Challenges in the Execution of Industrial Building System (IBS) Project in Private Sector

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ABSTRACT

The adoption of the Industrialised Building System (IBS) has been widely promoted in Malaysia to enhance construction efficiency, quality, and sustainability. However, despite its recognised benefits, IBS implementation in the private sector continues to face significant challenges. This study aims to identify and rank the key challenges affecting the successful execution of IBS projects in Malaysia's private construction sector from the perspectives of construction professionals. A quantitative research approach was employed, involving the distribution of structured questionnaires to professionals, including engineers, architects, quantity surveyors, site supervisors, and project managers. A total of 100 valid responses were received and considered valid for analysis, representing a response rate of 50%. The findings revealed that cost implications, a lack of skilled labour, and resistance to change were the top three challenges hindering effective IBS adoption in private sector projects. The study points out the need for enhanced stakeholder awareness, better training initiatives, and financial incentives to support the growth of IBS. These insights are valuable for policymakers, contractors, and developers aiming to improve the efficiency and acceptance of IBS in Malaysia's private construction landscape.

Keywords: Industrialised building system (IBS), execution, challenges, private sector

INTRODUCTION

The Industrialised Building System (IBS) has evolved as a revolutionary method in Malaysia's building sector, prioritising the use of prefabricated elements produced off-site for on-site assembly. This technology provides several benefits, such as improved building quality, accelerated project schedules, decreased dependence on manual labour, and a lower environmental impact (CIDB, 2020). The Malaysian government, through the Construction Industry Development Board (CIDB), has actively advocated for the implementation of the Industrialised Building System (IBS) to modernise the construction sector, utilising programmes such as the Construction Industry Transformation Programme (CITP) and the National Construction Policy (NCP) 2021–2025. Notwithstanding these initiatives, the adoption rates of IBS exhibit considerable variation among sectors. In 2021, the implementation of IBS in government projects increased to 84%, up from 79.5% in 2020. Simultaneously, the private sector expanded from 41% in 2020 to 60% in 2021 (Malaysian Investment Development Authority [MIDA], 2022). Although this growth is encouraging, the commercial sector's acceptance rate remains deficient, underscoring ongoing obstacles in IBS implementation.

The constraints encompass substantial initial investment expenditures, insufficient technical skills, inadequate coordination among stakeholders, and opposition to transitioning from traditional construction methods (Thanoon et al., 2021). As the industry advances towards industrialisation and sustainability, comprehending these challenges from the viewpoint of construction professionals is essential. Although numerous studies have investigated the barriers to IBS implementation in Malaysia, most previous studies have focused on general IBS adoption, public sector projects, or contractors' perspectives (Kamar et al., 2014; Nawi et al., 2012; Tarang et al., 2022). Limited empirical evidence specifically examines the execution challenges of IBS within the

Malaysian private construction sector, where project characteristics, investment decisions, procurement practices, and market-driven considerations differ significantly from those of public projects. Furthermore, recent policy initiatives under the National Construction Policy (2021–2025) and the increasing emphasis on Construction 4.0 have transformed the implementation environment, creating a need for updated empirical evidence on the current challenges faced by private sector stakeholders. Therefore, this study aims to identify and rank the current execution challenges affecting IBS implementation in Malaysia's private sector construction projects from the perspectives of construction professionals. The findings contribute to the current body of knowledge by giving updated empirical information on private sector IBS implementation, consequently delivering practical insights for policymakers, developers, contractors, and other industry stakeholders in designing strategies to enhance IBS acceptance.

LITERATURE REVIEW

The Diffusion of Innovation (DOI) Theory proposed by Rogers (2003) provides a useful theoretical foundation for understanding the adoption of Industrialised Building System (IBS) within the construction industry. The theory suggests that the adoption of an innovation is influenced by five key attributes, namely relative advantage, compatibility, complexity, trialability, and observability. These attributes determine how quickly new technologies are accepted and implemented by organisations. In the context of IBS, factors such as high initial investment, resistance to change, lack of technical expertise, and compatibility with existing construction practices directly influence stakeholders' willingness to adopt IBS, particularly within Malaysia's private construction sector. Recent studies emphasize that these systemic constraints act as severe innovation barriers, altering developers' risk perceptions and dragging down the diffusion rate in commercial markets (Hedayati, 2025; Yusof et al., 2024). Therefore, the Diffusion of Innovation Theory provides an appropriate framework for interpreting the challenges associated with IBS implementation.

