Interdependence between Factors Influencing the Selection of Project Delivery Systems and Modular Construction

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ABSTRACT

The construction sector is going through a period of learning caused partly by the resurgence of prefabricated construction, particularly modular construction. In addition, this is due to the emergence of collaborative project delivery systems, such as Progressive Design-Build (PDB) and Integrated Project Delivery (IPD). Numerous studies indicate that these innovations can play a key role in addressing the challenges of the sector and improving project performance. However, the lack of knowledge and skills required hinders their adoption in construction projects. As a result, public owners find themselves in a situation of ambiguity in choosing the construction methods and contractual modes appropriate for their projects. The objective of this research is to identify, verify and evaluate the decision-making factors for the joint choice of the construction method and the delivery mode appropriate for the context of the construction project and aligned with the expectations of public owners. We aim to examine the interdependence between factors influencing the selection of modular construction and those associated with collaborative contractual modes, highlighting common factors as well as criteria specific to each approach. To do this, a systematic literature review is conducted. A list of 28 factors is identified. These factors are divided into five categories: Project characteristics, Owner characteristics, Owner's requirements, Owner's preferences, and External factors. The use of selection factors has the potential to make decisions more objective and to support project owners in managing their uncertainties. However, it is crucial to prioritise these factors according to their importance and to their impact on project performance. This topic will be the subject of future research.

KEYWORDS

Modular construction (MC); Project delivery system; Integrated Project Delivery (IPD); Progressive Design-Build (PDB); Selection factors

INTRODUCTION

The construction industry faces several challenges that are holding back its progress. Studies highlight the potential of prefabricated construction, particularly modular construction (MC), to address some of these challenges, including low productivity and cost and time overruns in construction projects (Bertram et al., 2019; Jang & Lee, 2018). In addition, the construction sector is characterized by a traditional economic model where each project is unique and carried out by a temporary team. This leads to a significant fragmentation between its different parts. Therefore, to address these weaknesses, some researchers suggest adopting the most recent collaborative delivery methods, such as progressive design-build (PDB) and integrated project delivery (IPD) (Jobidon et al., 2019; Rankohi et al., 2023). Although modular construction and collaborative delivery systems have many advantages, they face challenges and barriers that hinder their selection in construction projects, including lack of knowledge and skills.

Many studies have been conducted to identify and classify the factors specific to the selection of the construction method, emphasizing the importance of modular construction particular. Other researchers are interested in the factors that influence the selection of a project delivery systems, highlighting their differences and advantages. However, the number of studies that address both the selection factors of the construction method and the delivery system is rather limited. This study aims to fill the aforementioned gaps. Our objective is to identify and evaluate the factors that allow the selection of both the construction method and the delivery system appropriate to the project contexts and the owner's expectations. A systematic literature review is conducted to identify the distinctive factors influencing the selection of MC and collaborative delivery systems (PDB or IPD). Following this, a theoretical analysis is conducted to examine these factors, to assess their consistency, and to justify the interdependence and mutual influence between MC and collaborative PDS.

METHODOLOGY

A systematic literature review (SLR) is adopted as a research methodology. As stated in the introduction, our study focuses on two distinct themes: construction methods and project delivery systems. After identifying the keywords and their synonyms, we established two search equations, one for each theme.

> **Eq 1:** (Criteria* OR factor* OR parameter* OR variable*) AND (Choice* OR selection* OR adoption* OR decision*) AND (prefabrication* OR "off-site construction" OR "modular construction")
>
> **Eq 2:** (Criteria* OR factor* OR parameter* OR variable*) AND (Choice* OR selection* OR adoption* OR decision*) AND ("Project delivery method " OR "project delivery methods" OR "project delivery system" OR "project delivery systems" OR "collaborative contract " OR "collaborative contracts")

In our research, we consulted three databases: Scopus, Engineering Village, and ScienceDirect.

