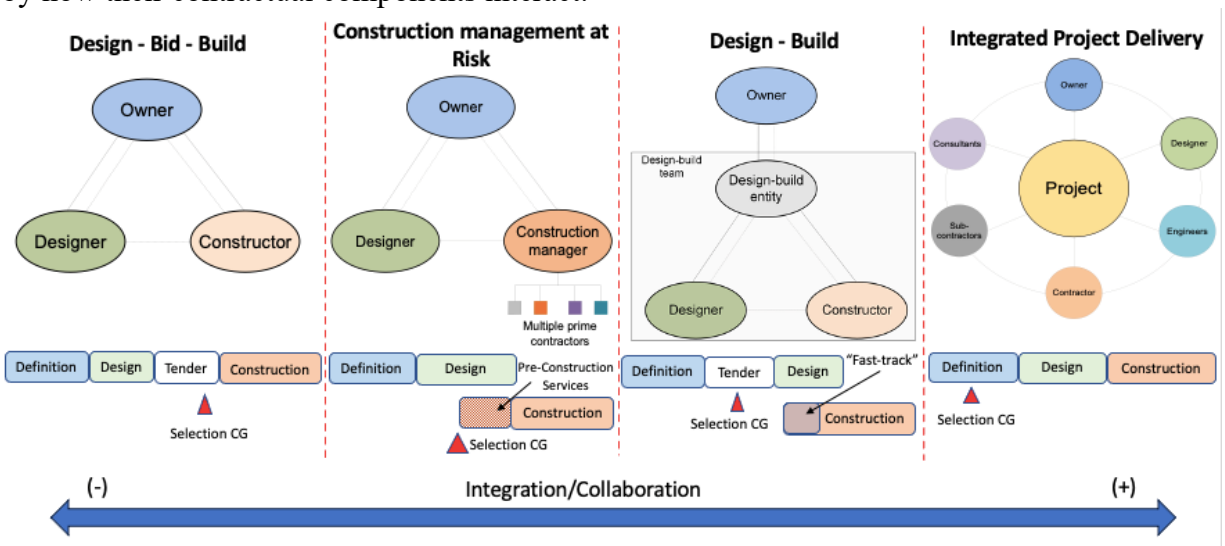

Figure 1: Main PDS (Adapted from Mesa, H. 2024)

According to the literature reviewed, the less studied PDS is IPD. Figure 2 summarizes the available evidence, showing that the PDS with the highest number of mentions is DBB with 25

references, followed by DB with 24 and CM with 18. In contrast, IPD has only seven mentions, indicating a lower presence in the analyzed literature. This difference in the number of references suggests that, although IPD has demonstrated collaborative advantages, it is still less studied than other traditional systems, limiting its validation and practical understanding. This condition demonstrates that further research on IPD is still required, especially to explore its performance in more complex and collaborative contexts.

PDS	Assaf et al., 2023	Mostafavi et al., 2010	Sullivan et al., 2017	Ibrahim et al., 2020	El Asmar et al., 2013	Mafakheri et al., 2007	Col et al., 2006	Oyetunji et al., 2006	Konchar et al., 1998	Abou et al., 2019	Minchin et al., 2013	Franz et al., 2020	Hale et al., 2009	El Asmar et al., 2015	Hanna, 2016	Francom, 2015	Cameron Lampe, 2015	Feghaly et al., 2021	Mosley et al., 2019	Plusquellec et al., 2017	Shakya, 2013	Antoine, 2017	Alleman, 2016	Ibrahim, 2016	El Asmar et al., 2012	Amount
IPD	X			X	X									X	X										X	X	7
DB	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	24
DBB	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	25
CMR	X	X	X	X	X	X	X	X	X			X		X	X			X			X	X	X	X	X	X	18

Figure 2: Literature on PDS

Another relevant aspect is selecting the most appropriate PDS for a project. This decision directly influences the managerial effort and the project's final results (Khan, 2023). Table 1 summarizes studies that analyze key factors associated with project delivery systems (PDS). These works rely on methods such as Multi-Criteria Decision-Making (MCDM), Fuzzy Technique for Order of Preference by Similarity to Ideal Solution (Fuzzy TOPSIS), and Interval Analytic Hierarchy Process (Interval AHP). They evaluate aspects such as quality, costs, financing, and flexibility. Although these methodologies provide useful tools for decision-making, the studies exhibit limitations, such as a lack of practical validation, a restricted approach to specific contexts, and the exclusion of more modern models such as IPD. This condition underscores the need for future research to address these gaps, broadening the analysis towards more integrated and collaborative approaches for PDS selection.