High upfront investment is one of the most cited barriers to IBS adoption. Establishing prefabrication facilities, purchasing mechanised equipment, adopting digital design tools and training personnel require considerable capital. This is especially burdensome for small and medium developers who dominate Malaysia's private sector (Mydin et al., 2014). Although IBS may offer long-term cost efficiencies, developers often remain unconvinced due to uncertainty in return on investment and the inability to recover costs in small or fragmented projects (Saberi et al., 2022). Consequently, many private developers prefer conventional construction due to lower initial financial commitments.

IBS requires specific expertise in digital modelling, factory production, on-site installation, and modular design. Nonetheless, the majority of Malaysia's construction working force still employs labour-intensive, manual techniques. Insufficient training programs, limited exposure to IBS practices, and poor technical competence all contribute to implementation inefficiencies and defects (Masrom et al., 2025; Nawi et al., 2012). Market acceptance is still a major hurdle. Private developers generally seek flexibility and lower costs, whereas IBS requires early design resolution and limits design changes (CIDB, 2021). Many still believe IBS is rigid, expensive, and unsuitable for customised projects. The lack of strong case studies and notable private-sector successes further reduces investor confidence (Rosli & Ismail, 2022). As a result, voluntary adoption remains low compared to government-mandated projects.

Private sector clients frequently emphasize cost-effectiveness and adaptability, which may clash with the rigid design and systematic characteristics of IBS (Masram et al., 2024). Consequently, this structural rigidity conflicts with the private market's demand for late-stage customizations. Furthermore, numerous developers are unaware of the enduring advantages of IBS, leading to diminished demand. According to CIDB Malaysia (2021), government regulations compel the majority of private developers to implement IBS, with only a minimal proportion adopting it freely. Furthermore, the private sector faces a profound technical knowledge gap; many local contractors and consultants lack specialized modular coordination expertise and resist transitioning from familiar conventional practices (Abdul Khalil et al., 2016). Ultimately, private developers treat IBS as a high-risk procurement route due to these integrated uncertainties spanning across project planning, transportation logistics, and long-term financial return on investment (Thomas Tarang, 2022).

Thanoon and Jaafar (2021) highlighted deficiencies in communication and comprehension among architects, engineers, and contractors in the adaptation to IBS. Such communication barriers stem heavily from deep-rooted, adversarial procurement habits where key stakeholders work independently rather than collaboratively (Mesa, 2025). Consequently, without synchronized, digitally-driven workflows such as Building Information Modeling (BIM), design clashes frequently go undetected until the prefabricated components arrive on-site (Hedayati, 2025). IBS necessitates prompt design finalisation; hence, it restricts design flexibility and requires robust cooperation among stakeholders. This operational rigidity often leads to a "design-lock" phase where late-stage real estate market adjustments become physically or financially impossible once factory production commences (Yusof et al., 2024).

The effective implementation of IBS depends on a well-structured supply chain capable of managing the transportation and delivery of prefabricated components to the site. Because offsite construction converts on-site building activities into a distributed factory manufacturing paradigm, the entire framework inherently requires an integrated, highly predictable logistical network (Hedayati, 2025; Nesarnobari et al., 2024). Logistical bottlenecks, insufficient road infrastructure, and substandard handling often impede project timeframes. These infrastructure failures are compounded by unstable supply chain capacity and rigid procurement models, which collectively threaten the commercial viability of private sector developments (Hedayati, 2025). Modern construction frameworks require a technological shift toward smart logistics ecosystems governed by Building Information Modeling (BIM) and the Internet of Things (IoT) to ensure transparent data exchange across distinct stakeholders. Without these tailormade digital interfaces, traditional contractors remain stuck in data silos, unable to track product origins or seamlessly optimize task and resource scheduling (Kayembe, 2025).

The lack of standardized components among IBS manufacturers results in compatibility challenges, higher prices, and inefficiencies in design and installation. Because different vendors design proprietary structural dimensions, private developers are frequently subjected to "supplier lock-in," which eliminates market competition and drives up procurement costs (Alawag et al., 2024; Yusof et al., 2024). Without these formalized national frameworks, the widespread integration of advanced digital layout tools remains restricted, leaving industry stakeholders to manually reconcile disparate modular component boundaries (Hedayati, 2025; Mesa, 2025).

Masram et al. (2024) emphasised that although IBS components are produced in controlled factory environments, the anticipated quality benefits cannot be fully realised without strict adherence to quality control procedures throughout the manufacturing and installation stages. He and Liu (2024) argued that comprehensive quality control mechanisms, including systematic inspection and monitoring processes, are essential to minimise construction defects and ensure compliance with required standards. Recent industry developments also indicate an increasing emphasis on formalised contractor quality management systems, such as CIS 29:2021, to enhance consistency, accountability, and overall quality performance within construction projects (CREAM, 2025). Therefore, strengthening quality assurance frameworks, enhancing inspection protocols, and improving factory management practices are critical to achieving the quality objectives associated with IBS implementation.

