Challenges in the Implementation of Industrialised Building System (IBS) in Klang Valley

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Abstract. Industrialised building system (IBS) in Malaysia has been expanding extensively where the proportion of IBS implementation in government projects was 84% in 2021, compared to 60% in private projects. It was reported that many top developers are currently successfully adopting IBS in their projects with good outcomes. The advantage of IBS implementation in construction projects is mainly the shorter time for project completion which potentially increase efficiency in housing provision. This paper focuses on developers' perception on the challenges in IBS implementation in the aspect of management. The objectives of this research are to identify the problems perceived by developers in Klang Valley when implementing IBS projects and to give general recommendations to overcome these problems. Quantitative approach was used and structured questionnaires were distributed to 50 developers in Klang Valley. The research indicated that the most prominent problems agreed by developers is in the category of supervision of site workers and also the aspect of logistic that is site monitoring The least problem perceived are in the design and IBS negative image category. Findings from this research is anticipated to give developers some insights on the implementation of IBS towards a more successful IBS project implementation.

1 Introduction

The Malaysian housing sector has always been a significant growth driver of the economy contributing towards the nation's infrastructure and construction industry as well as being a major source of employment. The current issues in the housing sector is how to increase the supply of affordable housing in the market. The construction industry contribute significantly

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towards the efficiency of housing provision. In this technology and innovation dominated generation, construction industry is adopting technology to improve the industry's performance. Many efforts have been introduced to improve Malaysian construction industry and eventually the efficiency of the housing provision for the nation. This effort includes implementing smart technologies such as Industrialized Building System (IBS). The Industrialised Building System (IBS), also known as prefabrication at the time, began in the early 1960s when Malaysian Ministry of Housing and Local Government officers visited a number of European nations and evaluated their housing development programmes (Thanoon et al., 2003a).

At the time, most Malaysians were unaware of the Industrialised Building System. Following their inspections and suggestions, the government launched a pilot project in 1964 with the goal of accelerating the production of high-quality, "low-cost" or affordable homes. Referring specifically to housing projects, IBS housing is a technique where a house will be built in sections manufactured from designated specifications within a factory and then assembled at the point of construction. Parts are produced in a controlled setting, either on or off site and after completion, it will be moved, installed, and then put together into building projects with the least amount of further site work (CIDB, 2003).

IBS is also characterised as an organisational process where continuity of production, which implies a constant flow of demand, standardisation, integration of the various stages of the entire production process, a high degree of organisational work, automation to replace labour wherever possible, and where research and organised experimentation are integrated with production (Hassim, 2009). This could refer to IBS as an integrated manufacturing and construction process, carefully planned organization, and efficient management, preparation and control of resources, activities and results from the highly developed components. The manufacturing of the components are done with machines, templates, and other forms of machinery and equipment. Components manufactured off-site, once completed, will be delivered to the General Assembly and erection of the construction site. The term IBS is often tossed around in the world of construction in Malaysia, overseas it goes by other terms such as pre-fabricated construction, Modern Method of Construction (MMC) or even Off-site Construction.

1.1 Problem Statement

According to CIDB, IBS is well-defined as a construction method with components that are factory-made in organized atmosphere, and at the same time, they are conveyed, placed and collected into a construction without excessive additional site works (Alawag A.M.M et al, 2021). Malaysia's very first IBS project was started by the government in the 1960's. The IBS technology has seen slow and steady growth in Malaysia. Even though, there are developers who prefer adopting conventional method in housing development, there are also good number of developers who prefer to implement IBS. IBS is preferred by developers due to many reasons including numerous benefits which include the ability to build cheap, fast and clean unit of houses.

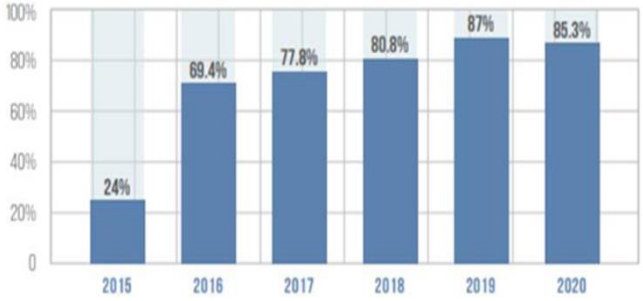

Fig. 1. Percentage of IBS Adoption Public Sector From 2015 – 2020 (CIDB, 2020).