The search terms, represented by the equations, must be present in the title or abstract of the articles to be considered. In addition, the search is limited to journal and conference articles published in English between 2005 and 2025. The detected articles were exported then to Zotero to eliminate duplicates. Subsequently, we reviewed the titles and abstracts of the remaining documents to verify their relevance, excluding studies unrelated to construction or using MC or PDS only as examples. After full evaluation, 25 articles were retained for MC and 19 articles for PDS, and two studies were detected in the results of both equations. Both studies (Agapiou, 2020 and Assaf et al., 2023) examined the factors of selecting the appropriate PDS for modular construction.

RESULTS

Using the SLR, we identified 19 lists of selection factors, distributed as follows: 6 for MC, 11 for PDS and 2 for selecting the PDS appropriate for MC (Table 1). Most studies on PDS factors mainly focus on DBB, DB, EPC, and CM at-risk (CMAR), with limited number of research on PDB and IPD, which represents a limitation to our study. Analyzing the factors from these lists allowed us to create a new list composed of 28 factors across five categories: Project characteristics, Owner

Table 1. List of CM and PDS selection factors.

			References																		
			MC						PDS for MC		PDS										
Cat.	**Id**	**Factors**	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Project characteristics	1.1	Project size and scale			x	x	x	x	x		x		x	x			x		x	x	
	1.2	Project scope	x				x			x	x		x	x		x	x	x	x		
	1.3	Project type						x		x			x	x					x		
	1.4	Complexity	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	
	1.5	Repetitivity	x	x	x	x	x	x	x												
	1.6	Project site	x	x	x	x	x	x	x	x						x	x	x	x	x	
Owner charact.	2.1	Experience	x		x		x		x	x	x	x		x			x			x	
	2.2	Ability								x		x		x			x		x	x	
Owner's requirements	3.1	Budget						x	x				x	x		x	x	x			
	3.2	Cost	x	x	x	x	x	x	x	x	x		x			x		x	x		
	3.3	Schedule	x	x	x	x	x		x	x	x		x	x		x	x	x	x	x	
	3.4	Quality			x	x		x	x	x		x		x			x				
	3.5	Sustainability	x	x	x	x		x	x	x									x		
	3.6	Safety	x	x	x	x	x	x									x		x		
Owner's preferences	4.1	Control	x	x	x		x	x		x	x	x	x	x		x	x	x	x	x	
	4.2	Flexibility	x	x	x	x	x	x	x	x			x	x		x	x	x	x		
	4.3	Stakeholders				x			x	x						x		x			
	4.4	Integration																			x
	4.5	Collaboration	x	x	x		x	x	x	x			x	x					x	x	
	4.6	Confidentiality										x	x			x	x	x	x		
	4.7	Responsability	x						x	x		x		x			x		x		
	4.8	Risk management	x					x	x	x	x	x		x			x		x	x	
External factors	5.1	Competitiveness level	x		x			x	x	x			x	x	x		x		x		
	5.2	Weather conditions	x	x	x		x	x	x						x				x		
	5.3	Resources	x	x	x	x	x	x	x	x		x		x	x	x	x	x	x		
	5.4	Use of technology	x		x		x							x	x						x
	5.5	Project financing	x		x	x	x		x	x	x	x				x	x	x	x	x	
	5.6	Legal and regulatory	x	x	x	x		x	x					x	x		x		x	x	

1:(Azhar et al., 2013); 2:(Sharafi et al., 2018); 3:(Abdul Nabi et al., 2020); 4: (Mehdipoor et al., 2023); 5: (Sing et al., 2023); 6:(Pouraghajan et al., 2024); 7:(Agapiou, 2020); 8:(Assaf et al., 2023); 9:(Li et al., 2015); 10:(B. Liu et al., 2015); 11:(B. Liu et al., 2016); 12:(B. Liu et al., 2017); 13:(Y. Liu et al., 2019) ; 14:(Zhu et al., 2020); 15:(Nouh Meshref et al., 2021); 16:(Alameri et al., 2022); 17:(Zhong et al., 2023); 18:(Chen et al., 2024); 19:(O'Dwyer et al., 2024) characteristics, Owner's requirements, Owner's preferences and External factors. The following section tackles each factor and its compatibility with MC, PDB, and IPD.

