BARRIERS TO THE ADOPTION OF THE INDUSTRIALISED BUILDING SYSTEM (IBS) IN MALAYSIA

Shino E Ching Tay[1*], Chee Fui Wong[2], Hooi Ling Khoo[3], Lay Sheng Ewe[4], Riza Suwondo[5]

Abstract

In Malaysia, the introduction of the Industrialised Building System (IBS) has allowed for the improvement of construction quality, productivity and sustainability through the use of prefabricated building components. However, there is still a relatively low rate of implementation of IBS in the Malaysian construction sector when compared with traditional methods of construction. This study seeks to identify the major barriers to the implementation of IBS and to investigate the relationship between perceived barriers and the willingness of relevant stakeholders in the Malaysian construction industry to use this building system. A total of 154 professionals working in Malaysia's building trade were given a structured survey. Using SPSS, the responses were analysed. The industry has several barriers that inhibit the adoption of IBS: difficulty coordinating between the different players (integration barrier), a lack of education and skills (insufficient knowledge), and logistics barrier. The RII (Relative Importance Index) indicates that the three major obstacles facing organisations attempting to adopt IBS is integration (RII = 0.812), logistics (RII = 0.809) and lack of knowledge (RII = 0.798). Running a multiple linear regression analysis found that the three barriers together accounted for 70.7% of the explanation of variance in readiness to adopt IBS (R^2 = 0.707, $p < .001$). The integration barrier has the greatest degree of correlation (β = 0.476) to readiness, logistics has the second highest degree of correlation (β = 0.283) and insufficient knowledge has the lowest degree of correlation to organisational readiness. (β = 0.141). The negative direction of these relationships indicated that heightened perceptions of these barriers correlate with diminished organisational readiness, thus constraining an organisation's ability to adopt IBS. Based on the findings, it is recommended that the industry provide enhanced training and education relating to IBS, facilitate early collaboration among project parties and improve logistics planning and supply chain coordination. This study contributes to an understanding of the barriers to adopting IBS in Malaysia and provides useful insights to assist policymakers and industry members in encouraging greater use of industrialised building methodologies.

Received: *3 April, 2026*
Revised: *22 July, 2026*
Accepted: *3 August, 2026*
Published: *30 August, 2026*

[1,2,3]Department of Civil Engineering Lee Kong Chian Faculty of Engineering and Science, Universiti Tunku Abdul Rahman, Jalan Sungai Long, Bandar Sungai Long, Cheras, 43000, Kajang, Selangor, Malaysia.

[4]College of Engineering, Institute of Sustainable Energy (ISE), Universiti Tenaga Nasional (UNITEN), Putrajaya Campus, Jalan IKRAM-UNITEN, 43000 Kajang Selangor, Malaysia.

[5]Department of Civil Engineering, Faculty of Engineering, Bina Nusantara University, Jakarta, Indonesia.

****Corresponding author:***
shinotay2003@gmail.com

DOI: *https://doi.org/10.54552/ycyvze13*

Keywords:
Industrialised Building System (IBS), Barriers to adoption, Integration barrier, Logistics, Insufficient knowledge, Malaysia construction industry

1.0 INTRODUCTION

The construction sector in Malaysia is still struggling compared to the manufacturing and pharmaceutical industries and is lagging particularly in the areas of productivity, quality and performance. The demands for affordable housing, safety standards and sustainable environmental practices have increased the pressure on the industry to improve efficiency and be more innovative in its approach to building (Gholanreza, Omar & Rahim, 2021). As a result, the system of IBS has been introduced to change and improve the overall construction industry.

Industrialised Building System (IBS) is acknowledged as the process of construction by using prefabricated or pre-cast components offsite, which are then delivered to the construction site for assembly. By using IBS, projects can be completed faster and with better quality, while also cutting down on waste, reducing environmental harm, and saving costs over the building's lifespan (Gholanreza, Omar & Rahim, 2021).

Despite Malaysia introducing IBS as early as the 1960s, it was not until the mid-1990s that it began to gain traction in the country. The initial systems faced challenges of incompatibility with local conditions and social practices. The issue of unskilled foreign labour has made the industry reliant and has raised safety and cost issues, and with low productivity. The various governmental steps taken to promote IBS have not necessarily resulted in major uptake. A number of contractors are hesitant to implement the IBS approach due to a lack of technical skills and well-trained workers. They are also discouraged because of the higher up-front cost than traditional construction methods. This is why the overall adoption of IBS remains low, even with continuous support from the government and incentives (CIDB, 2021a).

From 2003, Malaysia has seen acceleration in the use of IBS, particularly for both commercial and residential projects (Al-Aidrous *et al.,* 2021). However, infrastructure development projects, namely bridges, highways and rail, have seen modest amounts of use of IBS. This contrasts with the observations in the use of IBS where speed, waste reductions and sustainable development have been improved. While there are generic studies that address the prevalence of IBS development, there isn't a specific body of more focused research to support its proactive understanding and use in infrastructure development projects. This being said, there is no established means to overcome the unknown

barriers, obstacles, and opportunities that our industry category encounters with IBS. Many stakeholders in the industry need clearer information to help guide their decisions when adopting IBS in their future projects.

This study aims to explore the challenges that are holding back the wider use of the Industrialised Building System (IBS) in Malaysia. The research objectives are to determine the level of IBS adoption, identify the perceived barriers to IBS implementation and evaluate the correlation between the perceived barriers in IBS adoption and readiness of the construction industry in Malaysia to adopt IBS.

1.1 Aim and Objectives

This study aims to find out the challenges that are holding back the wider use of the Industrialised Building System (IBS) in Malaysia. It also looks at how these challenges can be overcome, so that IBS can be adopted more effectively across the construction industry. The objectives of this research are:

1. To determine the adoption of IBS in the Malaysia construction industries.
2. To investigate the perceived barriers of IBS in the construction industry in Malaysia.
3. To evaluate the correlation between the perceived barriers in IBS adoption and readiness of the construction industry in Malaysia to adopt IBS.

This study contributes by producing Malaysia-specific, stakeholder-based evidence on why IBS adoption remains uneven despite long-standing national targets and scoring requirements. The findings will help to resolve the challenges of limited adoption due to gaps within capability, higher than expected upfront costs, and implementation friction, as well as the need for increased clarity by stakeholders in making decisions about future adoption of IBS.

2.0 LITERATURE REVIEW

Malaysia has embraced IBS rapidly, mainly in multi-storey residential and commercial buildings. However, its use for infrastructure remains limited due to the complexity of infrastructure works, where only certain IBS components can be effectively applied (CIDB, 2022b). The standardisation of IBS is often incompatible with the varying specifications of infrastructure development (Masram *et al.,* 2024).

In 2003, IBS application in Malaysia was only 15%. The government then mandated public infrastructure projects to achieve 70% IBS content from 2008 onwards (IBS Survey, 2003). The IBS Roadmaps (2003-2010; 2011-2015) and CIMP (2006-2015) strengthened this requirement (IBS Centre, 2012).

Since then, there has increased in the adoption of IBS. In 2021, 84% of local governments were using IBS, with 60% of the private sector using it. By the beginning of 2022, 91.5% of public projects were using IBS (Masram *et al.,* 2024). By the end of 2025, local governments raised their minimum IBS scores to 70 for private sector projects that have a total value of RM50 million (Kementerian Perumahan dan Kerajaan Tempatan, 2024).

Other jurisdictions around the world have also been successful with their IBS adoption. For example, the country of Singapore has made excellent progress with its use of IBS. The Housing Development Board in Singapore has used prefabrication in its public housing (Abdul Rahim & Latif Qureshi, 2018). Similarly, Denmark has achieved about 80% IBS adoption in detached houses using panelised systems, while the Netherlands has seen steady market share growth for IBS, driven by standardised components and flexible manufacturing processes (Mohd Nawi *et al.,* 2019). These examples highlight that coordinated government and industry support, as seen in Singapore, along with standardisation strategies from European countries, offer valuable lessons for enhancing IBS adoption in Malaysia's construction sector.