According to the Construction Industry Development Board (CIDB), between 2015 to 2020, the percentage of IBS adoption in the Malaysian public sector increased from 24% (2015) to 87% (2019) and it experienced a minor decline by 2020 (85.3%). The increase from 20% to 80% indicates that the IBS implementation by Malaysian developers is currently significantly high. Moreover, the proportion of IBS implementation in government projects was 84% in 2021, compared to 60% in private projects, according to the Construction Industry Development Board (2020). Both industries experienced growth as compared to the previous year (Bernama, 2023). From this, it is evident that the IBS projects are highly favoured by developers. Many big developers are now using IBS in their projects with favourable results namely Gamuda Bhd, SP Setia Bhd, Mah Sing Group Bhd and many more (Bernama, 2023). The high implementation rate indicates that IBS is gaining popularity, and is potential to improve the efficiency of housing provision. Therefore, it is important to study the challenges faced and perceived by developers. Referring to the developers' role and responsibilities throughout the project cycle, management factors is seen as important to ensure successful implementation of IBS project. (Ismail, F et al, 2012).

1.2 Scope of Study

IBS is a building method known as an Industrialised Building System. It is one in which the parts are produced in a controlled setting, either on or off site. After it is finished, it will be moved, installed, and, then put together into building projects with the least amount of further site work (CIDB, 2003). IBS is also characterised as an organisational process continuity of production. Considering the advantages of using IBS system in particular in achieving a more efficient housing provision, perception of developers on problems in the implementation of IBS is crucial. In response to this issue, the objectives of the study are to study the challenges faced by developers in implementing IBS particularly in the aspect of management and to propose general recommendations to overcome these challenges. This study will look at the challenges perceived by developers in Klang Valley to implement IBS system in the aspect of management. Identification of the problem prone areas in implementing IBS could initiate recommendations for prevention. Eventually, this could lead to a more successful IBS project implementation by developers.

2 Literature

Literature will look into scholarly articles needed to develop a framework theory as a basis for study, as well as for gain a thorough understanding of the subject and the researcher pioneer in this field.

2.1 IBS – Industrialised Building System

IBS is a building method known as an Industrialised Building System. According to CIDB, there are five features of IBS; prefabrication, offsite manufacture, mass production (repeatability), standardized components and design using modular coordination IBS can be defined as a construction technique in which components are manufactured in a controlled environment or controlled setting either on or off-site where it minimises activities at the site of construction. After it is finished, it will be moved, installed, and then put together into building projects with the least amount of further site work (CIDB, 2003). These are transported, positioned and assembled into a structure with the least of additional site work. The components of the IBS are materials that are produced in factories where quality control is not compromised on. (Othuman Mydin et al, 2014).

IBS is also characterised as an organisational process continuity of production, which implies a constant flow of demand, standardisation, integration of the various stages of the entire production process, a high degree of organisational work, automation to replace labour wherever possible, and where research and organised experimentation are integrated with production (Hassim, 2009). IBS can be generally categorised into 5 types :

a. Pre cast concrete system (walls, slabs, columns, 3D components)
b. Steel framework system
c. Steel framing system
d. Prefabricated timber framing systems
e. Block work systems

2.2 Advantages and Disadvantages of IBS

Place the figure as close as possible after the point where it is first referenced in the text. If there is a large number of figures and tables, it might be necessary to place some before their text ctation.

Table 1. Advantages and Disadvantages of IBS .

ADVANTAGES	DISADVANTAGES
Optimal material utilisation, frequent and repeated use of moulds, and minimal material waste (Bing et. al. 2001).	Time delay as a result of poor planning and conventional procurement methods (Mohammad et al., 2016)
Factory-made quality products from rational and efficient manufacturing processes, employment of skilled workers, repetitive procedures, and constant quality surveillance and control, etc (Nawi et. al., 2007b; Shaari and Ismail, 2003; Thanoon et. al., 2003b	Lack of skills IBS systems with unskilled employees and a lack of technical knowledge (Mohammad et al., 2016). Insufficient Skilled Worker. Worker with insufficient skill. Prefabricated construction components produced by workers with insufficient expertise and understanding

	cannot be guaranteed to be of high quality (Luo et al., 2015)
Shorter construction time - less than half the amount of time required for traditional cast-in-situ construction (Shaari and Ismail, 2003; Nawi et. al., 2005; Thanoon et. al., 2003).	Difficult to Modify after Installation. The responses point out that there is no likelihood of changing the decision after the factory has begun producing the prefabricated component (Md. Ali et al., 2018).
Since prefabricated components are produced in a factory-controlled environment, bad weather has no impact on construction operations (Peng, 1986).	Transportation Limitation. For assembly tasks, the IBS needs enough channels to carry all the components to the building site (Md Azree & Abd Rahim, 2014).