ANALYSIS

Project characteristics

Project size and scale. Some research shows that project size influences the selection of MC and PDS (Agapiou, 2020; Sing et al., 2023; Zhong et al., 2023). Project size can be measured by budget, cost per square meter ($/m²) (Nouh Meshref et al., 2021; Pouraghajan et al., 2024), area of floors and area of identical floors, which also indicate repetitiveness, a crucial factor for MC success (Kasbar et al., 2021). Li et al. (2015) emphasized that the DBB delivery system is more often used in small projects. In addition, project scale affects delivery system choice (B. Liu et al., 2016, 2017), as large projects require more resources, stakeholders, and management than traditional methods like DBB can handle (Zhong et al., 2023).

Project scope. In the retained list, only Sing et al. (2023) identified project scope as a factor in MC selection, citing Azhar et al. (2013). This occurrence perhaps shows its low importance for MC selection. However, project scope is mentioned as critical factor for selecting PDS (B. Liu et al., 2016; Zhong et al., 2023). In fact, the clarity and flexibility of scope influence this choice (Li et al., 2015; B. Liu et al., 2017; Nouh Meshref et al., 2021). Alameri, R. et al. (2022) emphasized that, in PDB mode, owners can adjust scope while maintaining budget limits.

Project type. Project type significantly influences the choice of construction method and delivery mode. Bertram et al. (2019) highlighted modular construction's suitability for institutional (hospitals, prisons, schools) and residential (single or multi-family, student housing) projects. Delivery system selection depends on project type and its complexity (B. Liu et al., 2016, 2017).

Complexity. Project complexity is a critical factor to consider when selecting construction methods and delivery systems (Agapiou, 2020; Chen et al., 2024; B. Liu et al., 2016; Pouraghajan et al., 2024). Complexity may arise in design (Mehdipoor et al., 2023; Sharafi et al., 2018; Sing et al., 2023) and/or execution (Zhong et al., 2023; Zhu et al., 2020). It can include innovations or unique specifications, making the project non-standard (Alameri et al., 2022; B. Liu et al., 2016; Zhu et al., 2020). Assaf et al. (2023) noted that complexity also affects decision-making, especially with limited information. Sharafi's team (2018) found modular construction unsuitable for highly complex projects. Alameri et al. (2022) highlighted complexity as a key criterion to choose PDB. Walker et al. (2019) added that stakeholder collaboration in IPD helps to effectively manage project complexity.

Repetitivity. Repetitivity is a specific factor for selecting MC. It measures the proportion of identical rooms' area to the total area. Repetitivity affects design, manufacturing, and implementation of the modules, allowing for standardization (Pouraghajan et al., 2024; Sharafi et al., 2018; Sing et al., 2023). High repetitiveness enhances modular construction success by improving cost, time, and productivity (Bertram et al., 2019; Kasbar et al., 2021).

Project site. The project site refers to several aspects, including the topography, equipment accessibility and logistics and storage space availability (Azhar et al., 2013). For modular construction, proximity to manufacturing plants is crucial for cost-effective and timely delivery of prefabricated components (Azhar et al., 2013; Mehdipoor et al., 2023; Sing et al., 2023). Site conditions may influence also PDS choice, requiring early stakeholders' involvement to address its challenges (Chen et al., 2024; Nouh Meshref et al., 2021; Zhu et al., 2020). Alameri et al. (2022) highlighted PDB as suitable for sites with unfavorable conditions.

Owner characteristics

Owner's experience. An owner's willingness to adopt new construction methods or delivery systems is valuable with condition of aligning with their capabilities. Experience in MC, PDB and IPD is a key factor in their selection. Owners familiar with prefabrication understand better the design and execution processes which improves project outcomes (Abdul Nabi et al., 2020; Sing et al., 2023). Similarly, experience with a delivery system on similar projects enhances management skills and resources (Li et al., 2015; B. Liu et al., 2015, 2017; Nouh Meshref et al., 2021).

Owner's ability. Owner capacity is more frequently discussed in PDS selection literature than in modular construction. Researchers highlighted that the owner's ability to manage projects with a given PDS, demonstrated by sufficient and adequate management staff throughout the project lifecycle (Assaf et al., 2023; Chen et al., 2024; B. Liu et al., 2015).