Table 1: PDS Selection Models

Reference	Method Used	Key Factors Identified	Limitations/Knowledge Gaps
Assaf et al. (2023)	Multi-criteria model (MCDM) combining ANP and ER	Quality, cost control, financing	Applied only to OSC projects; limited in external factors
Mostafavi and Karamouz (2010)	Fuzzy TOPSIS	20 key factors to evaluate 12 PDS	Uncertain scenarios may generate residual uncertainty
Oyetunji and Ghassemi (2006)	FMADM with linguistic scale	Relative effectiveness of PDS	Focused on linguistic metrics; limited practical validation
Mafakheri et al. (2007)	Interval AHP	Prioritization in high-uncertainty scenarios	Superficial for low uncertainty environments
Liu et al. (2016)	Surveys in 101 projects in China	Scale, complexity, type, flexibility, scope definition, disputes	Limited to DBB, DB, and EPC; does not consider PDS like IPD or CM

Thus, the reviewed literature suggests a study opportunity related to the process used to identify the most appropriate type of PDS to address a project. This gap can be described as a lack of

clear criteria for choosing the most appropriate model. A condition that limits the effectiveness of decision-making (Khan, 2023). Most existing tools focus on traditional PDSs, ignoring emerging factors such as sustainability and digitization, as well as the particularities of industrialized projects (Khan, 2023). This lack of practical validation and consideration of emerging factors hinders alignment with Lean Construction principles, reducing the ability of projects to maximize value generation and eliminate waste, especially in complex environments.

METHODOLOGY

The methodology comprises three phases: literature review, contractual factors analysis, and PDS-Factors matrix generation (Figure 3). In addition, the analysis uses propositions 01 and 02 to guide the analysis of literature and the evaluation of findings:

1. Proposition 01. Structure: The structure of a PDS can be expressed in terms of a set of contractual factors grouped into various criteria
2. Proposition 02. Performance: A PDS that involves more factors related to collaboration and integration processes exhibits a better performance than other PDS models.

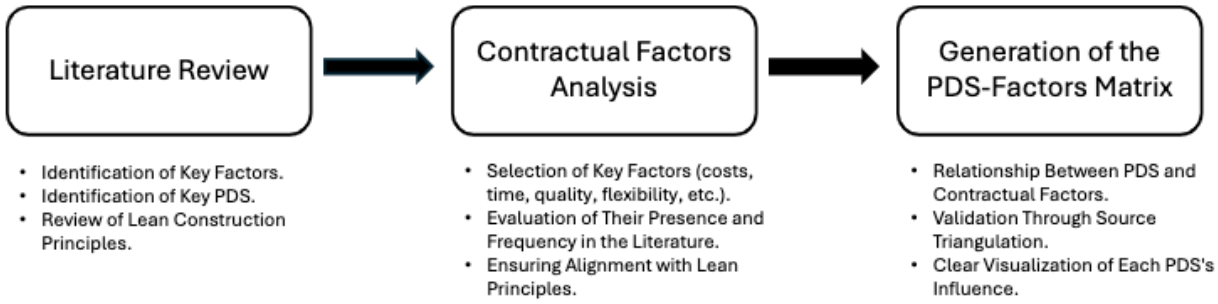

Figure 3 Methodology.