2.3 Project Management in IBS Project

Before discussing on the challenges of IBS implementation, success factors that has been observed should be addressed. Management factors are important to ensure successful implementation of IBS project. Some of the variables within the management aspect that have been highlighted as an indicator for a successful IBS project are rapid construction, quality production, completion within budget, extensive planning and scheduling, low risk handling, flexibility of design, technology of plant and equipment used (Ismail, F et al, 2012).

According to study by Yusof, M.R et al (2014) the need to make an early plan/strategy with all parties is very significant. This variable should be taken as an integral part of the design from the earliest stage of the project. The second most significant variable is a good logistic schedule for IBS product delivery by providing a clear and simple project hat a structure and supply chain management from top to bottom. It can be concluded that a good management is essential for a successful implementation of IBS.

2.4 Challenges of IBS Implementation

Challenges in IBS implementation is categorised into enormous capital cost, human barriers, insufficient knowledge, component standardisation issues, availability of cheap foreign labour, transportation coordination and on-site construction process issues. (Jabar, I.L. & Ismail, F, 2018). In addition to that, other problems were also highlighted by other scholars these include design issues, and image.

2.4.1 Capital Cost

Many housing developers are reluctant to take a risk by using IBS because of the high initial cost, requirement for upfront 4 payments of 30% to 50% before components can be manufactured, and demand for skilled labours in some countries that are experiencing economic difficulties (Bildsten, 2011). IBS contractors and developers are still obligated to pay for the fabrication of the components, transportation costs, and storage costs even if they decide to stop or suspend the project because of the contract (Lovell & Smith 2010). Prefabricated homes can still draw in a lot of interested purchasers and obtain positive customer reviews, but occasionally housing developers need to reassure and persuade the financial institution of this (Madigan 2012). This is the case due to the doubts held by certain

planners, bankers, lenders, and insurers that prefabricated homes cannot have the same level of success as traditional homes (Lovell & Smith 2010) Great investment is needed at the beginning to set up the plant, supplying machinery and moulds and engineering consideration (Qays et al., 2010) Require a huge volume of work to break even on the investment which means IBS needs mass production in order to achieve economic viability (Alinaitwe et al., 2011)

2.4.2 Human Barriers

IBS is not popular among architects and designers based on users' perception, IBS building are fragile and impermanent structure. It has been demonstrated that the adoption of IBS would not be successful without sufficient planning and preparation from builders (Nadim & Goulding, 2011). If a mistake occurs, fixes would also take longer than normal, especially for builders who are new to this system (Gibb & Isack, 2003). Apart from that, it is also difficult to change mindset due to the historical failure (CIDB, 2010). Players are a reluctant to change to the new construction method as they have to embrace new ways of thinking and working (Nadim & Goulding, 2010) In addition, IBS requires additional investment for human capital (Kamarul Anuar Mohd Kamar, 2011). Some businesses have problems as a result of workers' lack of familiarity with the IBS system and the difficulties they encounter while switching from the conventional technique to the IBS (Sadafi et al., 2011). Due to the lack of knowledge and awareness, local authorities tend to misinterpret IBS current building guidelines adding to further delays in approval (Kamar et. al., 2009).

2.4.3 Insufficient Knowledge

Majority of developers feel at ease utilizing conventional methods because they are more familiar with conventional cost estimates and construction processes, thus they are wary of using IBS since the system is unusual and they are unfamiliar with it (Nadim & Goulding, 2011). Lack of knowledge and exposure to IBS contributed to poor structural analysis and design which leads to problems such as cracks, leakage and other defects (Rahman & Omar,2006) The lack of knowledge of the consultants, client/owner of the project and the contractors is one of the reasons on delay of IBS take-up (Onyeizu et al., 2011). Moreover, lack of educational courses in universities' academic curricular had caused the industry players tend to choose familiar conventional construction method (Qays et al.,2010

2.4.4 Component Standardisation Issues

The successful of IBS usage also depends on the standardisation of components where the component standardisation is perceived to be low which prevent the same components to be used for other projects (Hashim & Kamar, 2011). The effect of low standardisation will increase the initial cost due to the design cost and moulding which cannot be used for other project (Hamid et al., 2008). As a result, it is advised that projects using IBS have their own set of construction regulations that are distinct from the usual regulations for traditional methods (Nadim & Goulding 2011; Zainul Abidin, 2010). In terms of health and safety, environmental effect, waste management, thermal performance, projects that are using IBS must adhere to the same standards as projects using conventional methods (Miller & Buys, 2012). There are still no particular IBS building laws, common standards for contract papers, or procurement mechanisms in terms of tendering, design, construction, and payment since the IBS Roadmap of 2003. The only sources or guidelines are IBS catalogues published by CIDB Malaysia such as Precast Concrete Building Components for Residential Buildings,