Owner's requirement

Owner's requirement for budget. The budget is the total amount an owner allocates for a project. Completing the project within budget is a key factor in PDS selection (B. Liu et al., 2016; Zhu et al., 2020). In fact, limiting the budget requires a PDS that ensures effective management and avoids the risk of overruns. Alameri's team (2022) suggested PDB ensures budget compliance, while Jobidon et al. (2019) cited that IPD also meets budget requirements.

Owner's requirement for cost. Some owners aim to optimize project costs. To do so, it is necessary to reduce various project costs such as design, execution, resources, conflict management, waste and transactions costs. PDS selection depends on the owner's cost certainty (Agapiou, 2020; Assaf et al., 2023; B. Liu et al., 2016). In DBB, owners evaluate costs at contract award and control overruns during execution. In contrast, in PDB, costs are determined collaboratively with the design-builder (Adamtey, 2021). Also, collaborative contracts reduce transaction costs like information search, negotiations, and litigation (Wu et al., 2022). Modular construction can save up to 20% of project costs (Bertram et al., 2019). While design costs may be higher due to inexperience, manufacturing and implementation are cheaper due to less waste, lower labor costs, and minimal rework (Jang & Lee, 2018).

Owner's requirement for schedule. Most researchers agree that meeting the owner's deadline and accelerating the schedule are critical factors in project delivery (Alameri et al., 2022; Azhar et al., 2013; B. Liu et al., 2017; Sing et al., 2023; Zhu et al., 2020). Modular construction reduces project time by allowing simultaneous foundation work on-site and module manufacturing off-site (Abdul Nabi et al., 2020; Assaf et al., 2023). Bertram's team (2019) explained that MC can reduce the schedule by 20 to 50% due to faster manufacturing process and simplified on-site assembly. Kasbar et al. (2021) highlighted that repeated assembly tasks enhance productivity and reduce lead time. DBB's sequential process is unsuitable for tight schedules (Chen et al., 2024). PDB shortens timelines by combining design and construction phases through a designer-builder approach, which decreases conflicts and resolves issues early (Adamtey, 2021). IPD exceeds timeline expectations by enabling early problem-solving and leveraging stakeholder expertise for quick solutions (Rankohi et al., 2024; Walker & Matinheikki, 2019).

Owner's requirement for quality. The quality requirement influences the selection of MC (Abdul Nabi et al., 2020; Mehdipoor et al., 2023; Pouraghajan et al., 2024). Indeed, it offers higher quality by minimizing errors through a high level of controlled factory manufacturing (De Laubier et al., 2019; Kasbar et al., 2021). The "design for manufacturing and assembly" (DfMA) process further enhances quality (Mehdipoor et al., 2023) by designing optimal details that minimize risks and simplify assembly. Liu's team (2017) found that quality is less important than cost and schedule in PDS selection. Whereas, Jobidon et al. (2019) cited that projects carried out in IPD mode have a higher quality performance than non-IPD ones.

Owner's requirement for sustainability. Modular construction is a sustainable alternative, shifting much of the work from the site to the factory, reducing on-site pollution and improving material management, which minimizes waste and allows for material reuse (Abdul Nabi et al., 2020; Azhar et al., 2013; Sharafi et al., 2018). MC also uses reusable materials and allows modules to be relocated or reused (Azhar et al., 2013; Sharafi et al., 2018). Additionally, it reduces material and worker movement on-site which reduces the carbon footprint.

Owner's requirement for safety. Owner safety requirements favor the selection of modular construction, which reduces on-site trades number and minimizes disruptions and hazards (Abdul Nabi et al., 2020; Azhar et al., 2013; Sharafi et al., 2018). MC offers a safer, climate-protected, and stable work environment (De Laubier et al., 2019). However, Zhong’s team (Zhong et al., 2023) found that safety is rarely considered in project delivery system selection.

Owner's preferences

Owner's preferences for control. Owner involvement in project control can cover costs, schedules and quality during its different phases (Assaf et al., 2023; Li et al., 2015; Sharafi et al., 2018; Zhong et al., 2023). MC meets owners’ preferences seeking high control. It offers supervision processes and quality checks during manufacturing and easier monitoring of costs and deadlines (Abdul Nabi et al., 2020; Azhar et al., 2013; Pouraghajan et al., 2024; Sharafi et al., 2018). Alameri et al. (2022) emphasized that PDB provides higher owner control than DBB.