IBS is generally more advantageous for large-scale projects when economies of scale validate the initial expenditure. Nonetheless, numerous private sector improvements are of small or medium scale, rendering IBS economically impractical. Jaillon et al. (2022) reported that the financial benefits of IBS are highly dependent on project volume, with small projects often failing to achieve sufficient cost savings to offset the substantial upfront investment. Rahman et al. (2023) found that private developers remain reluctant to adopt IBS due to concerns regarding limited economies of scale, uncertain returns on investment, and fluctuating market demand. Therefore, enhancing stakeholder collaboration and promoting collective implementation approaches may help overcome the economic constraints associated with IBS deployment in smaller private sector projects.

Tarang et al. (2022) found that limited dissemination of information and insufficient engagement between regulatory agencies and industry players impede the successful implementation of IBS initiatives. Furthermore, Nasrol et al. (2023) reported that although awareness of sustainable construction practices has improved, many stakeholders remain uncertain about the practical procedures and institutional support available for IBS adoption. Ismail et al. (2024) highlighted that fragmented policy execution and inadequate technical guidance continue to discourage private sector participation in advanced construction methods. Therefore, a more comprehensive policy framework encompassing effective enforcement, continuous awareness campaigns, and practical implementation support is essential to enhance IBS adoption within the private sector.

Procurement-related constraints as one of the major impediments to IBS implementation, emphasising that traditional contracting approaches are often incompatible with the collaborative nature of IBS processes (Tarang et al., 2022). Furthermore, Abdullah et al. (2023) argued that standard forms of contract inadequately address the allocation of risks associated with off-site manufacturing, transportation, and installation activities, thereby increasing the likelihood of disputes. Therefore, revising existing procurement and contractual frameworks to accommodate the unique characteristics of IBS is crucial for reducing conflicts, enhancing collaboration, and improving project performance.

RESEARCH METHODOLOGY

This research employs a quantitative methodology to investigate the challenges with the implementation of industrialised building systems (IBS) projects in Malaysia's private sector. A standard questionnaire was created to collect data from construction professionals involved in IBS projects, including engineers, architects, managers, and contractors. Due to the lack of a comprehensive and reliable roster of IBS practitioners in the private sector, the study regards the target group as unidentified. A purposeful sampling method was utilised to guarantee that only participants with pertinent IBS experience were included, thus enhancing the validity of the results. This survey aimed for a minimum of 200 completed responses. This sample size was selected for multiple reasons. Krejcie and Morgan's (1970) sample size table indicates that a sample size of 200 is statistically sufficient for a population of around 1,000 or more, which is presumed to represent the private sector IBS community. The sample size provides a strong basis for reliable statistics, allowing for important summaries and rankings and ensuring there is enough data to calculate trustworthy average scores and standard deviations. Although the target sample size was 200 respondents, only 100 completed questionnaires were received and considered valid for analysis, representing a response rate of 50%. Data was gathered through an online, self-administered questionnaire comprising three primary sections: demographic profile, IBS project experience, and ten specified problems evaluated on a 5-point Likert scale. Academic experts and industry practitioners created the instrument after conducting extensive literature research and evaluated it to ensure its relevance and intelligibility. Data analysis was performed via SPSS. Descriptive statistics identified response trends, while Cronbach's Alpha assessed internal consistency. Furthermore, ranking analysis was employed to highlight the most significant difficulties from the respondents' perspective. All ethical guidelines were adhered to, including the assurance of participant anonymity and the acquisition of informed, voluntary permission.

FINDING AND ANALYSIS

The data in Table 1 identifies the top ten challenges faced by the private sector in implementing the industrialised Building System (IBS), based on responses from 100 construction professionals. The mean values indicate a consensus of agreement to strong agreement, with all ten challenges scoring above 4.45. These findings are discussed in detail below and contextualised with previous literature.

TABLE 1: Challenges execution of IBS among the private sector

Challenges (n=100)	Rank	Mean	Std. Deviation
High initial cost	1	4.73	.830
Lack of technical expertise	2	4.66	.951
Low demand and market readiness	3	4.64	.902
Integration with existing practice	4	4.64	.869
Supply chain and logistics issues	5	4.63	.956

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Lack of standardization	6	4.62	.944
Quality control and assurance	7	4.55	.976
Project scale unsuitability	8	4.51	.944
Government support and incentives	9	4.46	.986
Contractual and legal barriers	10	4.45	.975