Despite this progress, IBS uptake in infrastructure projects remains below expectations. This study seeks to investigate the key factors that affect the application of IBS within Malaysia's infrastructure sector.

2.1 Integration Barrier

One of the main problems hindering wider acceptance of IBS in Malaysia is the lack of involvement from stakeholders throughout the full project lifecycle. Often, IBS manufacturers are asked to contribute much further along to the process (usually after tender/quotation stage), resulting in extensive revisions, rework, and delay. This scenario highlights the problem of fragmentation in the construction supply chain as minimal collaboration and adversarial relationships between stakeholders reduce the chances of effective application (Khalil *et al.,* 2016).

For effective delivery of IBS, there must be early participation from all stakeholders who can coordinate activities through design, logistics and installation while communicating effectively to minimise scheduling and site conflicts (Masram *et al.,* 2024). If such integration does not occur, projects lead to inefficiencies and delays, supporting that integration problems are a major barrier to the successful uptake of IBS in Malaysia (Rahman & Omar, 2006).

2.2 Insufficient Knowledge

Insufficient understanding and exposure to IBS is still a primary reason for the slow adoption rate among stakeholders. Developers, contractors, and consultants are more comfortable using traditional methods because they have better understanding of the fixed cost structure, process of construction, and design flow. IBS, on the other hand, is often seen as unfamiliar and complicated, leading to hesitation and misinterpretation of its benefits (Amede *et al.,* 2025).

Many designers struggle with IBS-related technical drawings, causing project delays, while local authorities often misinterpret IBS requirements, which slows down the approval process. In many cases, IBS elements are only considered after the tender stage, making early coordination difficult and increasing the chances of design errors and added costs. This issue is further rooted in education, as many universities do not focus on IBS or precast systems, leaving fresh graduates more comfortable with traditional methods (Qays *et al.,* 2010).

2.3 Logistics

One of the biggest issues in transporting IBS components is the size and weight of the individual parts. Moving them to any construction site involves significant planning (Aini *et al.,* 2025), as there are route restrictions, permit needs, and usually limited access to suitable lifting equipment. In many

areas, especially those with poor infrastructure, there are not enough proper access routes or transport channels, which causes delays during the assembly phase (Md Azree & Abd Rahim, 2014).

Majority of IBS manufacturers are located in the Klang Valley, which creates difficulty in transporting large components to far or rural locations, thereby compromising the practicality of using IBS in those areas (Fauzi *et al.,* 2017). The IBS supply chain requires a number of interconnected parties and involves multiple levels (Ismail *et al.,* 2016), meaning it is largely more complex than conventional systems. Effective communication and good supply chain management are needed to overcome transportation problems in IBS projects.

3.0 METHODOLOGY

Aim of this study is to investigate the barriers associated with the implementation of IBS in Malaysia and to explore the relationship between the perceived barriers and the willingness of stakeholders to adopt IBS. The target respondents were professionals from the building construction industry, such as contractors, quantity surveyors, architects and consultants.

Data were collected using a questionnaire survey as the primary research instrument, consisting of three distinct sections. Section A collected demographic information. Section B explored awareness and adoption level of IBS. Section C assessed the perceived barriers (integration barrier, insufficient knowledge, and logistics) and the readiness of organisations to adopt IBS using a five-point Likert scale.

By using Google Forms, the questionnaire was sent to participants through email, LinkedIn, WhatsApp, etc. There were 154 responses collected and analysed using SPSS. To achieve the research objectives, descriptive statistics, Relative Importance Index (RII), reliability testing, normality testing, correlation analysis, and multiple linear regression were used.

3.1 Conceptual Framework

A conceptual framework is a visual and written depiction that shows the significant variables in a research project. It clarifies and limits the scope of the research by providing a visual representation of what the research is going to study. It defines the intention of the study as well as shows where the study will take place. A conceptual framework gives structure to the research and represents the specific concepts of the study, gains and defines those concepts for the study, and shows the anticipated relationship between them. It acts as a roadmap that connects the research questions, objectives, and methodology to the expected outcomes (Walliman, 2018).

Ravitch and Riggan (2016) describe the conceptual framework as a construct beyond just a model. It is an ecosystem where all components of the study come together, guiding researchers through each phase of the study from design through to the analysis. It shows connections, assumptions, and contexts that shape the study and ensures the research remains grounded and focused.

In this study, the conceptual framework is constructed to examine the challenges affecting the adoption of the Industrialised Building System (IBS) in Malaysia. The framework identifies three independent variables: Integration Barrier, Insufficient Knowledge, and Logistics, that are hypothesised to influence the dependent variable, which is the Malaysia Construction Organisation's Readiness to Adopt IBS. Every independent variable identified is an important barrier that has frequently been reported in past research and industry reports.

The framework is key to helping make sure that the research design is congruent with the purpose of the study in terms of data collection instruments (in this case the survey), and data analysis. The framework also provides a visual representation of the independent variables and their assumed relationships with the dependent variable; it thus enables hypothesis generation and systematic result interpretation. Figure 1 showed the conceptual framework developed in this study, and the ways that the independent variables may contribute to the dependent variable.

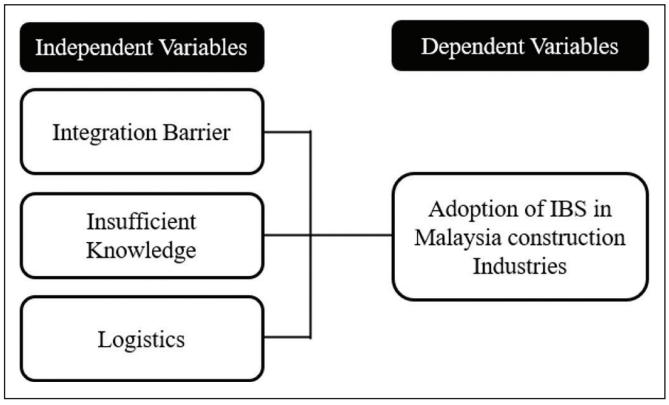


Figure 1: Conceptual framework of the study

3.2 Research Design

A research design is a transparent and ordered plan of action to give researchers direction during the research project. Research designs describe how data are collected, measured, and analysed, to address the research problem appropriately. A well-formulated research design is important as it affects the quality of the research study and guides the researcher in making relevant decisions about approaches, methods and instrumentation. A well-considered and formulated research design can unify thinking about how all pieces of the research paper connect, and ensure that if objectives are to be met, approaches to the objectives are developed logically. It also supports researchers in planning how to approach their questions and apply their chosen methods step by step. Typically, research methodologies can be categorised into three main types, one being quantitative, that has a main focus on numerical data and statistical analysis as its main source; and qualitative, that will investigate non-numerical data and meanings, opinions and experiences to delve into further understanding; and the mixed method, taking on both quantitative and qualitative approaches for more comprehensive understanding of a research problem (Narayan & Cheah, 2025).