Owner's preferences for flexibility. Flexibility provides the ability to make changes of the design during project execution (Assaf et al., 2023; B. Liu et al., 2016, 2017; Nouh Meshref et al., 2021). IPD offers a high level of flexibility and easy adaptation to any changes (Jobidon et al., 2019). PDB minimizes changes by involving the builder earlier, allowing design adjustments during the design phase (Alameri et al., 2022). For modular construction, flexibility is limited, as design changes during execution are complex, which pushes owners to finalize designs before manufacturing (Abdul Nabi et al., 2020; Pouraghajan et al., 2024).

Owner's preferences for stakeholders. Some owners prefer to limit the number of stakeholders (Alameri et al., 2022; Zhu et al., 2020). This leads them to minimize tenders and to select qualified stakeholders to ensure project success (Assaf et al., 2023). PDB addresses this by entrusting the design and build to a single organization (Adamtey, 2021). IPD also decreases tenders by firstly selecting qualified and collaborative stakeholders, then renegotiating fees.

Owner's preferences for integration. The owner's preference for integration between entities influences the delivery method choice. Integration reflects how organizations align informationally, operationally, and relationally (O'Dwyer et al., 2024). IPD is the best method for high integration across vertical, horizontal, and longitudinal levels (Rankohi et al., 2024).

Owner's preferences for collaboration. MC improves collaboration and coordination by allowing various trades to be performed in a controlled factory environment (Abdul Nabi et al., 2020; Azhar et al., 2013; Sharafi et al., 2018). In contrast, DBB is characterized by low collaboration and high conflict due to competition and multiple subcontractors on-site (Chen et al., 2024; B. Liu et al., 2016, 2017). PDB fosters owner-design-builder collaboration for scope, design, cost, and scheduling (Circo, 2014). IPD offers the highest collaboration level, ensuring continuous coordination throughout the project (Jobidon et al., 2019).

Owner's preferences for confidentiality. When confidentiality is crucial, selecting the delivery mode is critical. It is important to limit the number of stakeholders based on the owner's trust in them (B. Liu et al., 2015; Zhong et al., 2023). PDB, with a single contractor for design and construction, offers the highest levels of confidentiality (Alameri et al., 2022). IPD fosters trust among stakeholders which promotes confidential information sharing (Jobidon et al., 2019).

Owner's preferences for responsibility. Responsibility allocation is crucial in choosing a PDS (Assaf et al., 2023; B. Liu et al., 2015, 2017; Nouh Meshref et al., 2021). In the DBB, according to the contract terms, the contractor assumes responsibilities for execution, while the designers are responsible for the design. PDB assigns total responsibility to the designer-builder, while IPD shares responsibilities among all stakeholders (Jobidon et al., 2019).

Owner's preferences for risk management. Risk distribution is an important factor in selecting PDS (Chen et al., 2024; Nouh Meshref et al., 2021; Zhong et al., 2023). Each method offers a different risk distribution approach (B. Liu et al., 2017). IPD equitably distributes risks and benefits among stakeholders (Jobidon et al., 2019) and helps contractors manage modular construction risks better than DBB and DB contracts (Abdul Nabi et al., 2024). DBB distributes risks per contract clauses. Adamtey's team (2021) emphasized that the PDB distributes risks fairly.

External factors

Competitiveness level. The level of competitiveness reflects the number of qualified contractors available for a project. This factor influences the choice of PDS (B. Liu et al., 2017; Y. Liu et al., 2019; Nouh Meshref et al., 2021). Liu et al. (2019) highlighted its importance, explaining that, in DBB, DB, or EPC, more qualified contractors lead to more optimistic bids. The widespread use of DBB leads to entrepreneurs becoming familiar with the process, which increases competition and reduces bids. However, a lack of expertise can reduce competitiveness (Zhong et al., 2023). So, contractor's qualifications in modular construction (Pouraghajan et al., 2024) and/or PDS (Zhong et al., 2023) affect competitiveness. Although, Jobidon et al. (2019) emphasized that IPD's competitive advantage is a factor in its selection. For MC, competitiveness depends on the experience of the general contractor, the availability of manufacturing plants and their competition (Abdul Nabi et al., 2020).