The methodology involves three sequential phases. First, a systematic selection process was conducted, reviewing 50 scientific articles to identify key factors influencing PDS selection, considering value generation and Lean Construction principles. Articles were sourced from Google Scholar, Scopus, and Web of Science, using keywords related to PDS, contractual selection, and Lean principles. Selection criteria included relevance to PDS decision-making, empirical or theoretical contributions, peer-reviewed status, and a focus on studies from the last 20 years. To ensure transparency and replicability, only studies explicitly addressing PDS classification or performance evaluation were considered.

Then, contractual factors such as cost, time, quality, communication, and changes were analyzed to determine their relationship with different PDS. Finally, a PDS-factors matrix was developed, associating each delivery system with the identified factors, validated through source triangulation and based on a comparative analysis of the reviewed studies. The classification of PDS models was based on statistical evidence from peer-reviewed studies, applying hypothesis testing and comparative statistical metrics at a 95% confidence level. For instance, if one study indicated no difference between IPD, CM, and DB, but these were superior to DBB, and another study highlighted IPD as better than CM and DB, the classification assigned was "Good" for IPD, "Medium" for CM and DB, and "Poor" for DBB. This process ensures that the matrix reflects both quantitative and qualitative evidence, providing a reliable basis for PDS performance evaluation.

BACKGROUND

Based on Lean Construction, PDS selection should promote integration and collaboration, as both drive performance and value. This requires contractual criteria—mainly cost and time—that align with client needs.

VALUE GENERATION & COLLABORATION

Performance improvement in construction projects is based on waste elimination and value generation to align client expectations with final results. White and Yetmen (2014) conceptualize the contrast between collaborative and traditional practices and their implications for PDS performance (Figure 4). The model shows that collaborative processes, such as constraint management and proactive problem solving, increase value over time, while processes associated with a traditional design-bid-build PDS tend to reduce value due to the arising of conflicts in cost, time, and scope (Ballard and Howell, 2003; Koskela, 1992; White and Yetmen, 2014). Thus, the lack of early coordination and collaborative tools may affect the ability to manage risks and changes and increase the variability of results. Therefore, fostering a collaborative approach may promote greater stability and control during project execution.

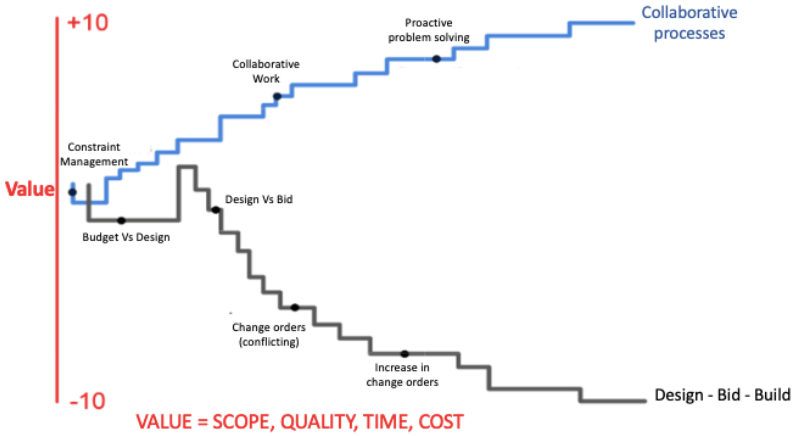

Figure 4. Relationship between PDS and Value (Adapted from White and Yetmen 2014)

For PDS deployment, integration and collaboration are crucial aspects of generating value. Integration refers to aligning financial, scheduling, and other business systems to enable a transparent and efficient business relationship among stakeholders (Gransberg et al. 2022). In turn, Collaboration is an emergent property of social agents, which arises from the relationships and behaviors between the team members of the PDS due to the fostering of trust and transparency (Ibid). Together, these concepts influence the selection of a PDS by promoting early stakeholder involvement, joint decision-making, and adaptability, which is particularly relevant for complex and large-scale projects.

Lean Construction provides an operational framework to address value generation and waste elimination while promoting team integration. Tools such as the Last Planner System and Target Value Design improve predictability and efficiency by facilitating joint decisions and continuous collaboration (Ballard, 2000; Koskela et al., 2002). This makes identifying problems early and reducing conflicts possible, contributing to a more stable and controlled workflow.