A quantitative research design is suitable for this research because the emphasis is on understanding the perceptions, experiences, and opinions on the barriers to IBS adoption in Malaysia. The analysis is conducted using SPSS, an extensively used software program in social science research that helps researchers to manage, process and analyse data easily and efficiently. SPSS provides functions for data transformation and

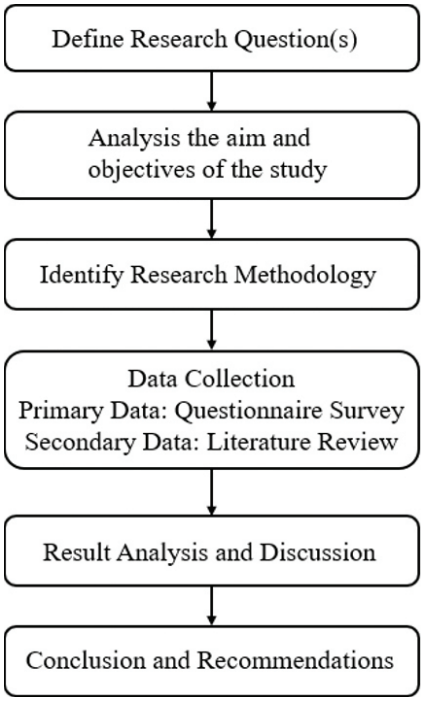


Figure 2: Flowchart of the research process and methodology

regression analysis which enable the researcher to find patterns and relationships among the variables and is designed to work with large data sets such that calculations are performed with minimal error and presented accurately and reliably. Figure 2 presents the flowchart of the research process and methodology adopted in this study.

3.3 Data Collection

Data collection is paramount to the quality and accuracy of any research outcomes. It involves strategic execution to ensure that the outcome is less prone to errors that could compromise the findings. Data collection can be defined as the systematic use of established or well-documented procedures for gathering and measuring information from a variety of information sources to develop a complete and accurate picture related to a research problem (Kabir, 2016). There are two types of data collection methods: primary data and secondary data.

Primary data is information obtained directly by the researcher for their own research purposes. This means that the data has neither been published nor shared through other means by others. Primary data is usually collected when researchers cannot access sufficient or available data, allowing them to gain first-hand expertise from the source. Data collection consists of surveys, interviews, focus groups, observation, and experimentation (Taherdoost, 2021).

Secondary data is information that has been collected, analysed, and disseminated by other parties for purposes unrelated to the present study. Researchers use secondary data as opposed to obtaining new data specifically to support or inform their study. Taherdoost (2021) suggested that secondary data might be useful to save time and resources, usually if the data is relevant and reliable. The most popular or often collected secondary data is government statistics, academic journals, articles, books, research reports, and records from companies and websites or official online databases.

In this research, the primary data was collected via a questionnaire survey distributed to construction industry practitioners in Malaysia via Google Forms through email, LinkedIn, WhatsApp, Rednote and Instagram. Secondary data was obtained from academic journals, conference papers, CIDB publications, government reports, and other published materials relevant to IBS adoption in Malaysia.

3.4 Questionnaire Survey

A questionnaire survey instrument is a structured, standardised research instrument that allows researchers to collect data from subjects. A questionnaire is defined as a collection of questions and prompts that is pre-written, usually in a specific order so that all participants hear the same prompt. Standardisation helps to minimise researcher bias and makes it easier for researchers to compare responses from participants (McLeod, 2023a). In this research study, the questionnaire was developed using Google Forms. The methods used to reach the respondents were online questions distributed through email, LinkedIn, WhatsApp, Rednote, and Instagram. A total of 246 questionnaires were distributed, and 154 valid responses were collected and used for data analysis. The questionnaire comprised three sections: Section A, Section B, and Section C. Table 1 shows the summary of the questionnaire.

3.5 Data Analysis Using SPSS

Data were collected through a questionnaire and then analysed using the Statistical Package for Social Sciences (SPSS). The demographic characteristics of respondents in Section A were provided through descriptive analyses. This section also provided descriptive analyses of awareness of and adoption rates for IBS in Sections B1 and B2. To test the reliability and validity of the findings, data collected

Table 1: Summary of the questionnaire

Section	Item
A	Section A of the questionnaire gathers background information respondents' profiles, capturing key information including their age, years of working experience in the construction industry, role in the organisation, organisation's scope of services, highest academic qualification, number of employees in the company, type of construction projects handled and whether the organisation has directly used IBS.
B1	Section B1 of the questionnaire is to characterise the level of awareness and implementation of IBS by survey respondents who are either already using IBS or who have previously used IBS. Section B1 assesses the varying levels of usage of IBS, type of IBS systems used, the level of familiarity with the IBS Score (CIS 18) and the primary reasons for choosing IBS and obstacles to using IBS.
B2	Section B2 of the questionnaire aims to characterise the respondents' level of awareness and implementation of IBS by those respondents who have never implemented IBS. Section B2 assesses the respondents' level of familiarity with IBS concepts, barriers to implementation of IBS, the perceived appropriateness of implementation of IBS in the Malaysian construction environment, the importance of evaluating IBS for the respondents' company's future projects, and likelihood of supporting the use of IBS through training or financial incentives.
C1	Section C1 of the questionnaire aims to assess responses regarding the perceived barriers to implementing IBS through evaluating respondents' opinions regarding integration barriers, insufficient knowledge and logistics using a five-point Likert scale.
C2	Section C2 of the questionnaire evaluates the company's readiness to adopt IBS by evaluating various indicators related to readiness on a five-point Likert scale.

Table 2: Hypothesis of the study

H_{01}	Integration barrier does not have a significant relationship with the organisation 's readiness to adopt IBS.
H_{A1}	Integration barrier has a significant relationship with the organisation's readiness to adopt IBS.
H_{02}	Insufficient knowledge does not have a significant relationship with the organisatio 's readiness to adopt IBS.
H_{A2}	Insufficient knowledge has a significant relationship with the organisation's readiness to adopt IBS.
H_{03}	Logistics does not have a significant relationship with the organisation's readiness to adopt IBS.
H_{A3}	Logistics has a significant relationship with the organisation's readiness to adopt IBS.

from sections C1 and C2 were subjected to reliability testing, multicollinearity testing, and normality testing using a five-point Likert scale. Regression analysis was performed with Spearman's rank correlation coefficient and multiple linear regression analysis to determine the relationship between the stated perceived barriers to the adoption of IBS and the agency's readiness to adopt IBS, and to measure the negative impact these barriers on the agency's overall preparedness for adopting IBS. These three hypotheses are documented in Table 2.

3.6 Hypothesis Development

Hypothesis testing may be inherently unclear, given that the researcher must presume no variation or correlation between variables until contradictory evidence emerges. Hypothesis testing is a statistical procedure for making population inferences using sample data. It involves two opposite statements: the null hypothesis (H_0), which states no effect or no difference, and the alternative hypothesis (H_1), which states that there is an effect or a difference.

Researchers determine whether the sample information is strong enough to reject H_0 in favour of H_1 (Anderson & Sweeney, 2025). For this study, three hypotheses were developed corresponding to the three independent variables (integration barrier, insufficient knowledge, and logistics) and the dependent variable (Malaysia construction organisation 's readiness to adopt IBS).

4.0 RESULTS AND DISCUSSION

The data collection and analysis are reported and discussed in this section. Prior to the main survey, a pilot test of 31 participants was conducted to improve upon the design of the questionnaire. Various analytical methods were applied to the final dataset, which consisted of 154 valid responses.

4.1 Pilot Study

A pilot study involving 31 respondents was conducted to evaluate the reliability and internal consistency of the questionnaire prior to the main survey. Cronbach's alpha reliability analysis was performed using the original set of questionnaire items, with all items retained and assigned to their respective constructs. In Table 3, the Cronbach's alpha coefficient for the dependent variable, Malaysia's construction organisation 's readiness to adopt IBS was 0.729. For the independent variables, integration barrier recorded an alpha value of 0.785, insufficient knowledge 0.841, and logistics 0.799. As all constructs achieved alpha values above 0.70, the questionnaire demonstrated acceptable to good internal consistency and was considered reliable for the main data collection (Arof, Ismail & Saleh, 2018).