Weather conditions. Weather is one of the determining factors in choosing MC (Azhar et al., 2013; Sing et al., 2023). Harsh climates can disrupt traditional construction, delaying projects and increasing costs (Y. Liu et al., 2019). MC allows most work to be done in a controlled and weather-protected factory environment while reducing on-site work duration and enabling construction during adverse weather. Climatic conditions also influence the choice of the project delivery system, especially in disaster-prone areas requiring experienced stakeholders for effective solutions (Zhong et al., 2023).

Resources. The choice of MC and PDS depends on resource availability and qualifications (Agapiou, 2020; Nouh Meshref et al., 2021; Zhong et al., 2023). MC attracts labor by offering stable, secure, and cost-effective factory conditions (De Laubier et al., 2019). Material availability, cost, and early access are important elements (Abdul Nabi et al., 2020; B. Liu et al., 2017; Y. Liu et al., 2019; Pouraghajan et al., 2024). Equipment needs are minimal, mainly for handling and lifting, but transport availability for prefabricated modules must be considered (Azhar et al., 2013; Sing et al., 2023). Contract choice depends on the availability and expertise of professionals and companies, with success more likely when stakeholders are familiar with the contract type.

Use of technology. The use of advanced technologies, especially BIM, is another selection factor (Azhar et al., 2013; O'Dwyer et al., 2024; Sing et al., 2023). BIM enhances modular construction by simulating the manufacturing and the assembly of components and by ensuring coordination between disciplines. It helps in detecting conflicts earlier, optimizing production, and improving on-site assembly efficiency (Jang & Lee, 2018). BIM's information management capabilities also support PDS selection by optimizing IPD benefits and ensuring its success (Circo, 2014).

Project financing. The project's financing type and the owner's financial capacity influence the selection of the PDS (B. Liu et al., 2015; Nouh Meshref et al., 2021; Zhong et al., 2023). The owner's preferred payment method is also a key factor (Agapiou, 2020; Assaf et al., 2023).

Legal and regulatory. This factor influences the choice of construction method and PDS (Abdul Nabi et al., 2020; Chen et al., 2024; Y. Liu et al., 2019). The existence of standards clarifying the MC process encourages its adoption (Azhar et al., 2013; Mehdipoor et al., 2023; Sharafi et al., 2018). Government policies and local rules further impact the PDS choice (B. Liu et al., 2017; Y. Liu et al., 2019; Zhong et al., 2023).

Summary

Using RSL, we identified 28 factors influencing construction method and PDS selection, divided into five categories. The theoretical analysis assessed each factor's importance in choosing MC, PDB, or IPD. Common factors are listed below: project size and scale, Project type, Complexity, Project site, Owner's experience, Owner's requirement for budget, cost, schedule, quality, sustainability, safety, competitiveness level, use of technology, project financing and, legal and regularity. In addition, we identified factors that have a particularly significant impact on the choice of modular construction (MC), including repetitive, weather conditions, and resources. Whereas, the factors that influence the choice of PDS more than the construction method are:

project scope, owner's ability, flexibility, stakeholders, collaboration, confidentiality, responsibility and risk management.

CONCLUSION

The objective of this study was to identify the factors that help owners choose the appropriate construction method and PDS based on project context and expectations. Through a systematic literature review, we defined 28 factors classified in five categories: project characteristics, owner characteristics, owner's requirements, owner's preferences, and external factors. We classified these factors into three types: common factors, those favoring construction method selection, and those favoring PDS selection. A limitation of this study is the small number of articles on PDB and IPD selection factors. These factors guide decision-making, reduce uncertainty, and improve project management. Prioritizing them for project success will be explored in future research.