CONTRACTUAL FACTORS

Proper selection of PDS relies on a set of both internal and external contractual criteria that directly influence project success. Thwala (2021) points out that disregarding these factors can result in disputes, delays, and cost overruns. In addition, the client's involvement and

willingness to share risks also play an essential role in choosing the most appropriate PDS (Al Khalil, 2002). These factors highlight the need to comprehensively assess project conditions and the parties' alignment to minimize risks and promote more stable results. Figure 5 depicts a comparative analysis of the criteria addressed by various authors, evidencing the attention paid to factors such as cost, time, quality, and communication, which reinforces their importance in project delivery decision-making.

Criterion vs Autor	(Assaf et al., 2023)	(Mostafavi et al., 2010)	(Sullivan et al., 2017)	(Ibrahim et al., 2020)	(El Asmar et al., 2013)	(Mafakheri et al., 2007)	(Col et al., 2006)	(Oyetunji et al., 2006)	(Konchar et al., 1998)	(Abou et al., 2019)	(Minchin et al., 2013)	(Franz et al., 2020)	(Hale et al., 2009)	(El Asmar et al., 2015)	(Hanna, 2016)	(Francom, 2015)	(Cameron Lampe, 2015)	(Feghaly et al., 2021)	(Mosley et al., 2019)	(Plusquellec et al., 2017)	(Shakya, 2013)	(Antoine, 2017)	(Alleman, 2016)	(Ibrahim, 2016)	(El Asmar et al., 2012)	
Costs	X	X	X	X	X			X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	21
Financing	X																									1
Time	X			X	X			X	X	X	X	X	X	X	X	X	X	X		X		X		X		17
Relations and Risks	X							X																		2
Collaborative Processes	X	X						X																		3
Communication	X			X	X				X	X					X			X						X		8
Quality	X			X	X				X					X	X					X				X	X	9
Prefabrication Processes	X																									1
Project Conditions	X				X										X											3
Changes				X	X			X							X				X		X			X		7
Project Regularity	X																									1
Safety				X	X																			X		3
Owner Capabilities	X																									1
Owner Preferences	X	X						X																		3

**Project Regularity: Refers to consistency and clarity in the processes and agreements during execution, minimizing uncertainties and conflict.*

Figure 5: Criteria vs Authors

Figure 5 reveals that cost and time are the most used criteria to describe PDS performance. In contrast, the least used criteria include financing, prefabrication processes, project regularity, and owner capabilities. This reinforces the need to explore how different PDS models address these factors and their impact on value generation within Lean Construction.

RESULTS

IPD remains the least studied PDS model, highlighting a research gap in its evaluation. Figure 6 illustrates the distribution of references among PDS models, showing that DBB (24 references) and DB (23 references) are the most frequently analyzed, while IPD appears in only seven studies. This suggests a predominant focus on traditional PDS, limiting the understanding of more collaborative approaches.

PDS vs Criterion	Costs	Financing	Time	Relations and Risks	Collaborative Processes	Communication	Quality	Prefabrication Processes	Project Conditions	Changes	Project Regularity	Safety	Owner Capabilities	Owner Preferences	Total (References)
IPD	7	1	7	1	2	7	7	1	3	5	1	4	1	1	**7**
DBB	24	1	23	3	4	10	14	1	6	9	1	6	2	3	**24**
DB	24	1	22	3	4	9	14	1	6	9	1	6	2	3	**23**
CMR	19	1	17	2	4	9	11	1	5	9	1	3	2	3	**19**
Sub Total (References)	**25**	**1**	**23**	**3**	**4**	**10**	**14**	**1**	**6**	**10**	**1**	**6**	**2**	**3**	

Figure 6: Amount of Evidence Criteria vs PDS.

The studies analyzed also reveal a stronger emphasis on cost (25 references), time (23 references), and quality (14 references) as primary evaluation criteria, particularly in DBB and DB models. Conversely, criteria such as collaborative processes (10 references), project

regularity (10 references), and relations and risks (4 references) appear less frequently, even though they are key aspects in modern PDS. Additionally, prefabrication processes (1 reference) and owner preferences (3 references) remain underexplored, reinforcing the gap in evaluating PDS aligned with industrialized and client-driven construction.

