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A Study of Factors Affecting the Use of Industrialized Building System (IBS) Construction in Sabah

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Abstract

The Industrialized Building System (IBS) has been introduced in Malaysia since the early 1960s, offering numerous advantages. This study aims to investigate the factors influencing the implementation of IBS in the construction industry in Sabah. A quantitative research approach was adopted, involving a sample of respondents registered with the Construction Industry Development Board (CIDB) who are actively engaged in IBS-related projects. The study focused on four key constructs: perception (P), knowledge (G), skills (K), and technology (N) in relation to the utilisation of the IBS system. A total of 182 participants, representing both government agencies and private sector entities, contributed to this study. Findings related to the knowledge construct revealed a strong consensus among respondents, indicating that individuals involved in IBS possess relevant knowledge and experience, with mean scores ranging from 4.19 to 4.40. However, concerns emerged regarding the skills dimension, where mean values ranged between 3.48 and 4.01. This suggests a degree of uncertainty or lack of confidence among respondents regarding the skill levels of personnel engaged in IBS. In terms of technology, the perception of IBS safety appeared to be a critical issue, with a relatively low mean score of 3.81. This perception may stem from the lighter structural components of IBS compared to conventional systems, potentially leading to misconceptions about its structural integrity. Overall, the insights derived from this study are significant for policymakers and stakeholders in the construction sector. The findings underscore the need for targeted strategies to enhance awareness, provide training, and promote the advantages of IBS—particularly in advancing its adoption within construction projects in Sabah.

Keywords: - Industrialized, building, system, technology, skills, knowledge

1. Introduction

The Industrialized Building System (IBS) represents a modern and innovative approach in construction, where transported and assembled with minimal reliance on manual labor at the construction site. Despite its introduction in Malaysia over five decades ago, the adoption of IBS remains far from widespread, with its implementation still limited and lacking in depth from an observational perspective. Findings from a comprehensive desk study reveal a significant gap in research related to the IBS system in Sabah, particularly when compared to the extensive studies conducted in Peninsular Malaysia. Based on data gathered from both governmental and private sector sources, it is hypothesized that one of the key challenges hindering the effective implementation of IBS in Sabah is the lack of skilled labor.

1.1 Research Question

There are three questions to be highlighted and presented.

1. What is the perception of the construction sector community towards the IBS system in Sabah?

2. Do the parties involved have knowledge and skills in using the IBS system?
3. Is IBS construction technology suitable for use in construction in Sabah?

1.2 Objective

Based on the research questions above, this study focuses on the following three objectives:

1. To identify the perception of the construction sector community towards IBS in Sabah.
2. To identify knowledge and skills on IBS.
3. To identify the suitability of IBS technology in building construction in Sabah.

2. Literature Review

The adoption of Industrialized Building Systems (IBS) in construction projects can significantly elevate on-site performance by enhancing safety, improving quality, increasing cost efficiency and productivity, and minimizing waste (Alawag et al., 2021). The government has agreed to make the use of the IBS method compulsory for Government projects worth RM10 million and above with a minimum rate of 70% of the IBS score value and set modular coordination to be used as a standard in building design (Malaysia, 2008). The top three critical factors are high initial capital cost, high initial cost of customized design, and transportation cost (Al-Aidrous et al., 2023). The manufacturing of components is done systematically using machines, molds, and other mechanical equipment (Azman et al., 2011). The benefits off-site construction is shorter project duration as both site work and higher build quality (Broadhead et al., 2023; Azman et al., 2012a). Among the advantages seen in IBS are in terms of quality, cost-effectiveness, safety and health, waste reduction, efficiency and productivity (Azman et al., 2012b; Nawi et al., 2011a). IBS is said to be able to replace conventional methods that are labor-oriented (Abedi et al., 2011). The use of IBS in Malaysia is still on a small scale and is often used in concentrated works such as bridge and tunnel construction (Rahim et al., 2022). Therefore, this study aims to identify the factors that influence the use of IBS systems in the construction of buildings in Sabah in terms of perception, knowledge, skills, and technology.