Modular Coordination Implications - Building By Laws and Regulations, and Joints and Tolerances for Building Construction (Kamar et al. 2009; Hussein, 2007)

2.4.5 Supervision of Workforce

People involved in the IBS project workforce are important key players in accomplishing successful IBS project implementation (Khaled M., 2019). Poor communication and misunderstanding immediately affect the quality of information and communication as well as the complexity of the construction project's successful completion (Mohammad et al., 2014). A skilled workforce with the ability to organize, plan, and manage the design, manufacture, coordination, and distribution of components is necessary for implementation to be effective (Warszawski, 1999). Monitoring and effective communication becoming vital for the distribution of information regarding decisions, designs, transportation requirements and schedules

2.4.6 Transportation

Challenges in transporting and coordinating IBS construction are size and weight limitations, route restrictions, permitting and the availability of lifting equipment Haas & Fagerlund, (2002) Additional lift planning is required when the components reach the construction site. The complexity of lift normally increases with the increase in level of IBS usage

2.4.7 Coordination

Coordination of design, transportation, tracking, and installation to ensure successful implementation. Apart from that, the work breakdown structure, terminology, drawings, progress measurement, scheduling for materials management and supply chain scheduling should also take into consideration some coordination, These coordination also involves the management of the workers on-site.

2.4.8 On-site Construction Issues

The IBS components such as concrete panels are generally heavy and difficult to align which may lead to the problem of improper assembly, leakage and crack in the future (Rahman & Omar, 2006). Site specifics or constraints also caused problems to the IBS construction process since IBS components required extra space for storage, mobilisation and circulation of machineries and equipment.

2.4.9 Design Issues

Some designers are not interested in adopting IBS due to a lack of "ecstatic value" and limited creativity in design (Hamid et. al., 2008). Additionally, the majority of housing developers give priority to their homebuyers, even if some homebuyers worry that IBS would restrict the building's size and style and prevent future renovations (Blismas & Wakefield, 2009). In order to meet the government's goal of implementing IBS, homeowners are not prepared to give up their desire to decorate their homes and their ability to change the design (Madigan, 2012).

2.4.10 Image

The term IBS is often misinterpreted with negative image due to its past failures (Kamar et al., 2009 and Rahman and Omar, 2006). For example, customer perceptions of an IBS product is still perceived in terms of lack of flexibility, problematic accommodation such as leaks and faults, low quality finish and use of unfamiliar materials (Nawi et. al., 2007b). For example, in architectural design prefabricated elements are considered inflexible with respect to changes which may be required over its life span. This may occur when small span room size prefabrication is used (Thanoon et. al., 2003). All these factors create a dilemma among clients or developers to apply IBS to their housing projects because of a fear of customer rejection (Kamar et. al., 2009).

These challenges are categorised into 7 main topics that represent all the challenges. This is represented in Figure 2.

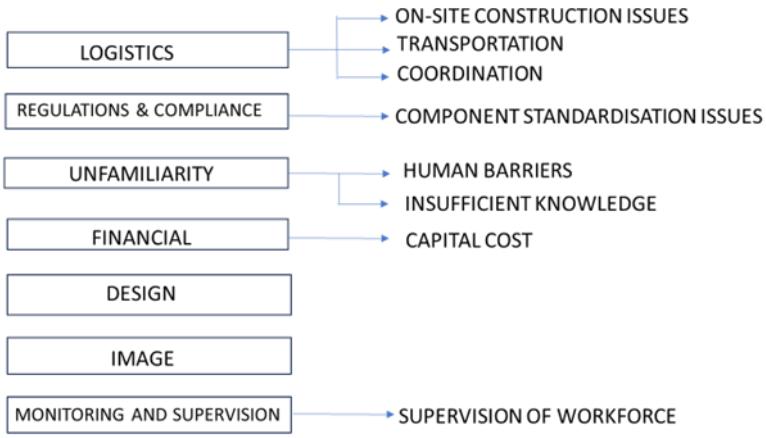

Fig. 2. Categorisation of the Problems

3. Methodology

The study used quantitative approach where a random sampling method was used to collect responses from a list of developers operating in Klang Valley. Quantitative approach was chosen as this would give a consensus on the developers view on problems in implementing IBS system for their projects. Quantitative approach is able to give an indication on the dominance of the problems A number of 50 perception questionnaires were distributed via googleform and physically to the listed developers with projects in Klang Valley (as per Table 2). The developers were chosen based on these criterias 1) Companies doing projects around Klang Valley 2) Companies that are still active or still in operations. The random sampling method gives an equal chance for any developers around Klang Valley to be selected as respondent, considering that Klang Valley is experiencing a high intensity of property development projects and in particular high demand for housing.