These findings indicate an imbalance in the literature, where cost and scheduling efficiency dominate PDS assessments over collaboration and adaptability. Figure 6 highlights this discrepancy, suggesting the need for future studies to explore underrepresented criteria in modern project delivery models.

Figure 7 presents 29 critical factors grouped into five key criteria: Cost, Time, Communication, Quality, and Change, evaluating the performance of IPD, DB, DBB, and CM project delivery systems (PDS). Each factor is analyzed from two perspectives: statistical evidence (Good, Average, Poor, or No Difference) and perception of impact (Major or Minor Impact). The distinction between these perspectives allows for a more comprehensive assessment of PDS performance by integrating both quantitative validation and qualitative industry insights.

		Statistical Evidence				Perception	
CRITERION	FACTORS	GOOD	MEDIUM	BAD	NO EVIDENCE OF DIFFERENCE	Greater Impact	Lesser Impact
Costs	Minimize total costs				X	DB	CM
	Accurate cost estimation				X	DB	DBB
	Minimize unit cost	DB	CM	DBB	IPD	DB	DBB
	Reduce punch list costs	IPD	DBB/DB/CM			IPD	DBB
	Facilitate early cost estimation				X	DB	DBB/CM
	Early consideration of transportation costs				X	IPD	DB
	Cost certainty	IPD	DBB/DB/CM			DB	DBB
	Control cost growth	IPD/DB	CM	DBB		DB	DBB
	Cash flow control systems				X	DB	DBB
TIme	Minimize total project duration	IPD	DB	DBB/CM		IPD	DBB
	Optimize RFI processing time	IPD	DB/CM	DBB		IPD	DBB
	Minimize construction time				X	CM	DBB
	Reduce time lost due to accidents				X		
	Optimize change order processing time	IPD	DBB/DB/CM			IPD	DBB
	Avoid schedule extensions	IPD	DB/CM	DBB		IPD	DBB
Communication	Minimize the number of RFIs	IPD	DB/CM	DBB			
	Efficient management of information requests	IPD	DB/CM	DBB		DB	DBB
	Control the number of document resubmissions	IPD	DB/CM	DBB		IPD	CM
Quality	Reduction of construction waste	IPD	DBB/DB/CM			IPD	DBB
	Control construction impacts on adjacent facilities				X	IPD	DBB
	Ensure asset maintainability				X	IPD	DBB
	Ensure overall project quality	IPD	DB	DBB	CM	IPD	DBB
	Prevent deficiency issues	IPD	DB/CM	DBB			
	Minimize rework				X		
	Control punch list items	IPD	DB	DBB/CM		IPD	DBB
Changes	Monitor project percentage changes	IPD	DB/CM	DBB		DB	DBB/CM
	Manage regulatory changes	IPD	DBB/DB/CM			DBB	DB
	Manage design-related changes	IPD/DB		DBB/CM		DB	DBB
	Manage quality/value-related changes	IPD/DB		DBB/CM		DB	DBB

Figure 7. Comparative analysis of statistical evidence and perception on the performance of factor per PDS.

Statistical evidence is based on peer-reviewed studies that analyze PDS performance using real-world project data. These studies validate differences among PDS models through statistical methods, ensuring that classifications are derived from objective findings rather than subjective interpretation. Factors categorized as "Good," "Average," or "Poor" indicate a statistically validated difference, while "No Difference" reflects cases where no significant variation was identified. In contrast, perception of impact is derived from qualitative sources, such as surveys and expert opinions, which provide insights based on stakeholder experiences rather than statistical validation.