Table 3: Cronbach's alpha of pilot test

Variables	Cronbach's Alpha
Independent Variables (IV)	
IV1: Integration Barrier IV2: Insufficient Knowledge IV3: Logistics	0.785 0.841 0.799
Dependent Variable (DV)	
Malaysia's Construction Organisation's Readiness to Adopt IBS	0.729

Table 4: Demographic profile of the respondents

	Percentage	Respondent (N = 154)
Age		
Below 25	38.3%	59
25 – 34	30.5%	47
35 – 44	20.1%	31
45 – 54	5.8%	8
Year of Working Experience in Construction Industry		
6 – 10 years	16.9%	26
11 – 15 years	14.3%	22
16 – 20 years	4.5%	7
More than 20 years	4.5%	7
Role in the Organisation		
Management (CEO, CCO, COO, Director)	5.2%	8
Project Manager / General Manager	6.5%	10
Senior Engineer / Engineer	35.7%	55
Architect	35.7%	55
Quantity Surveyor	16.2%	25
Technical Assistant	0.6%	1
Organisation's Scope of Services		
Client / Developer / Project Owner / Government Agencies	5.2%	8
Contractor	35.7%	55
Engineering Consultancy	35.1%	54
Quantity Surveying (QS) Consultant	6.5%	10
Architecture	11.7%	18
Material Supplier	0.6%	1
Highest Academic Qualification		
Diploma	13.0%	20
Degree	61.0%	94
Master	19.5%	30
PhD	3.2%	5
Professional Certification	3.2%	5
Number of Employees in Company		
Less than 5 employees	17.5%	27
5 to < 30 employees	33.8%	52
30 to < 75 employees	33.1%	51
More than 75 employees	15.6%	24
IBS Adoption in Projects		
Yes	91.6%	141
No	8.4%	13

4.2 Descriptive Analysis

Descriptive analysis of data is the process of organising and summarising data to reveal the most significant trends, thereby facilitating easier comprehension of the information and enabling appropriate action (Hayes, 2024). Section A presented the demographic profile of respondents including age, working experience, role, organisation scope, academic qualification, company size, project types, and IBS adoption. Section B focused on respondents' awareness and exposure to IBS, divided into Section B1 for IBS users and Section B2 for non-IBS users. Section C examined the perceived barriers (integration barrier, insufficient knowledge, and logistics) and organisation al readiness to adopt IBS using a five-point Likert scale, where 1 represented "Strongly Disagree" and 5 represented "Strongly Agree". Table 4 showed the demographic profile of the respondents including their age, year of working experience in construction industry, role in the organisation , organisation 's scope of services, highest academic qualification, number of employees in company and IBS adoption in projects.

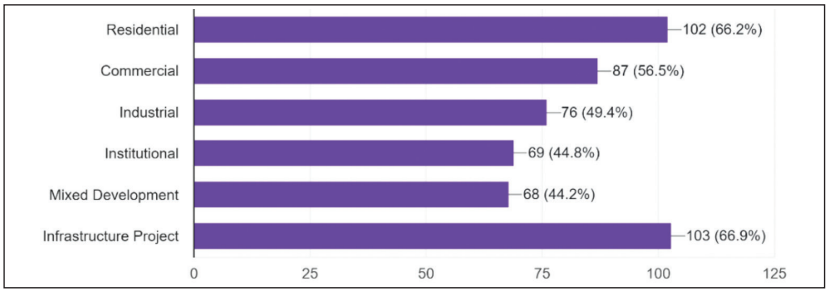


Figure 3: Type of construction projects handled by respondents

4.2.1 Type of Construction Projects You Have Handled

Figure 3 showed that survey participants had a wide variety of different types of construction projects they worked on (multiple answers were allowed), and 103 or 66.9% of those surveyed reported having worked on an infrastructure project. Residential projects were the second most common type of construction project reported by participants (66.2%). The other most often reported types of construction projects were commercial (56.5%), industrial (49.4%), institutional (44.8%), and mixed-use development (44.2%). Majority of participants had worked at some time in their careers on multiple types of construction projects. Overall, most participants had a wide range of project experience, particularly with respect to large, complex projects, which were of the most relevance and significance in terms of IBS.

4.2.2 Industrialised Building System (IBS) Adoption in Projects

Figure 4 showed majority of respondents (91.6%) reported having been involved as direct participants in projects using IBS systems, whereas the remaining 8.4% stated that they were not directly involved. This high degree of participation suggested that most participants had first-hand knowledge and experience with IBS implementation, thus adding greater credibility to their responses regarding the issues faced in adopting IBS systems in Malaysia.

The high percentage of respondents with direct IBS involvement could be attributed to several factors. Firstly, any project utilising prefabricated components even partially was classified as an IBS project, as IBS encompassed various prefabricated elements (i.e., wall panels, beams and columns) (CIDB, 2022b). Secondly, government requirements mandated that all government projects over RM10 million and private projects with a development cost of at least RM50 million and a gross floor area of at least 50,000 m^2 must achieve a minimum IBS score of 70 (Ministry of Housing and Local Government (Kementerian Perumahan dan Kerajaan Tempatan), 2024). Thirdly, most respondents were drawn from industry members with experience in IBS, as the survey targeted individuals working in construction firms, consultancies and government agencies typically engaged in IBS-related projects.

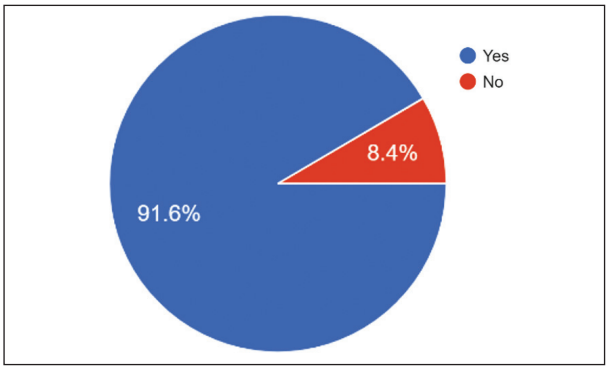


Figure 4: Industrialised Building System (IBS) adoption in projects

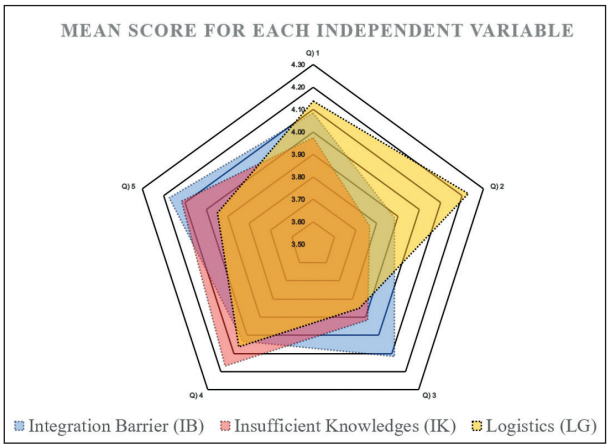


Figure 5: Radar chart for each independent variable

4.3 Relative Importance Index Analysis (RII)

The Relative Importance Index (RII) method was used to analyse respondents' perceptions of the challenges to IBS adoption in Malaysia. A higher RII value indicated greater significance of a factor (Azman *et al.,* 2019).

In Table 5, the barrier with the highest RII was route restrictions and limited site access when delivering large IBS modules (RII = 0.845), indicating that logistic constraints were the most critical challenge (Ibrahim *et al.,* 2022). The second and third highest ranked barriers were limited IBS experience among project parties (RII = 0.835) and dependence on external IBS specialists due to limited internal capability (RII = 0.834), indicating that insufficient technical knowledge and limited in-house expertise were significant obstacles to IBS adoption (Kaur *et al.,* 2024; Lee *et al.,* 2020; CIDB, 2021b). Overall, most barriers registered RII values above 0.80, indicating high perceived importance.