A literature review on the categories of IBS practiced in Malaysia were carried out in aspects of project implementation problems and success factors. The questionnaire was formulated based on the literature of the previous challenges in IBS implementation with

likert scale to assess the developers perception. The data collected were analysed using descriptive techniques using data collected from the structured questionnaire to study the perception of the developers on problem encountered during the implementation of IBS system.

4. Results and Disccussion

A number of 41 responses were recorded from 50 respondents that were approached for this study. (Refer to Table 4.1 for the list of developers) The data showed that among 41 respondents, 20 of the companies (49%) have undertaken IBS project before. The remaining 21 companies (51%) have not implemented IBS.

Table 2. List of Respondents

	COMPANY / DEVELOPER NAME		
1	Megah Land Development Sdn Bhd	21	Mitraland Group
2	SUDITASIA (M) SDN BHD	22	LBS Bina Group BHD
3	Welloyd Properties Sdn Bhd	23	Gamuda Land
4	Luxor Properties Sdn Bhd	24	Eco World Development
5	IJM Land Berhad	25	Harp Soon Corp Sdn Bhd
6	Central Spectrum (M) Sdn Bhd	26	UEM Sun Berhad
7	CNH Development Sdn Bhd	27	Protasco Berhad
8	Land Pacific Development Sdn Bhd	28	Hua Yang Berhad
9	Y&G Corp Bhd	29	OSK Property Holdings Berhad
10	Mah Sing Group	30	Cergas Luhur Sdn Bhd Group
11	CPI Land Sdn Bhd	31	Glomac Berhad
12	Luxury Form Development Sdn Bhd	32	Paramount Berhad
13	WCT Land Sdn Bhd	33	IGB Corporation Berhad
14	Simas Group of Companies	34	Upaya Park Development Sdn Bhd
15	Nestcity Holdings Sdn Bhd	35	Selangor Dredging Berhad
16	BV Land Holdings Bhd	36	Avaland Berhad
17	Titijaya Land Berhad	37	SPK Homes
18	Estinia Sdn. Bhd.	38	Tropicana Corporation Berhad
19	Ck East Group	39	See Hoy Chan Sdn Bhd Group
20	Lebar Daun Group of Companies	40	WD Development Sdn Bhd
		41	Suntrack Development Sdn Bhd

4.1 Problems in IBS Implementation in Klang Valley IBS – In

The means were ranked to see the hierarchy of problems perceived by developers in Klang Valley in implementing IBS system for their projects.

Table 3. Overall Ranking Of Problems in IBS Implementation

PROBLEMS	MEAN	CATEGORY	RANKING
Site workers requires intense monitoring to avoid incorrect installation of the components and component flaws.	4.66	Strongly agree	1
There is no exception in standards for health and safety, environmental effect, waste management and thermal performance with IBS system.	4.46	Agree	2
Improper management of the construction process will lead to unsmooth and delayed project. Involvement of all parties from beginning to end of project	4.44	Agree	3
IBS project sites requires a more intense 24-hour surveillance due to the danger to its surroundings.	4.37	Agree	4
Not working closely with authorities and failing to ensure all requirements are met will lead to unsmooth approval process.	3.78	Agree	5
Developers face challenges in finding skilled labours and resources specific to IBS methods.	3.66	Agree	6
Newcomers in IBS might make mistakes due to unfamiliarity that could result to delay in the construction progress.	3.63	Agree	7
Obtaining necessary permits and approvals for an IBS project by relevant authorities is time-consuming.	3.56	Agree	8
Developers may encounter unexpected additional costs during implementation of IBS	3.54	Agree	9
IBS requires high upfront payment by developer for components, before it can be manufactured	3.44	Moderately agree	10
IBS is costly as it requires import of materials from foreign countries.	3.27	Moderately agree	11
Transporting heavy and large size IBS panels posed danger to surrounding area. Management of supply chain & logisctics	3.15	Moderately agree	12
When IBS is used, the design is limited from an architectural perspective	2.80	Moderately agree	13

The complex nature of IBS makes it difficult for developers to obtain finance since planners, bankers, lenders, and insurers aren't convinced that IBS projects can succeed to the same extent as traditional projects.	2.71	Moderately agree	14
Developers are more likely to prefer conventional method because they have grown familiar to this approach.	2.49	Disagree	15
Homebuyers highly prefer conventional housing due to design factors	2.46	Disagree	16
Some people see IBS negatively since they believe it to be not unique, which causes developers to be hesitant to implement it.	2.39	Disagree	17
IBS is often misinterpreted with negative image among people due to its past failures.	2.20	Disagree	18
IBS lacks building laws, common standards for contract papers, or procurement mechanisms in terms of tendering, design, construction, and payment.	2.05	Disagree	19

The results indicated that supervision and monitoring category (Min = 4.66) has the most prominent problems to be focused on followed by regulations and compliance (Min = 4.46) unfamiliarity and financial category being second, third and fourth most important problems. Negative image (Mean = 2.20) being the least important ones to focus on. Supervision and monitoring is important to ensure correct installation of the components on site. This compliments the view from respondents that proper management is crucial (Mean = 4.44). This emphasise the need for proper management of the man power and project planning.