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REFERENCES

Abdul Nabi, al., & El-adaway, I. H. (2024). Studying contribution of associated stakeholders in risk control of modularized construction under different project delivery methods: A graph-restricted cooperative games approach. *Computing in Civil Engineering 2023*, 221–230. https://doi.org/10.1061/9780784485231.027

Abdul Nabi, M., al., & El-adaway, I. H. (2020). Modular construction: Determining decision-making factors and future research needs. *Journal of Management in Engineering*, 04020085, p. 21. https://doi.org/10.1061/(ASCE)ME.1943-5479.0000859

Adamtey, S. (2021). Cost and time performance analysis of progressive design-build projects. *Journal of Engineering, Design and Technology*, *19*(3), 686–697. https://doi.org/10.1108/JEDT-05-2020-0164

Agapiou, A. (2020). Factors influencing the selection of a procurement route for UK off-site housebuilding. *Proceedings of Institution of Civil Engineers: Management, Procurement and Law*, *175*(1), 3–15. Scopus. https://doi.org/10.1680/jmapl.20.00027

Alameri, R., al., & Esmaeili, B. (2022). Selection factors for progressive design-build delivery method. *Construction Research Congress 2022: Project Management and Delivery, Controls, and Design and Materials, CRC 2022*, 244–253. https://doi.org/10.1061/9780784483978.026

Assaf, M., Hussein, M., Abdelkhalek, S., & Zayed, T. (2023). A multi-criteria decision-making model for selecting the best project delivery systems for offsite construction projects. *Buildings*, *13*(2). Scopus. https://doi.org/10.3390/buildings13020571

Azhar, S., Lukkad, M. Y., & Ahmad, I. (2013). An investigation of critical factors and constraints for selecting modular construction over conventional stick-built technique. *International Journal of Construction Education and Research*, *9*(3), 203–225. Scopus. https://doi.org/10.1080/15578771.2012.723115

Bertram, N., Fuchs, S., Mischke, J., Palter, R., Strube, G., & Woetzel, J. (2019). Modular construction: From projects to products. *Capital Projects*.

Chen, S., al., & Liu, X. (2024). Key factors affecting project delivery system selection in the Chinese construction industry. *Heliyon*, *10*(21), e39201. https://doi.org/10.1016/j.heliyon.2024.e39201

Circo, C. J. (2014). A case study in collaborative technology and the intentionally relational contract: Building information modeling and construction industry contracts. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.2463467

De Laubier, R., Burfeind, A., Arnold, S., Witthöft, S., & Wunder, M. (2019). The offsite revolution in construction. *Boston Consulting Group*.

Jang, S., & Lee, G. (2018). Process, productivity, and economic analyses of BIM–based multi-trade prefabrication—A case study. *Automation in Construction*, *89*, 86–98. Scopus. https://doi.org/10.1016/j.autcon.2017.12.035

Jobidon, G., Lemieux, P., & Beauregard, R. (2019). Comparison of Quebec's project delivery methods: Relational contract law and differences in contractual language. *Laws*, *8*(2). Scopus. https://doi.org/10.3390/laws8020009

Kasbar, M., Staub-French, S., Pilon, A., Poirier, E., Teshnizi, Z., & Froese, T. (2021). Construction productivity assessment on Brock Commons Tallwood House. *Construction Innovation*, *21*(4), 951–968. https://doi.org/10.1108/CI-11-2019-0118

Li, H., Qin, K., & Li, P. (2015). Selection of project delivery approach with unascertained model. *Kybernetes*, *44*(2), 238–252. https://doi.org/10.1108/K-01-2014-0012

Liu, B., al., Fu, M., Shen, G., Tai, S., & Zhang, S. (2017). Research on factors influencing project delivery system selection for construction projects. *2017 International Conference on Construction and Real Estate Management: Project Management and Construction Technology, ICCREM 2017*, 292–302. https://doi.org/10.1061/9780784481080.033

Liu, B., al., Huo, T., Liang, Y., Sun, Y., & Hu, X. (2016). Key factors of project characteristics affecting project delivery system decision making in the Chinese construction industry: Case study using Chinese data based on rough set theory. *Journal of Professional Issues in Engineering Education and Practice*, *142*(4). https://doi.org/10.1061/(ASCE)EI.1943-5541.0000278

Liu, B., Huo, T., Shen, Q., Yang, Z., Meng, J., & Xue, B. (2015). Which owner characteristics are key factors affecting project delivery system decision making? Empirical analysis based on the rough set theory. *Journal of Management in Engineering*, *31*(4). https://doi.org/10.1061/(ASCE)ME.1943-5479.0000298