Notes: Strongly disagree = 0.00<AI<1.50, Disagree = 1.50<AI<2.50, Neutral = 2.50<AI<3.50 Agree = 3.50<AI<4.50, Strongly agree = 4.50<AI<5.00

The results revealed that high initial cost was perceived as the most critical challenge in executing IBS among private sector projects, with the highest mean score of 4.73 (SD = 0.830). This finding corroborates the literature, wherein Masram et al. (2024) and Yusof et al. (2024) emphasise that unlike traditional methods that use a gradual "pay-as-you-go" progress billing structure, IBS demands massive upfront capital before manufacturing begins. The deficiency of technical expertise was ranked second, with a mean score of 4.66. The survey data supports the concerns raised by Alawag et al. (2024), who highlighted that private firms are consistently reluctant to invest in training due to staff poaching hazards. Consequently, contractors revert to a abundant, cheap, low-skilled manual workforce. This skills deficiency directly cascades into operational execution failures on-site during crucial modular placement. The third-ranked barrier was insufficient demand and market preparedness (mean = 4.64), indicating the belief that the private sector remains reluctant to fully adopt IBS. Concurrently, the industry's long-standing reliance on conventional construction methods contributes to resistance toward organisational and procedural change. Yusof et al. (2024) noted that despite government initiatives, IBS adoption in Malaysia remains below the intended targets, particularly within the private sector. Integration with existing processes was rated fourth (mean = 4.64), indicating the challenges of implementing IBS into typically disjointed building workflows. Without synchronized, digitally-driven workflows such as Building Information Modeling (BIM), design clashes frequently go undetected until the prefabricated components arrive on-site (Hedayati, 2025).

The fifth challenge pertained to supply chain and logistical difficulties, yielding a mean score of 4.63. Modern construction frameworks require a technological shift toward smart logistics ecosystems governed by Building Information Modeling (BIM) and the Internet of Things (IoT) to ensure transparent data exchange across distinct stakeholders. Without these tailormade digital interfaces, traditional contractors remain stuck in data silos, unable to track product origins or seamlessly optimize task and resource scheduling (Kayembe, 2025). The challenge of lack of standardisation (Mean = 4.62; SD = 0.944) suggests that the absence of uniform component specifications and design coordination limits the efficiency benefits associated with industrialised construction. Because different vendors design proprietary structural dimensions, private developers are frequently subjected to "supplier lock-in," which eliminates market competition and drives up procurement costs (Alawag et al., 2024; Yusof et al., 2024). The seventh item on the list was quality control and assurance (mean = 4.55). He and Liu (2024) argued that comprehensive quality control mechanisms, including systematic inspection and monitoring processes, are essential to minimise construction defects and ensure compliance with required standards. Recent industry developments also indicate an increasing emphasis on formalised contractor quality management systems, such as CIS 29:2021, to enhance consistency, accountability, and overall quality performance within construction projects (CREAM, 2025). The mean score of 4.51 rated IBS as inappropriate for small-scale initiatives. Jaillon et al. (2022) contented that the financial benefits of IBS are highly dependent on project volume, with small projects often failing to achieve sufficient cost savings to offset the substantial upfront investment.

The lack of governmental support and incentives received an eighth-place ranking, with a mean score of 4.46. Ismail et al. (2024) highlighted that fragmented policy execution and inadequate technical guidance continue to discourage private sector participation in advanced construction methods. Finally, the study ranked contractual and legal obstacles eighth, with a mean score of 4.45. Abdullah et al. (2023) contended that standard forms of contract inadequately address the allocation of risks associated with off-site manufacturing, transportation, and installation activities, thereby increasing the likelihood of disputes.

CONCLUSION

This study analysed the significant challenges encountered by construction professionals in implementing industrialised building systems (IBS) projects in Malaysia's private sector. The primary challenges included a deficiency of competent workers, insufficient knowledge and training, reluctance to change, substantial initial investment, and inadequate coordination among parties. These findings show that there are deep-rooted structural and cultural issues that continue to block the widespread use of IBS, even though it could improve construction quality, productivity, and sustainability. The findings show that successfully using IBS in the private sector requires not only having the right technology but also a complete change that involves training workers, engaging key stakeholders, and adjusting policies. Government entities, corporate developers, and academic institutions must cooperate to improve education, offer incentives, modernise procurement, and create legal frameworks that facilitate modular construction. Failure to solve these interrelated difficulties would impede the transition to IBS, limiting the industry's capacity to fulfil rising demands for efficiency and innovation in building delivery. In conclusion, although the potential of IBS to transform Malaysia's construction industry is acknowledged, its implementation in the private sector encounters significant challenges. This research establishes a basis for targeted interventions and strategic planning to promote more effective and extensive implementation of IBS in private construction projects.

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