IPD outperforms all the evaluated PDS models. Figure 7 reveals that the assessment of different PDS models is clustered around similar evaluation factors, with IPD exhibiting the strongest statistical evidence and the highest perceived impact. Regarding cost and time,

analysis identifies validated advantages of IPD in factors related to project efficiency. Quality also demonstrates a strong association with IPD, particularly in areas such as waste reduction, issue resolution, and quality consistency. Finally, communication and change criteria align most with IPD, as all their factors show statistically significant performance advantages. This suggests that IPD facilitates better information management and reduces variability in project execution.

DISCUSSION

This study aims to evaluate the impact of selecting the PDS type on the value generation. The work relies upon analyzing the literature about selecting PDS models and contractual factors to develop a comparative analysis. The results align with previous studies, reinforcing the relationship between collaboration, integration, and project outcomes (El Asmar et al., 2013; Howell, 1999).

DIFFERENCES IN PERFORMANCE AMONG THE PDS

The difference in performance between PDSs may be explained by the different collaboration and integration levels that each PDS involves. The results indicate that IPD outperforms other PDS in all five analyzed factors (cost, time, quality, change, and communication), consistent with findings from the literature (El Asmar et al., 2013; Azhar, 2014). However, Figure 7 indicates that, in terms of perception, DB has a stronger impact on Cost and Change compared to IPD. Other PDS exhibit medium and low performance levels.

IPD outperforms other PDS, plausibly driven by a better level of collaboration and integration. IPD is a model characterized by emphasizing early stakeholder involvement and intensive use of IT to facilitate collaboration (El Asmar, 2013). In this regard, the observed performance may be explained by a better overall integration between the components of PDS. This condition may be related to better communication and adaptability. In turn, this may explain the presence of superior outcomes related to aspects such as cost, time, quality, and changes. However, the stronger perceived impact of DB on Cost and Change suggests that, in certain contexts, DB may be preferred when budget control and adaptability are prioritized over full integration.

The DB, CMR, and DBB models exhibit integration characteristics but do not reach the IPD performance levels. These models are useful in projects where cost and time control is a priority, but high interaction between the parties is not required (Konchar & Sanvido, 1998). The analysis reveals that the DB, CM, and DBB models emphasize the same factors as the IPD model. However, unlike the IPD model, they exhibit medium and low levels of relationship. A plausible explanation may be the presence of weaker levels of integration. Nonetheless, the results in Figure 7 suggest that these models, particularly DB, may offer advantages in specific criteria such as cost and change.

CONTRACTUAL FACTORS AND PDS SELECTION

Key contractual factors such as collaboration, cost, quality, communication, flexibility, and timing influence PDS selection. These factors do not operate independently but rather maintain significant interdependence, where improvements in one aspect can enhance the performance of others. For example, effective communication promotes collaboration between parties, while greater contractual flexibility facilitates adaptation to unforeseen changes, reducing the need for rework and conflict (Assaf et al., 2023; Ballard, 2000). This interconnectedness suggests that a holistic assessment of contractual factors is essential when selecting a PDS, as neglecting one of these elements could negatively affect project efficiency and outcomes. Therefore, a

holistic analysis of these factors, as proposed in this study, is key to effective contract management and informed decision-making.

Analysis of the relationship between PDS and contractual factors evidences significant differences in collaboration and flexibility. Previous studies have highlighted that IPD enables early stakeholder integration and transparency in decision-making, while traditional models such as DBB tend to employ more rigid sequential approaches, limiting collaboration and adaptability (El Asmar et al., 2013; Howell, 1999). This disparity explains why, in highly complex projects, IPD is preferred, as it facilitates joint participation from the early stages, which allows for generating collaborative solutions, maximizing value and reducing waste. However, as indicated in Figure 7, DB has a higher perceived impact on Cost and Change, which suggests that stakeholder perception may play a role in PDS selection beyond statistical performance alone.

The relationship between contractual factors and PDS has practical implications for contractual decision-making. Previous studies highlight that, in projects with high uncertainty or technological innovation, flexibility and collaboration become essential, favoring systems such as IPD and, to a lesser extent, CM, because of their capacity for integration and joint decision-making (Koskela, 1992; Howell et al., 2011). However, DB may be perceived as a more suitable alternative in projects with strong cost constraints or frequent changes due to its perceived efficiency in those aspects.