3. Methodology

This study uses random sampling to collect quantitative data obtained through the Questionnaire Survey Form distributed through the Google form application, QR code link, physical form, questionnaire Information of companies and agencies involved in the use of the IBS system in Sabah obtained and collected from the CIDB SMART website and other sources. The questionnaire distribution method is as follows:

i. Email the employer of the company involved with the IBS system in Sabah
ii. Online questionnaire distribution (Google Forms) is done through the WhatsApp application.
iii. Visits and interviews with company agencies and institutions involved in the use of the IBS system.

The survey was conducted at parties directly involved in the use of the IBS system. Descriptive analysis is carried out using quantitative methods because the study explains various factors and aspects that need to be analyzed. Research design is the central planning and strategy in answering research questions presented through data collection procedures and forms. Descriptive research is a classification of scientific research, with the goal of translating the nature of the population, experience or phenomenon to the study being conducted. In addition, it is carried out by considering the criteria for the formulation of questions that lead to research guidance and raising the link between the variables proposed in the object of study under analysis. In descriptive research, the researcher must choose whether to study, analyses, record and translate the facts of physical findings without manipulating or changing them.

4. Data Analysis

The data was analyzed based on the questions presented in the questionnaire that were distributed to the respondents according to the categories shown in Table 1. Through the responses given, the data were analysed using SPSS software to identify the scale of perception, knowledge, skills, and IBS technology used in construction in Sabah.

Table 1. Respondent category

Category	Employer / Agency / Company	Agency/Company Example
Category 1	Government	Jabatan Kerja Raya (JKR), Kementerian Pembangunan Luar Bandar (KPLB), etc.
Category 2	Statutory Body	Construction Industry Development Board
Category 3	Private (Developer/ Contractor/ consultant)	KTI Property, Hume Concrete Sdn Bhd, IBK Jurutera Perunding, Corebuilder IBS Sdn Bhd etc.
Category 4	Manufacturer / IBS industry	Beau Villas Sdn Bhd, Laysaght Blue Scope Sdn Bhd, City Top Sdn Bhd, ROII Innovation Industries (M) Sdn Bhd, Axtrada (M) Sdn Bhd. Bristeel Corporation Sdn Bhd
Category 5	Training providers/Skills Training Institutions/IPTS	Universiti Malaysia Sabah, Kolej Vokasional, Akademi Binaan Malaysia, Institut Kemahiran Mara, etc.

Table 2 presents data based on responses measured using a Likert scale. Overall, respondents predominantly indicated levels of agreement, with responses generally clustered around "strongly agree," "agree," and "neutral" options. In question category P (Perception), items 1 to 3 yielded an average Likert scale score of 4 with a mean score of 4.22. The reliability analysis for this category

produced a Cronbach's Alpha of 0.718, indicating good internal consistency. Similarly, for question category G (Knowledge), items 4 to 6 yielded an average score of 4, with a mean score of 4.32. The reliability for this category, indicated by a Cronbach's Alpha of 0.678, falls within an acceptable range.

Table 2. Respondent data

No of Question	Question Category	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree	Percentage %
Q1	Perception (P)	0.5	0	11	56	31.3	98.90%
Q2		0.5	0	12.6	43.4	77	98.90%
Q3		0.5	2.2	14.3	46.7	36.3	100%
Q4	Knowledge (G)	1.1	0	6.6	45.6	46.7	100%
Q5		0	0	7.1	45.1	46.7	98.90%
Q6		0	1.6	14.3	46.2	36.3	98.40%
Q7	Skill (K)	1.6	12.1	36.3	35.7	13.7	99.50%
Q8		2.2	12.1	33.5	37.4	13.7	99.50%
Q9		2.7	9.9	35.7	37.9	13.2	99.50%
Q10		1.1	11	28	37.9	19.8	97.80%
Q11		0	2.7	18.7	52.7	25.3	99.50%
Q12	Technology (N)	0.5	2.2	14.3	57.1	25.3	99.50%
Q13		0	2.2	16.5	50	29.7	98.40%
Q14		0.5	6.6	24.7	44.5	21.4	97.80%
Q15		0.5	2.7	15.4	46.2	33.5	98.40%