Table 5: RII ranking of perceived barriers

No.	Statements	RII	Rank
LG2	Route restrictions and limited site access create challenges in delivering large IBS modules.	0.845	1
IB5	Limited IBS experience among project parties hinders smooth integration.	0.835	2
IK4	We rely on external IBS specialists due to limited in house technical capability.	0.834	3

Table 6: RII ranking of perceived barriers

Perceived Barriers	Mean RII	Rank
Integration Barrier	0.812	1
Insufficient Knowledge	0.809	2
Logistics	0.798	3

Table 7: VIF and tolerance multicollinearity test

Variables	Tolerance	VIF	Multicollinearity
IV1: Integration Barrier	0.339	2.946	No issue
IV2: Insufficient Knowledge	0.399	2.505	No issue
IV3: Logistics	0.453	2.206	No issue

The radar chart in Figure 5 depicted the average scores of the three independent variables across their respective measurement statements. For Integration Barrier, IB5 recorded the highest mean value, while IB2 had the lowest. For Insufficient Knowledge, IK4 and IK5 showed comparatively high averages, whereas IK2 had the lowest. For Logistics, LG2 and LG4 had nearly equal high averages, while LG3 had the lowest.

Based on the RII results showed in Table 6, the integration barrier received the highest mean RII (0.812), followed by logistics (0.809) and insufficient knowledge (0.798). Therefore, operational and functional barriers were the primary barriers to the use of IBS in Malaysia.

4.4 Measurements of the Data

The measurement of data is fundamental to confirming the reliability and validity of the collected information for subsequent analysis. This procedure entails the execution of reliability tests, multicollinearity tests, and normality tests. Reliability testing verifies the consistency of the collected data; should the data fail to meet the required criteria; additional responses must be collected to enhance its reliability. Multicollinearity testing examines whether collinearity issues exist between the independent variables because overlapping variables would indicate a multicollinearity problem. In the meantime, normality testing assesses whether the collected data follows a normal distribution.

4.4.1 Multicollinearity Test

A multicollinearity test was conducted to examine the independent variable relationships through the tolerances and variance inflation factors (VIFs). The results in Table 7 showed a high value of tolerance (greater than 0.100) indicating acceptable levels of tolerance. In addition, all VIF values were well below the threshold value of 5.00. None of the independent variables showed indications of multicollinearity, providing further support for the independence of these variables from one another and consequently qualifying them for inclusion in regression analysis (Frost, 2023a). These findings suggested that integration barrier, insufficient knowledge, and logistics did not exhibit problematic intercorrelations and can reliably be used to explain the readiness of Malaysian organisations to adopt IBS.

4.4.2 Reliability Test

An assessment of internal consistency among the questionnaire items was carried out through a reliability analysis. Cronbach's alpha coefficient was calculated using SPSS software. Based on established reliability guidelines, alpha values above 0.70 indicate acceptable internal consistency, while values above 0.80 represent good reliability (Arof, Ismail & Saleh, 2018).

Based on Table 8, the results showed that all constructs achieved acceptable to good reliability levels. The integration barrier and logistics constructs recorded Cronbach's alpha values of 0.828 and 0.802 respectively, indicating good internal consistency. The insufficient knowledge construct produced an alpha value of 0.773, which fell within the acceptable reliability range. For the dependent variable, Malaysia's construction organisation 's readiness to adopt IBS obtained a Cronbach's alpha value of 0.765, also indicating acceptable internal consistency. Each variable passed the reliability tests, yielding sufficient internal consistency per the standard threshold. Therefore, the measurement tool exhibited acceptable reliability and consistency, and the final dataset was appropriate for conducting further inferential analyses such as correlation and regression testing.

4.4.3 Normality Test

A normality test was conducted via SPSS software to determine whether the dataset satisfied the distributional assumptions required for parametric analysis. Since the study involved a sample size of 154 respondents, which was considered a large sample, the Kolmogorov-Smirnov test was adopted as the primary reference for interpreting normality (Habibzadeh, 2024). As shown in Table 9, the significance values for all constructs were 0.000 ($p < 0.05$). The distributions of samples were significantly different from normal distributions.

Table 8: Cronbach's alpha on reliability test

Variables	Cronbach's Alpha	Level of Acceptance	Number of Items
Independent Variables (IV)			
Integration Barrier (IB)	0.828	Good	5
Insufficient Knowledge (IK)	0.773	Acceptable	5
Logistics (LG)	0.802	Good	5
Dependent Variable (DV)			
Malaysia's Construction Organisation's Readiness to Adopt IBS	0.765	Acceptable	5

Statistically significant p-values indicated that the distribution is unlikely to be normally distributed (Habibzadeh, 2024). This conclusion was further supported by the histogram for the integration barrier variable, which displayed a visibly skewed distribution with responses clustering toward higher Likert-scale values rather than forming a symmetric bell-shaped curve. Such patterns were common in perception-based construction management surveys, where respondents often express stronger agreement or disagreement rather than forming a symmetric bell-shaped distribution (Koo & Yang, 2025).

Since all independent and dependent variables demonstrated non-normal distributions, subsequent inferential testing applied non-parametric methods. Specifically, for correlation analysis involving Likert-based constructs, Spearman's rank correlation was preferred when the normality assumption was violated and when working with ordered categorical data.

Table 9: Kolmogorov-Smirnov test

	N	Sig
IV1: Integration Barrier	154	.000
IV2: Insufficient Knowledge	154	.000
IV3: Logistics	154	.000

Multiple linear regression analysis was performed despite the non-normal distribution of the data in this present study. Parametric regression analysis has been shown to be robust against violations of the normality assumption provided a large sample size (> 50) and the residuals are normally distributed (Schmidt & Finan, 2018). The Central Limit Theorem provides additional support for the appropriateness of drawing inference from large sample sizes, regardless of the distribution of the underlying data (Frost, 2023b). Diagnostics on the residuals provided evidence that the underlying assumption of linearity, homoscedasticity, and independence was satisfied.

4.5 Correlation Analysis

Spearman's rank-order correlation (r_s) was performed to analyse the three independent variables (Integration Barrier, Insufficient Knowledge, and Logistics) relationship and the dependent variable (Malaysian Construction Organisations' Readiness to Adopt IBS) because the data were non-parametric and measured using a 5-point Likert scale. In Table 10, all correlations were found to be statistically significant at the 0.01 level ($p < 0.001$). There was a significant correlation between willingness to Logistics with organisation al readiness ($r_s = 0.844$, $p < 0.001$). In addition, the integration barrier was also significantly correlated with organisation al readiness ($r_s = 0.842$, $p < 0.001$). Thus, the directionality of these two correlations is consistent with way the variables were coded; as such, higher scores on the barriers corresponded to higher degrees of perceived challenge whereas higher scores on the readiness scale were associated with a higher level of organisational readiness.

Therefore, these findings indicate that organisations that perceive higher levels of integration barriers are more likely to report lower levels of organisational readiness, and thus would be expected to experience a greater challenge to successfully adopting IBS. It is reasonable to conclude that logistics problems and integration barriers were critical factors affecting the degree of readiness for an organisation to adopt IBS. Previous studies identified logistics as a major barrier to IBS adoption in Malaysia, indicating that transportation problems and supply chain inefficiency were key barriers (Yee, 2020; Samsi, 2024). There was a strong positive relationship between lack of knowledge/technical skills and organisational readiness ($r_s = 0.540$, $p < 0.001$) indicating that while insufficient knowledge/technical skills does restrict the adoption of the integration barrier, that relationship is less than the restraining effects of operational/integration barriers.

In addition to the strong positive relation between the integration barrier and logistics, there were also moderate positive relationships between logistics and insufficient knowledge ($r_s = 0.569$, $p < 0.001$) and between the integration barrier and insufficient knowledge ($rs = 0.674$, $p < 0.001$). These moderate positive correlations indicated that coordination troubles and logistical problems existed side by side and reinforced each other in the context of the Malaysian IBS adoption environment. The positive correlations also suggested that organisation s' increased perception of barriers led them to a greater concern for their degree of readiness to adopt IBS.