Liu, Y., Wu, X., Baumgartner, T., Zimpfer, D., Wedgwood, D., Teff, C., Zhu, J., Jia, Y., Zhao, Y., & Tao, L. (2019). Real-time drilling advisor appstore – An agile development and deployment program. *SPE/IADC International Drilling Conference and Exhibition 2019, DC 2019*. https://doi.org/10.2118/194100-ms

Mehdipoor, A., Iordanova, I., & Al-Hussein, M. (2023). Identification and evaluation of the key decision support factors for selecting Off-site construction in Canada : A Building Information Modeling (BIM)-enabled approach. *Digital Manufacturing Technology*, *3*(2), 137–155. https://doi.org/10.37256/dmt.3220232944

Nouh Meshref, A., Elkasaby, E. A., & Wageh, O. (2021). Identifying innovative reliable criteria governing the selection of infrastructures construction project delivery systems. *Open Engineering*, *11*(1), 269–280. Scopus. https://doi.org/10.1515/eng-2021-0028

O'Dwyer, C., Cormican, K., Sampaio, S., & Mitchell, S. (2024). Analysis of integrated project delivery in the Irish Construction industry. *CENTERIS – International Conference on ENTERprise Information Systems / ProjMAN - International Conference on Project MANagement / HCist - International Conference on Health and Social Care Information Systems and Technologies 2023*, *239*, 2184–2191. https://doi.org/10.1016/j.procs.2024.06.407

Pouraghajan, M., Omrani, S., & Drogemuller, R. (2024). Precast versus in situ concrete: Developing an initial feasibility study for early decision-making in the Australian construction industry. *Journal of Architectural Engineering*, *30*(4). Scopus. https://doi.org/10.1061/JAEIED.AEENG-1668

Rankohi, S., Bourgault, M., & Iordanova, I. (2023). The latest operational, contractual and organizational trends in IPD literature: Review and future directions. *Engineering, Construction and Architectural Management*, *30*(9), 4339–4357. Scopus. https://doi.org/10.1108/ECAM-02-2022-0170

Rankohi, S., Bourgault, M., & Iordanova, I. (2024). The concept of integration in an IPD context: A grounded theory review. *Engineering, Construction and Architectural Management*, *31*(1), 48–72. Scopus. https://doi.org/10.1108/ECAM-01-2022-0009

Sharafi, P., al., Rashidi, M., Samali, B., Ronagh, H., & Mortazavi, M. (2018). Identification of factors and decision analysis of the level of modularization in building construction. *Journal of Architectural Engineering*, *24*(2). https://doi.org/10.1061/(ASCE)AE.1943-5568.0000313

Sing, M., Chan, J., Liu, H., & Ngai, N. N. H. (2023). Developing an analytic hierarchy process-based decision model for modular construction in urban areas. *Journal of Engineering, Design and Technology*, *21*(4), 1212–1229. Scopus. https://doi.org/10.1108/JEDT-05-2021-0242

Walker, D. H., & Matinheikki, J. (2019). IPD from a Lean-supply-chain management perspective. In *Routledge Handbook of Integrated Project Delivery*, 365–392. Routledge.

Wu, H., Qian, Q. K., Straub, A., & Visscher, H. J. (2022). Factors influencing transaction costs of prefabricated housing projects in China : Developers' perspective. *Engineering, Construction and Architectural Management*, *29*(1), 476–501. Scopus. https://doi.org/10.1108/ECAM-07-2020-0506

Zhong, Q., Tang, H., Chen, C., & Igor, M. (2023). A comprehensive appraisal of the factors impacting construction project delivery method selection: A systematic analysis. *Journal of Asian Architecture and Building Engineering*, *22*(2), 802–820. Scopus. https://doi.org/10.1080/13467581.2022.2060983

Zhu, X., Meng, X., & Chen, Y. (2020). A novel decision-making model for selecting a construction project delivery system. *Journal of Civil Engineering and Management*, *26*(7), 635–650. https://doi.org/10.3846/jcem.2020.12915