Table 3. Respondent category

No of Question	Question Category	Mean % (Average)	Standard Deviation Cronbach's Alpha (Average)
Q1 Q2 Q3	Perception (P)	4.22	0.718
Q4 Q5 Q6	Knowledge (G)	4.32	0.678
Q7 Q8 Q9 Q10 Q11	Skill (K)	3.63	0.908
Q12 Q13 Q14 Q15	Technology (N)	4.02	0.789

In the K category (Skills), items 7 to 11 received an average Likert scale score of 3, with a mean of 3.63, and demonstrated Cronbach's Alpha reliability coefficient of 0.908, indicating a high level of reliability. For the N category (Use of Technology), items 12 to 15 had an average score of 4 (mean: 4.02), with a Cronbach's Alpha of 0.789, reflecting good reliability. Based on the histogram bar P, on question P1 in Fig. 1 (a), respondents agree that the IBS system is essential and effective in construction. The bar histogram P2 in Fig. 1 (b) indicates that respondents also agree the IBS system contributes to cost, workforce, and time saving. Meanwhile, P3 in Fig. 1 (c), the IBS system, is very supportive of the green technology policy based on the data given by the respondents.

Analysis of histogram bar K reveals some issues to items K1 and K2 in Fig. 1 (d) – (e), where the averages scores were 3.48 and 3.5 respectively. These scores suggest that respondents are uncertain about construction workers' skills in using the IBS system or in understanding technical drawings and installation instructions.

The data analysis of histogram bar G for item G1 in Fig. 1 (g) indicates that respondents agree on the importance of knowledge and experience in the effective use of the IBS system. On histogram bar G2 in Fig. 1 (h), respondents agree that knowledge of IBS technology enables quicker completion of construction tasks. Similarly, on histogram bar G3 in Fig. 1 (i), respondents concur that knowledge of IBS is essential for evaluating its profitability compared to conventional systems. On histogram bar analysis K, exists because in K1 and K2, respectively, the average respondents answered on a scale of 3.48 and 3.5, which means that respondents are not sure that construction workers have skills in the use of IBS or are skilled in understanding technical if construction workers are skilled or not installing IBS components. Drawings and installation instructions for IBS components. In K3, the scale is 3.49, and the respondents are wondering if construction workers are skilled in interpreting technical drawings and installing IBS components.

For item K3, with an average score of 3.49, respondents expressed uncertainty regarding whether current construction workers are skilled in interpreting technical drawings and installing IBS components. Histogram bars for K4 and K5 (see Fig. 1 (j) – (k)) show average scores of 3.66 and 4.01, respectively. In K4, respondents question whether workers involved in the IBS system have received adequate training. In contrast, respondents in K5 agree that IBS courses and training are appropriate for supporting the use of the latest technology.

Histogram bar analyses for N, N1, and N2 as illustrate in Fig. 1 (l) – (m) are at 4.05 and 4.09, where the respondents agree that the IBS system technology is suitable for meeting Malaysian standards and can guarantee the quality of building construction compared to conventional methods. In N3, the average data was 3.81, which means that respondents are still determining whether IBS technology is safe compared to conventional methods. In N4, respondents agree that the IBS technology system is suitable for Sabah.