Table 10: Spearman's correlation analysis

	r_s	p - value
IV1: Integration Barrier	0.842	< 0.001
IV2: Insufficient Knowledge	0.540	< 0.001
IV3: Logistics	0.844	< 0.001

Correlation is significant at the 0.01 level (2-tailed)

4.6 Regression Analysis

Multiple linear regression model was used for analysis even though the independent variables did not meet the requirements of normality. However, due to the robustness of multiple regressions when having a large sample size and also because the assumption of normality for the residuals was met (Frost, 2023b; Schmidt & Finan, 2018), this analysis was done. Multiple linear regression analysis was performed to examine the effect of the identified challenge factors on Malaysia construction organisation s' readiness to adopt IBS.

The independent variables included integration barrier, insufficient knowledge and logistics, while the dependent variable was readiness to adopt IBS. Multiple linear regression was determined to be the best statistical analysis to use in this study as there are more than one independent variable which are affecting a single dependent variable at the same time. This method allowed evaluation of the combined effect of all predictors as well as the individual contribution of each factor. Simple linear regression was not performed as it would not reflect the actual combined influence of multiple interrelated barriers.

4.6.1 Multiple Linear Regression

As indicated by the model summary that showed in Table 11, the R value of 0.841 shows a strong relationship between the independent variables and readiness to adopt IBS. The R Square value of 0.707 indicated that 70.7% of total variance of organisational readiness could be explained by the independent variables (Frost, 2023b). In addition, as shown in Table 12, the ANOVA results provided support for the regression model's statistical significance: $F(3,150) = 120.489$, $p < 0.001$ (Frost,

2023b). Using Table 13, coefficients of the regression analysis (both unstandardised and standardised) were used to construct the following regression equation:

Readiness = 0.591 + 0.423 (Integration Barrier) + 0.142 (Insufficient Knowledge) + 0.266 (Logistics)

All three predictors produced statistically significant effects on readiness (i.e., integration barrier, $p < 0.001$; insufficient knowledge, $p = 0.045$; Logistics, $p < 0.001$) (Frost, 2023b). The standardised beta coefficients (β) indicate the relative strength of association: integration barrier (β = 0.476), logistics (β = 0.283), and insufficient knowledge (β = 0.141). The direction of these associations suggests that higher perceived barriers are associated with lower organisational readiness to adopt IBS, confirming that these barriers act as impediments to IBS adoption. Integration barrier had the largest standardised Beta (β = 0.476), followed by logistics (β = 0.283) and insufficient knowledge (β = 0.141), indicating that integration barrier was the most influential factor affecting readiness to adopt IBS (Bevans, 2023).

4.7 Hypothesis Testing

Hypothesis testing was tested using multiple linear regression to assess the impact of integration opportunities, insufficient knowledge and logistics on the readiness of construction organisations in Malaysia to use an IBS system. The significance level used to test is $\alpha = 0.05$, indicating statistical judgment (Frost, 2023b). Any p-value found to be less than 0.05, thus signifies statistical significance and would reject the null hypothesis.

In Table 14, the results from the integration barrier indicate there is a highly significant impact on the readiness of the organisation to adopt an IBS ($p < 0.001$) and that an increase in the perception of an integration barrier decreases the organisation 's willingness to adopt an IBS, therefore the null hypothesis is rejected. The p-value associated with this estimate being below 0.05 indicates that H_0 is rejected and H_1 is accepted. Lastly, insufficient information was identified as a statistically significant positive predictor of readiness ($p = 0.045 < 0.05$), and so due to the p-value being below the level of significance, H0 was rejected and H_1 was accepted. The logistics barrier also indicated a statistically significant positive influence on readiness ($p < 0.001$). As with all variables, the p-value being below the level of significance indicates H_0 was rejected and H_1 was accepted (Frost, 2023b; Nieminen, 2022).

Overall, all three independent variables significantly influenced Malaysia construction organisation s' readiness to adopt IBS. Among them, integration barrier emerged as the dominant predictor, followed by logistics and insufficient knowledge (Pan & Sidwell, 2020).

Table 11: Model Summary

R	R Square	Adjusted R Square
0.841	0.707	0.701

Table 12: ANOVA

	Sum of Squares	df	Mean Square	F	Sig
Regression	56.428	3	18.809	120.489	.000
Residual	23.416	150	0.156		
Total	79.844	153			

Table 13: Multiple Linear Regression Coefficient

	Unstandardised Coefficients	Standardised Coefficients Beta
IV1: Integration Barrier	0.423	0.476
IV2: Insufficient Knowledge	0.142	0.141
IV3: Logistics	0.266	0.283

Table 14: Significant value of hypothesis testing

	p - value
IV1: Integration Barrier	< 0.001
IV2: Insufficient Knowledge	< 0.05
IV3: Logistics	< 0.001

4.8 Recommendations

This study revealed multiple barriers to IBS adoption, with integration barrier, logistics challenges, and insufficient knowledge identified as primary influences. A number of strategies need to be adopted to eliminate these factors and ensure an increase in the application of IBS within the industry.

The integration barrier was the most significant barrier identified. For successful implementation of IBS, there must be a high level of integration and coordination between the members of each project team: the designer, the contractor, the manufacturer and the supplier. Adopting collaborative project delivery techniques such as BIM and utilising digital coordination systems will improve communication and integration among the team members (Pan & Sidwell, 2011).

Logistical challenges were also identified as a significant barrier. To assist with these logistical issues, government and industry stakeholders can improve the IBS supply chain by enhancing transport planning and increasing the number of IBS manufacturing facilities. Improved coordination between manufacturers and contractors during the planning phase of the project will also contribute to the reduction of logistics issues (Yee, 2020).

Another barrier is a lack of technical knowledge and experience with IBS technologies. Therefore, there is a need for more emphasis on education, training and professional development of IBS. It is important for government agencies, commercial organisations and educational institutions to cooperate in the development and provision of training programmes and workshops to enhance industry knowledge and technical competence (Rahman & Omar, 2006).

By addressing these three barriers, the readiness of organisations to use IBS will be improved and will contribute to improved productivity and efficiency in the Malaysian construction sector.

5.0 CONCLUSIONS

The aim of this study was to identify the barriers affecting IBS adoption in the Malaysian construction industry. A survey was conducted among building contractors, building consultants and project managers using descriptive statistics, RII and inferential statistical analysis methods.

The first objective was to determine the level of IBS adoption in Malaysia. The results indicate that 91.6% of

respondents were involved with IBS, showing that exposure of the Malaysian building industry to IBS is quite high. This high involvement is attributed to mandatory IBS requirements for government projects above RM10 million and private projects above RM50 million with 50,000 m^2 GFA, alongside the classification of any project with prefabricated components as an IBS project. However, despite this high exposure, many factors still contribute to the limited use of IBS.

The second objective was to investigate the perceived barriers affecting IBS adoption. Using RII, the integration barrier (RII = 0.812) was the top-ranking barrier, followed by logistics (RII = 0.809) and insufficient knowledge (RII = 0.798). The top three barrier statements are:

(i) Route restrictions and limited site access create challenges in delivering large IBS modules.
(ii) Limited IBS experience among project parties hinders smooth integration.
(iii) We rely on external IBS specialists due to limited in-house technical capability.

The third objective evaluated the relationship between perceived barriers and organisational readiness. A Spearman Correlation Analysis showed that all three barriers were negatively correlated to organisational readiness with all three being statistically significant at a p-value < 0.001. There was a negative correlation shown between all three barriers and higher perceived barriers to adopting an IBS indicating that the greater the perceived barrier to adoption of an IBS, the lower the organisation's readiness to adopt was. Multiple regression analyses provided support for the model used (R^2 = 0.707, p < 0.001). The barrier to integration was the largest barrier presented to the adoption of an IBS, followed by logistics and insufficient knowledge.