4.2 Ranking According to Categories

The identified problems were categorised according to categories as the literature review. This is to further detail out the issues in each categories and how the respondents perceived the problems.

4.2.1 Monitoring and Supervision

Under the monitoring and supervision category, it includes items on monitoring the site workers and surveilance of the project sites. Table 4 presents the list of problems faced by developers when implementing IBS.

Table 4. Ranking of Problems in Monitoring and Supervision

PROBLEMS FOR MONITORING & SUPERVISION CATEGORY	MEAN	CATEGORY	RANKING
Site workers requires intense monitoring to avoid incorrect installation of the components and component flaws	4.66	Strongly agree	1
IBS project sites requires a more intense 24-hour surveillance due to the danger to its surroundings	4.37	Agree	4

The two problems related to intense monitoring (M=4.66) and 24 hours surveillance of project site (M=4.37) are almost similar in the aspect of monitoring. Project supervision somewhat can make or unmake a project (Syamsyul, 2022). Not only that, if a mistake occurs, fixes would also take longer than normal, especially for builders who are new to this system (Gibb & Isack, 2003). Hence it can be seen that lack of monitoring can be the most critical problem in developers' point of view.

4.2.2 Logistics

Under the logistics category, it includes items on intense monitoring on site and transportation Table 5 presents the list of problems faced by developers when implementing IBS.

Table 5. Ranking of Problems in Logistic

PROBLEMS FOR LOGISTICS CATEGORY	MEAN	CATEGORY	RANKING
IBS project sites requires a more intense 24-hour surveillance due to the danger to its surroundings	4.37	Agree	4
Transporting heavy and large size IBS panels posed danger to surrounding area	3.15	Moderately agree	12

In logistics category, even though transporting heavy and large-sized IBS panels might endanger nearby residents and other road users (Hassim, 2009). Transporting heavy components that could cause cause danger is seen as a potential problem. However, this is perceived as a least prominent problem that needs full attention with the mean score of 3.15. Nevertheless, monitoring of the on-site works, for example cordination of design, transportation, tracking, and installation to ensure successful implementation is perceived as a significant problem.

4.2.3 Regulations and Compliance

Table 6. Ranking of problems in regulations and compliance

PROBLEMS FOR REGULATION AND COMPLIANCE CATEGORY	MEAN	CATEGORY	RANKING
There is no exception in standards for health and safety, environmental effect, waste management and thermal performance with IBS system	4.46	Agree	2
Not working closely with authorities and failing to ensure all requirements are met will lead to unsmooth approval process	3.78	Agree	5
Obtaining necessary permits and approvals for an IBS project by relevant authorities is time-consuming.	3.56	Agree	8
IBS lacks building laws, common standards for contract papers, or procurement mechanisms in terms of tendering, design, construction, and payment as a problem	2.05	Disagree	19

Under the category of or regulations and compliance, it is indicated that IBS have sufficient laws and regulations and developers do not see it as a problem with the mean score of 2.05. When it comes to non-compliance problem, it is essential to make sure that all applicable laws, norms, and standards are followed (Mohammad, 2014). Time-consuming approval process is also seen as a problem with the mean score of 3.56. Weakness in context of coordination causes the process of building approval take a longer time (M=3.78). Problem on coordination can lead to many problems that will complicate the implementation. However, respondents are in the view that there should be an exception in standards for certain aspects of IBS system eg for health, safety, environmental effect, waste management and thermal performance. (Mean = 4.46). Therefore, a specific standard to tackle IBS system is seen as the way forward.