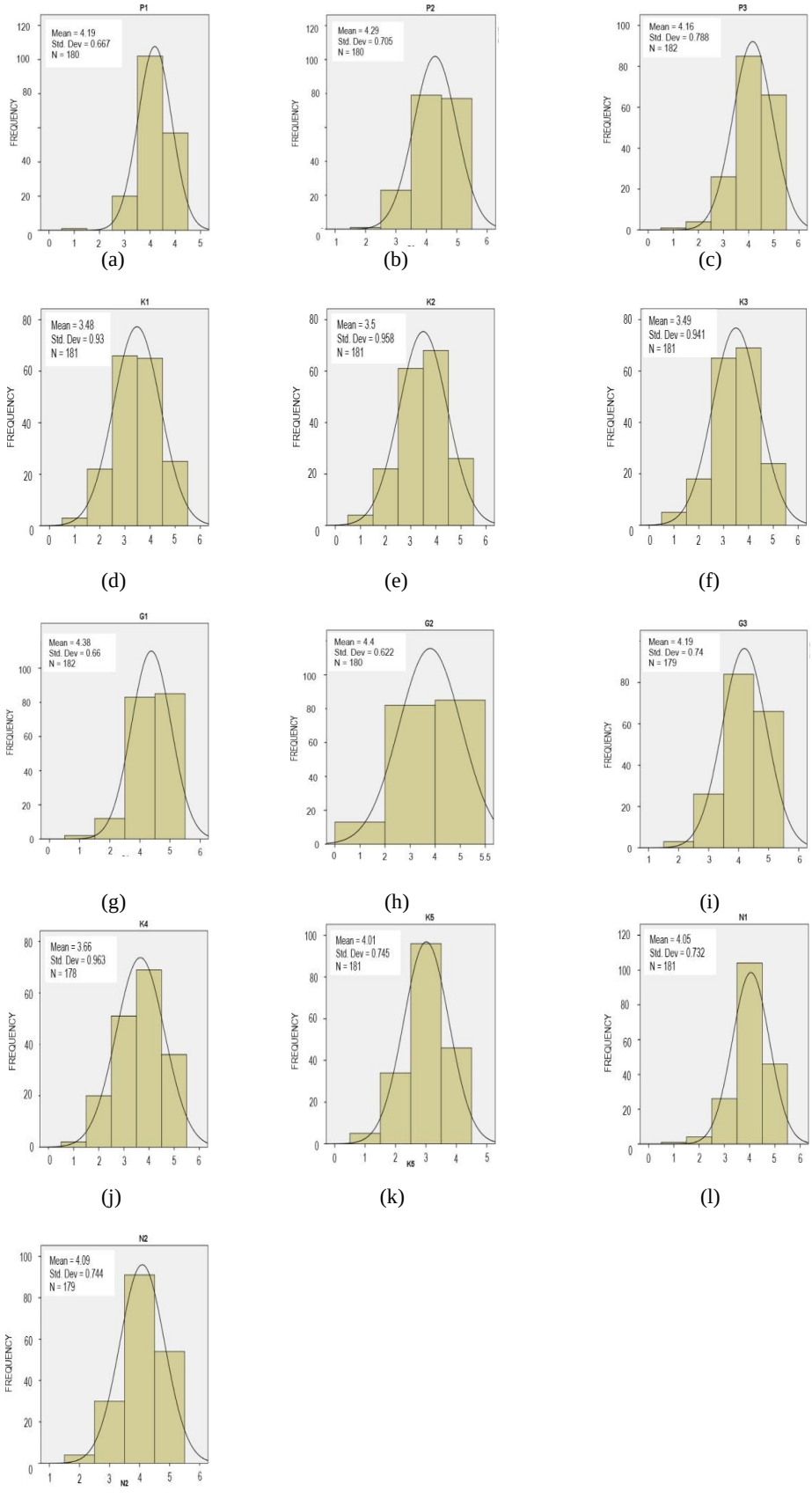

Fig. 1. Histogram of (a) P1, (b) P2, (c) P3, (d) K1, (e) K2, (f) K3, (g) G1, (h) G2, (i) G3, (j) K4, (k) K5, (l) N1 and (m) N2

5. Result and Discussion

Malaysia, as a developing country, is presently attempting to implement the innovative or contemporary construction system of IBS. This will be a substitute for sustainable construction productivity and enhancement of construction performance. The level of implementation of IBS still needs to improve, though it is under the governmental development strategic aims. The construction industry plays a vital role in the development of Malaysia, and it is predicted to be a key contributor towards the Construction Industry Development Board's vision.