In conclusion, many professionals have had exposure to IBS, but numerous challenges remain. It is acknowledged that the sample predominantly comprised respondents with direct IBS involvement (91.6%), which may not fully represent the perspectives of organisation s with limited or no IBS experience. Nevertheless, this high level of involvement enhances the credibility of the findings, as the responses were provided by professionals with direct, practical knowledge of IBS implementation. Based on these findings, actions required include addressing integration and logistics issues and enhancing knowledge to encourage widespread IBS utilisation. ■

AUTHORS' CONTRIBUTIONS

Shino E Ching Tay	Conceptualisation, study design, data collection, analysis, writing original draft preparation, visualisation, and software implementation
Chee Fui Wong	Supervision, guidance on conceptual direction, format and structure, and final manuscript approval
Hooi Ling Khoo	Supervision, format and structure, language refinement, and final manuscript approval
Lay Sheng Ewe	Technical support, visualisation and investigation
Riza Suwondo	Technical support, visualisation and investigation

REFERENCES

[1] Aini, A. A., Wee, S. T., Shafii, H., & Khalid, Z. (2025). The challenges of supply chain management (SCM) in industrialised building system (IBS): Case study in Selangor. *Research in Management and Technology Bulletin, 6*(1), 1-10. https://doi.org/10.30880/rmtb.2025.06.01.043

[2] Abdul Rahim, A., & Latif Qureshi, S. (2018). A review of IBS implementation in Malaysia and Singapore. *Planning Malaysia: Journal of the Malaysian Institute of Planners, 16*(2), 323-333.

[3] Al-Aidrous, M. H., Rahmawati, Y., Yusof, K. W., & Baarimah, A. O. (2021). Review of industrialized buildings experience in Malaysia: An example of a developing country. *IOP Conference Series: Earth and Environmental Science, 682*(1), Article 012003. https://doi.org/10.1088/1755-1315/682/1/012003

[4] Amede, E. A., Woldesenbet, A. K., Bahiru, A. K., Tibebu, F. T., & Hailemariam, L. M. (2025). Transforming construction in emerging economies: Overcoming barriers to the adoption of industrialized building systems. *Journal of Construction in Developing Economies*.

[5] Anderson, D. R., & Sweeney, D. J. (2025). Hypothesis testing. In *Encyclopaedia Britannica*. https://www.britannica.com/science/statistics/Hypothesis-testing

[6] Arof, K. Z. M., Ismail, S., & Saleh, A. L. (2018). Contractor's performance appraisal system in the Malaysian construction industry: Current practice, perception and understanding. *International Journal of Engineering & Technology, 7*(3.9), 46-51.

[7] Azman, N. S., Ramli, M. Z., Razman, R., & Hafiz, M. (2019). Relative importance index (RII) in ranking of quality factors on industrialised building system (IBS) projects in Malaysia. *AIP Conference Proceedings, 2129*(1), Article 020029. https://doi.org/10.1063/1.5118037

[8] Bevans, R. (2023). *Multiple linear regression: A quick guide (examples)*. Scribbr. https://www.scribbr.com/statistics/multiple-linear-regression/

[9] Construction Industry Development Board Malaysia. (2021a). *IBS adoption on government and private projects in Malaysia 2019* (Technical Publication No. 212). https://www.cidb.gov.my/wp-content/uploads/2022/07/212-IBS-Adoption-on-government-private-projects-2019-min.pdf

[10] Construction Industry Development Board Malaysia. (2021b). *Guideline for IBS production (Precast concrete system)*. https://www.cidb.gov.my/wp-content/uploads/2022/07/2115-Guideline-for-IBS-Production-Precast-Concrete-System-min.pdf

[11] Construction Industry Development Board Malaysia. (2022). *IBS & QLASSIC: Making it work for the industry*. https://www.cidb.gov.my/wp-content/uploads/2022/07/217-IBS-QLASSIC-Making-it-Work-for-the-industry-min.pdf

[12] Fauzi, M. A., Hasim, S., Awang, A., Mohd Ridzuan, A. R., & Yunus, J. N. (2017). Supply chain management on IBS implementation in Klang Valley construction industry: Challenges and issues. *IOP Conference Series: Materials Science and Engineering, 291*(1), 1-7. https://doi.org/10.1088/1757-899X/291/1/012009

[13] Frost, J. (2023a). Multicollinearity in regression analysis: *Problems, detection, and solutions*. Statistics by Jim. https://statisticsbyjim.com/regression/multicollinearity-in-regression-analysis/

[14] Frost, J. (2023b). *How to interpret coefficients and p-values in regression*. Statistics by Jim. https://statisticsbyjim.com/regression/interpret-coefficients-p-values-regression/

[15] Gholanreza, N., Omar, M. F., & Rahim, A. A. (2021). The development of the construction industry in Malaysia: Challenges and solutions for sustainable industrialised building system (IBS). *IOP Conference Series: Earth and Environmental Science, 682*(1), Article 012065. https://doi.org/10.1088/1755-1315/682/1/012065

[16] Habibzadeh, F. (2024). Statistical testing of normality: Practical considerations for biomedical and social science research. *Journal of Korean Medical Science, 39*, e35. https://doi.org/10.3346/jkms.2024.39.e35

[17] Hayes, A. (2024). *Descriptive statistics: Definition, overview, types, example*. Investopedia. https://www.investopedia.com/terms/d/descriptive_statistics.asp

[18] Ibrahim, I. H., Sorazan, W. M. F. W., & Wan Muhammad, W. M. N. (2022). *Transportation and cost issues in modular construction for IBS (Industrialized Building System)*. https://kwpublications.com/papers_submitted/11517/transportation-and-cost-issues-in-modular-construction-for-ibs-industrialized-building-system.pdf

[19] IBS Centre. (2012). *IBS roadmap 2011-2015*. http://www.vertilite.asia/f/2012/09/IBS-Roadmap-2011-2015.pdf

[20] Construction Industry Development Board Malaysia. (2003). *IBS survey 2003*. Construction Industry Development Board Malaysia.

[21] Ismail, Z. A., Mutalib, A. A., & Hamzah, N. (2016). A case study of maintenance management systems in Malaysian complex and high-rise industrialized building system buildings. *International Journal of Economics and Financial Issues, 6*(3S), 28-35.

[22] Kabir, S. M. S. (2016). *Methods of data collection: Basic guidelines for research: An introductory approach for all disciplines* (1st ed.). Book Zone Publications.

[23] Ismail, Z. A., Mutalib, A. A., & Hamzah, N. (2016). A case study of maintenance management systems in Malaysian complex and high-rise industrialized building system buildings. *International Journal of Economics and Financial Issues, 6*(3S), 28-35.

[24] Kabir, S. M. S. (2016). *Methods of data collection: Basic guidelines for research: An introductory approach for all disciplines* (1st ed.). Book Zone Publications.