IMPACT OF PDS SELECTION ON VALUE

The selection of a PDS influences value generation. This work considers that value can be understood as an outcome of the relationship between the client's needs and the deployed PDS. Where a better level of integration between PDS components drives the emergence of a better collaboration level. Finally, better levels of integration and collaboration may generate conditions for a better performance level, as follows:

The level of generated value results from the fit between the client's needs and the deployed PDS. As stated earlier, this article understands PDS as a business model that intertwines and transforms resources to generate value for clients and stakeholders (Magretta 2002). Thus, the needs express the requirements set by the client, whereas the PDS expresses an alternative available to provide these needs. In this context, a better PDS may generate a better response to the requirements.

A better level of integration favors the emergence of better levels of collaboration. According to the literature, IPD excels in this dimension because of its focus on integration and collaboration, which allows teams to anticipate problems and resolve them before they affect project flow (Ballard, 2000; Koskela, 1992). In that sense, the analysis suggests that IPD exhibits the best relationship with contractual factors. Then, DB, CM, and DBB (in that order) also exhibit a relationship with contractual factors but with lower intensity. However, although these models generate collaboration, they lack the full and explicit integration that IPD offers with all contractual factors. This condition would explain their lower performance in comparison to IPD.

Better integration and collaboration generate conditions for better performance. The contractual factors are directly related to the reduction of the seven types of waste identified by Koskela (1992). The findings suggest that IPD is the model that is best associated with all five key factors: cost, schedule, quality, change, and communication. In contrast, the DBB model presents the greatest challenges in waste elimination. Its sequential approach creates bottlenecks during the transition between the design, bidding, and construction phases (El Asmar et al., 2013). These bottlenecks lead to non-productive activities, such as task reprocessing or duplication of efforts, especially when contractors are not actively involved in the design process.

CONCLUSIONS AND PERSPECTIVES

This study examines the impact of PDS selection on the generation of value. The evaluated data suggest that IPD performs best among the studied PDS. The findings revealed that despite being the least studied, IPD exhibits the best results in terms of statistical evidence and perceived impact. In parallel, the evaluation also found that, despite the type of PDS, their analysis emphasizes using five criteria, i.e., cost, time, quality, communication, and change.

This study contributes to the theoretical framework by studying how contractual factors (cost, time, quality, communication, and change) influence PDS performance and, hence, value generation. It highlights the need to explore collaborative models like IPD and their alignment with Lean Construction principles, serving as a foundation for future empirical research.

The findings offer practical guidance for decision-makers in selecting PDS. The PDS-Factors matrix deepens the understanding of how each system addresses project needs, providing a practical tool for identifying the delivery system best aligned with cost, schedule, quality, sustainability, and flexibility objectives. Moreover, it reinforces the importance of collaboration and contractual flexibility as essential elements for value generation and waste reduction.

This study focuses on four PDS models (IPD, DB, DBB, and CM) due to the limited literature exploring other models in detail. While addressing key factors like sustainability, it does not cover emerging aspects such as digitalization, which could further enhance the analysis and expand PDS applications.

Unlike other selection models in the literature, which often focus on theoretical methods like AHP or Fuzzy TOPSIS and overlook factors like sustainability, this study integrates a practical approach using a matrix that links key factors with PDS. This tool aligns contractual decisions with sustainability and collaboration principles, offering an advantage over traditional models limited to specific contexts or abstract metrics.

This study opens new research directions, such as the empirical validation of the relationship between contractual factors, PDS, and value generation; the dynamic analysis of these factors throughout the project lifecycle; the integration of sustainability into the matrix; and the exploration of predictive models for selecting the most suitable PDS. These avenues can further strengthen understanding of the interaction between contractual factors, PDS, and Lean Construction, contributing to more efficient project decisions.

DECLARATION OF GENERATIVE AI AND AI-ASSISTED TECHNOLOGIES

While writing this work, the authors used ChatGPT to improve the draft's style. After using this tool/service, the authors reviewed and edited the content as needed and took full responsibility for the publication's content.

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