5.1 Perception

The study's analysis of respondents' perceptions indicates optimism about the IBS construction system in Sabah, with an average mean score of 4.22. This aligns with findings from Razak & Awang (2014), which show that respondents are aware of the existence, benefits, and limitations of IBS. Developers are reportedly collaborating with the government to promote IBS implementation nationwide. Although IBS components are not yet fully adopted in all housing projects whether government or private, gradual acceptance of IBS warrants consideration. As a versatile approach for diversifying Malaysia's housing construction system, IBS requires the committed support of various stakeholders for successful integration. Knowledge on average, respondents agree that knowledge of the IBS system is essential, where the average Mean is as much as

4.32. This finding is in line with Nawi et al. (2011b), where IBS contractors think that knowledge of fabrication is also essential to avoid errors during IBS component connection works. Therefore, monitoring and standardizing the size and shape of components is very important to prevent problems during the installation process. In addition, there is a lack of knowledge and skilled workers, a lack of incentives, negative perception, project delivery matters and extra cost (Rashid et al., 2018).

5.2 Skills

There is an issue in terms of skills, where the results of the analysis range from 3.48 to 3.5, and the response is not sure about the level of skills of workers in the field of IBS. Among the various barriers affecting the implementation of IBS in the Malaysian construction industry, cost, time, and labor shortages are considered the primary challenges (Rahman & Omar, 2006). The review through various studies showed that the adoption of IBS in the Malaysian construction industry had taken place decades ago. However, the contractors still prefer the use of conventional methods for several reasons, such as familiarity with those methods and the difficulty of changing to an automated system, as this new technology can be applied appropriately for small-scale projects. The site should have a well-trained worker in addition to intense monitoring by installing 24-hours surveillance cameras in problem prone areas (Masram et al., 2024).

5.3 Technology

In relation to safety, on average, the analysis results were 3.81, which shows that respondents wonder whether this IBS system is safe or not to be applied in Sabah. Therefore, to convince the public, this IBS system needs to be studied to produce a solid structure. The adoption of IBS in construction projects promises a practice that increases productivity and the construction industry toward sustainability and the IR 4.0 industrial revolution that can compete with other countries to realize an image of professionalism (Halim et al., 2024). However, this involves high capital investment, lack of training, and technological acceptance.

6. Conclusion

Based on the findings of the study, it was identified that there are issues related to worker skills in the IBS system, as indicated by the histogram bar scores, which range between 3.66 and 4.01. This suggests that respondents remain uncertain about the skill levels of IBS construction workers with responses clustering around the midpoint of the scale.

In addition, from a safety perspective, a relatively low score of 3.81 was recorded. This result may be interpreted as a reflection of the perception that IBS components, most of which are hollow panels, are less sturdy compared to conventional building structures. The findings of this study should be taken into serious consideration by stakeholders directly involved in the IBS system, to strengthen confidence among industry players and users, thereby fostering greater support for IBS and advancing the vision of sustainable construction in the future as illustrate in Table 4.

Table 4. Suggestion

Agency	Suggestion
Ministry public of Works Public Works Department)	Determine the use of the IBS system on part of the project- government projects other than schools/teachers' quarters such as IPT/Court/Ministry buildings and so on.
CIDB	Establishing the use of the IBS system on some government projects other than schools / teachers' quarters, such as IPT / Court/ Ministry buildings and so on.
Developer/Contractor	Need to be given certain conditions (e.g. IBS certification) before getting involved with a project that uses the IBS system.
Manufacturer of IBS Products	Supplying and monitoring the installation work at the construction site so that quality can be controlled.
Training Provider (Malaysian Building Academy)	Intensify IBS courses and offer courses to contractors and construction workers so that they are more skilled.
Higher Education	Consistently collaborate with the industry so

Institution/ Skills Training Institution (Kolej Vokasional /Polytechnic/Institut Kemahiran Mara etc.)	that the IBS courses offered meet the standards and use the latest technology.

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Conflicts of Interest: The authors declare no conflict of interest.

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