[25] Kaur, S., Abas, N. H., Hasmori, M. F., Ta'at, N. H., Sabtu, H., & Abbasi, S. A. (2024). Stakeholders' perception on the current practices of industrial building system (IBS) construction technology. *Journal of Advanced Research in Applied Sciences and Engineering Technology, 44*(2), 199-209. https://doi.org/10.37934/araset.44.2.199209

[26] Kementerian Perumahan dan Kerajaan Tempatan. (2024). *Pekeliling Ketua Setiausaha Kementerian Perumahan dan Kerajaan Tempatan Bilangan 4 Tahun 2024: Garis panduan pemantauan dan pelaksanaan IBS bagi projek swasta*. https://www.kpkt.gov.my/kpkt/resources/user_1/MENGENAI%20KPKT/PEKELILING/2024/PK_KSU_KPKT_Bil_4_Tahun_2024_Pelaksanaan_IBS_Projek_Swasta.pdf

[27] Khalil, F. D. A., Abd Aziz, F. N. A., Hassim, S., & Jaafar, M. S. (2016). A review on industrialised building system issues in Malaysia. *MATEC Web of Conferences, 47*, Article 04019. https://doi.org/10.1051/matecconf/20164704019

[28] Koo, M., & Yang, S. W. (2025). Likert-type scale. *Encyclopedia, 5*(1), 18. https://doi.org/10.3390/encyclopedia5010018

[29] Lee, Y. Y., Abdullah, N. M. Q. B., Lee, Y. H., Gui, H. C., & Whyte, A. (2020). Perception analysis of industrialized building system (IBS) implementation for G7 contractors in Kuching, Sarawak. *ASM Science Journal, 14*, 1-7. https://doi.org/10.32802/asmscj.2020.641

[30] Masram, H., Yassin, A. M., Shafii, H., & Murugappah, P. (2024). Challenges in the implementation of industrialised building system (IBS) in Klang Valley. *MATEC Web of Conferences*. https://www.matec-conferences.org/articles/matecconf/pdf/2024/09/matecconf_icecon24_01001.pdf

[31] McLeod, S. (2023). *Questionnaires: Definition, examples, and types*. Simply Psychology. https://www.simplypsychology.org/questionnaires.html

[32] Md Azree, O. M., & Abd Rahim, N. M. S. (2014). Performance of IBS-concrete structures under environmental exposure. *MATEC Web of Conferences, 10*, 1-9. https://doi.org/10.1051/matecconf/20141001002

[33] Mohd Nawi, M. N., Ahmad Pozin, M. A., Mohamad Kamar, K. A., Lee, A., & Harun, A. N. (2019). The global adoption of industrialised building system (IBS): Lessons learned. *The Journal of Social Sciences Research, Special Issue 6*, 1272-1278. https://doi.org/10.32861/jssr.spi6.1272.1278

[34] Narayan, E., & Cheah, R. (2025). Qualitative research in cardiac surgery: Importance, challenges, and opportunities. *Indian Journal of Thoracic and Cardiovascular Surgery, 41*(4), 498-502.

[35] Nieminen, P. (2022). Application of standardized regression coefficient in meta-analysis. *BioMedInformatics, 2*(3), 434-458. https://doi.org/10.3390/biomedinformatics2030028

[36] Pan, W., & Sidwell, C. (2020). Supply chain integration and performance in industrialised construction. *Construction Innovation, 20*(2), 234-252. https://doi.org/10.1108/CI-07-2019-0067

[37] Qays, M., Mustapha, K. N., Al Mattarneh, H., & Mohamed, B. S. (2010). *Proceedings of the International Conference on Science and Engineering 2010 (ICSE2010)*. Melaka, Malaysia.

[38] Rahman, A. B. A., & Omar, W. (2006). Issues and challenges in the implementation of industrialised building systems in Malaysia. In *Proceedings of the 6th Asia-Pacific Structural Engineering and Construction Conference (APSEC 2006)* (pp. 5-6). Kuala Lumpur, Malaysia. https://eprints.utm.my/529/1/AhmadBaharuddinAbd2006_IssuesAndChallengesInTheImplementation.pdf

[39] Ravitch, S. M., & Riggan, M. (2016). *Reason and rigor: How conceptual frameworks guide research* (2nd ed.). Sage.

[40] Samsi, M. S. B. (2024). *The readiness and challenges in the industrialised building system adoption in Malaysia's construction industry* (Master's thesis, Universiti Teknologi MARA). https://ir.uitm.edu.my/98856/1/98856.pdf

[41] Schmidt, A. F., & Finan, C. (2018). Linear regression and the normality assumption. *Journal of Clinical Epidemiology, 98*, 152-153. https://doi.org/10.1016/j.jclinepi.2017.12.006

[42] Taherdoost, H. (2021). *Data collection methods and tools for research: A step-by-step guide to choose data collection technique for academic and business research projects*. ResearchGate. https://www.researchgate.net/publication/359596426_Data_Collection_Methods_and_Tools_for_Research_A_Step-by-Step_Guide_to_Choose_Data_Collection_Technique_for_Academic_and_Business_Research_Projects

[43] Walliman, N. (2018). *Research methods: The basics* (2nd ed.). Routledge. https://us.sagepub.com/sites/default/files/upm-assets/110533_book_item_110533.pdf

[44] Yee, C. Y. (2020). *Barriers to implement industrialised building system (IBS) in Malaysia* (Bachelor's thesis, Tunku Abdul Rahman University College). https://eprints.tarc.edu.my/15622/

PROFILES



SHINO E CHING TAY is a dedicated student pursuing a Bachelor's degree in Civil Engineering with Honours from Universiti Tunku Abdul Rahman (UTAR), with an expected graduation date in June 2026. She is committed to her studies and actively seeks to learn about the latest advancements in engineering. Her enthusiasm for the field drives her to contribute positively to the engineering community.
Email address: shinotay2003@gmail.com



CHEE FUI WONG is Assistant Professor at Universiti Tunku Abdul Rahman (UTAR). He holds a MSc degree in Highway and Transport Engineering and a B.Eng. Degree in Civil Engineering, both from Universiti Putra Malaysia and Phd (Engineering) from UTAR. He is a Professional Engineer with Practicing Certificate (P.Eng), Professional Technologist (P.Tech); Certified Construction Project Manager (CCPM), Honorary Member of AFEO; Fellow of the Institution of Engineers, Malaysia (F.IEM), Fellow of Technological Association Malaysia (F.TAM), Fellow of ASEAN Academy of Engineering and Technology (F.AAET) and Fellow of the Academy of Engineering and Technology of Developing World (F.AETDEW). Internationally, he is registered as International Professional Engineer (IntPE) , APEC Engineer; ASEAN Engineer and ASEAN Chartered Professional Engineer (ACPE).
Email address: cfwong@utar.edu.my



HOOI LING KHOO is currently holding the Professor position in the Department of Civil Engineering of Lee Kong Chian Faculty of Engineering and Science in the Universiti Tunku Abdul Rahman (UTAR) Sungai Long Campus. She has more than 18 years of experience in the traffic engineering and transportation-related studies. She obtained her Bachelor and Master degrees in Civil Engineering from the University of Malaya and she earned her PhD degree from the National University of Singapore. Her research interests are in transportation system optimisation, travel demand management, travel behaviour modelling, public transportation, and traffic safety. She is a Professional Engineer with Practicing Certificate. She has been involved in many consultancy projects that relate to traffic impact assessment, traffic simulation, and township masterplan assessment. She is currently a fellow member of IEM and AAET.
Email address: khoohl@utar.edu.my



LAY SHENG EWE was born in Penang, Malaysia. She received her Ph.D. in Pure Physics from the National University of Malaysia (UKM). She is currently an Associate Professor at Universiti Tenaga Nasional (UNITEN), Putrajaya Campus, Malaysia. Her research interests include material science, superconductivity, and magnetoresistance (MR). In 2020, she was awarded the Professional Technologist certification by the Malaysia Board of Technologists (MBOT). She also serves as an active committee member of the Malaysia Association of STEM Olympiads (MASO).
Email address: laysheng@uniten.edu.my



RIZA SUWONDO is an accomplished researcher, engineer, and educator currently serving as a lecturer in the Civil Engineering Department at Bina Nusantara University. Riza also boasts over 15 years of rich experience in the construction industry. At the core of his current research endeavours is a pursuit to enhance the technical performance, resilience, low-carbon footprint, sustainability, cost efficiency, and circular economy aspects of construction materials and civil engineering structures. In addition, he has recently been an associate member of the ASCE with over ten years of experience in various industries, including civil construction, power plants, and natural gas development in Indonesia as well as abroad.
Email address: riza.suwondo@binus.ac.id