4.2.4 Unfamiliarity with IBS

Table 7. Ranking of problems in Unfamiliarity/Lack of Knowledge

PROBLEMS FOR UNFAMILIARITY CATEGORY	MEAN	CATEGORY	RANKING
Improper management of the construction process will lead to unsmooth and delayed project	4.44	Agree	3
Developers face challenges in finding skilled labours and resources specific to IBS methods	3.66	Agree	6

Newcomers in IBS might make mistakes due to unfamiliarity that could result to delay in the construction progress	3.63	Agree	7
Developers are more likely to prefer conventional method because they have grown familiar to this approach	2.49	Disagree	15

Overall, it can be concluded that Unfamiliarity or lack of knowledge category, not having skilled IBS workers (M=3.66), improper management due to lack of knowledge (M=4.44) and mistakes by newcomers (M=3.63) are significant problems to be focused on. Some company have problems as a result of workers' lack of familiarity with the IBS system and the difficulties they encounter while switching from the conventional technique to the IBS (Sadafi et. al., 2011). Skilled worker is paramount in implementation of IBS. Similarly, knowledge is important to ensure a proper management where effective project management depends on early planning in order to retain project control, get high quality, and ensure the project goes smoothly. Technical training to newcomers is vital because training and knowledge is important to reduce the possibilities for mistakes. Meanwhile majority of Malaysian developers prefer conventional project over IBS, because they naturally found it easier to stick to conventional construction methods for their construction projects than to adopt IBS (Kamar et. al., 2009), However, based on the findings of this research, unfamiliarity or lack of knowledge is not perceived as,a,major problem by companies or developers in Klang Valley region (mean 2.49 and ranked at number 15)

4.2.5 Financial

Table 8. Ranking of problems in Financial

PROBLEMS FOR FINANCIAL CATEGORY	MEAN	CATEGORY	RANKING
Developers may encounter unexpected additional costs during implementation of IBS	3.54	Agree	9
IBS requires high upfront payment by developer for components, before it can be manufactured	3.44	Moderately agree	10
IBS is costly as it requires import of materials from foreign countries.	3.27	Moderately agree	11
Complex nature of IBS makes it difficult for developers to obtain finance since planners, bankers, lenders, and insurers aren't convinced that IBS projects can succeed to the same extent as traditional projects	2.71	Moderately agree	14

Respondents agreed that developers may encounter unexpected additional costs during implementation of IBS with the mean score rank of 9 (M=3.54) these costs might include costs during the project due to unexpected site condition, regulatory changes, supply chain disruption, labour issues and so on can impact the budget and timeline of the project. This can impact the budget and timeline of the project. On the statement that IBS is costly as it requires import of materials from foreign countries (M=3.27). According to Blismas and Wakefield (2009) production of IBS components occasionally necessitates the importation of materials from foreign nations. However, this was not perceive as a significant problem by the respondents. Generally respondents did not perceive financial as a significant problem in implementing IBS. This could be due to the fact that the advantages of IBS outweigh the costs incurred.

4.2.6 Design

Table 9. Ranking of problems in design

PROBLEMS FOR DESIGN CATEGORY	MEAN	CATEGORY	RANKING
When IBS is used, the design is limited from an architectural perspective	2.80	Moderately agree	13
Homebuyers highly prefer conventional housing due to design factors	2.46	Disagree	16

According to Hamid et al. (2008), some customers are unsure about the design because they think it would limit the architectural flexibility. However, respondents moderately agreed to this and indicated that IBS could establish some limitations, although architectural design is not always constrained by it. Structurally appealing constructions may still be achieved with careful planning and teamwork.

4.2.7 Monitoring and Supervision

Table 10. Ranking of problems in negative image

PROBLEMS FOR NEGATIVE IMAGE CATEGORY	MEAN	CATEGORY	RANKING
Some people see IBS negatively since they believe it to be not unique, which causes developers to be hesitant to implement it	2.39	Disagree	17
IBS is often misinterpreted with negative image among people due to its past failures	2.20	Disagree	18

Negative image category has the least weightage of mean score of problems compared to other category of problems with mean of 2.19 and 2.20 and ranked at number 17 and 18. This could be related to the better evolution of IBS compared to when it was initially implemented.

Looking at the number of developers that are implementing IBS projects these days, it is proven that it does not make them hesitate to implement IBS.

4.3 General Recommendations

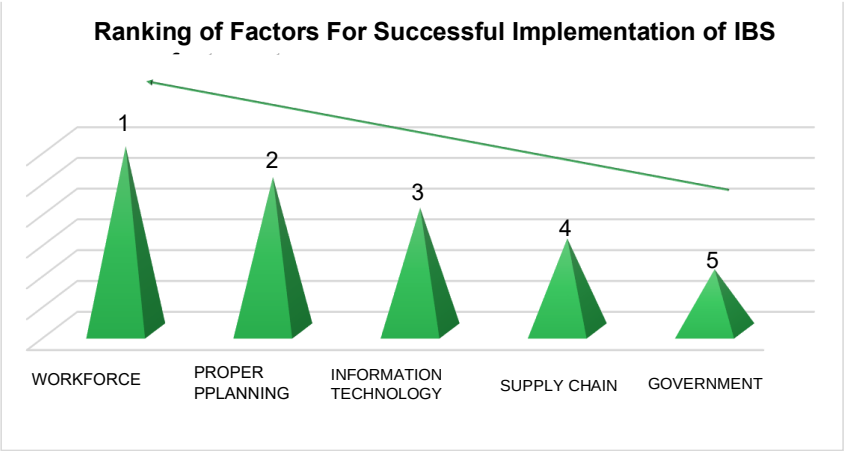

Fig. 3. Ranking of Factors

Respondents were asked on the factors that contributes towards a successful implementation of IBS projects and their perception was ranked as shown in Figure 3. The Through the results, it can be seen that 5 factors that were perceived as most important that contribute towards successful implementation of IBS projects are :

1. Developers greatly benefit from guidance from Construction Industry Development Board (CIDB) such as training programs, workshops and sharing best practices.(4.78)
2. In early stages the project team, stakeholders, and suppliers must effectively communicate to prevent errors, project delays, and budget overruns. (4.68)
3. Existence of standards for health and safety, environmental effect, waste management and thermal performance is significant in making IBS project progress more efficient. (4.55)
4. Developer should maintain efficient communication channels throughout the supply chain with suppliers of materials and components.(4.54)
5. Successful IBS project needs skilled and well-trained workforce who is able to operate machinery, assemble and install components, and perform quality checks (4.54).
6. Proper planning by developer helps them to fulfil the unique demands and specifications of the project. (4.54)

These factors are further elaborated with some general recommendations according to the categories as indicated in figure 3.

4.3.1 Workforce

Referring to findings in problems identified, respondents indicated intense surveillance and monitoring of workers as a crucial problems. This problem is related to problem of having to monitor the workers to avoid incorrect installation of components, component flaws and danger in project. The site should have a well-trained skilled workers in addition to intense monitoring by installing 24-hours surveillance cameras in problem prone areas. A pool of skilled workers could be achieved with CIDB's training which is from the factors perceived by respondents. Training programs, workshops and sharing best practices by CIDB could prevent and reduce mistakes. CIDB 's role in providing training could provide skilled and well-trained workforce who is able to operate machinery, assemble and install components, and perform quality checks These could improve project monitoring and prevent bigger picture problems like delay and additional costs that hinders successful IBS implementation by developers.

4.3.2 Proper Planning

The need to make an early plan/strategy with all parties is very significant . In early stages the project team, stakeholders, and suppliers must effectively communicate to prevent errors, project delays, and budget overruns (Yusof, M.R et al , 2014) It is recommended that more intense proper planning for example by using BIM technology and achieving effective communication to ensure projects are planned properly from beginning to the end.

4.3.3 Information Technology and Government's Role

Government could introduce policies that could assist the developers in terms of securing and maintaining efficient communication and dealings throughout the supply chain with suppliers of materials and components of the IBS system. The government could play a role in ensuring the conducive environment for the supply chain to enable smooth implementation of IBS system in housing projects. The government should also look into the formulation of standards for health and safety, environmental effect, waste management and thermal performance specifically suited to IBS system in project implementation to achieve a more efficient progress to prevent errors, project delays, and budget overruns

5. Conclusion

The most important problems are from surveillance and monitoring category because it plays a vital role in operational effectiveness that can prevent most of the problems. This involves the need to have skilled workers that will reduce the monitoring and surveillance on workers. It is recommended that a proper planning using specified software and technologies to ensure better coordination throughout the project implementation. Regulations and compliance comes in second because of the importance of regulatory compliance and non-compliance can lead to delays of project. Unfamiliarity or lack of knowledge in IBS system being is also significant because the knowledge gaps can lead to big mistakes. Government's support such as training programs and workshops by CIDB Malaysia could improve this problem in ensuring a highly skilled workers in the workforce. Financial category should be looked into

because their direct effects on budgeting, resource allocation, and long-term growth directly affect the company's overall financial health and sustainability. Lastly design limitations of IBS and negative image towards IBS are problem categories that is least important to be focused on because design limitation can be improved by technology advancement and negative image of IBS by others have changed due to the good evolution of IBS implementation. Findings on the problems perceived by developers could potentially give a better insight to developers not only in Klang Valley, but other parts of the country on problems that they could anticipate in implementing IBS system for their development projects. Through a look into the problems and what the developers perceived as factors that could help them to successfully implement IBS system, will give some indicators on how the industry could be improved and eventually increase the production of houses with more interests to adopt IBS system amongst developers.

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