INTERNATIONAL JOURNAL OF ACADEMIC RESEARCH IN BUSINESS & SOCIAL SCIENCES

www.hrmars.com
ISSN: 2222-6990

Indicative Level on The Determinants of Tangible and Intangible Cost Elements in Industrialised Building System (IBS) Projects

Alya Ilyani Mohammad Shukri, Husrul Nizam Husin, Mohammad Nasharudine Shuib, Zaiwannizar Zainal Abidin, Mohamad Tajudin Saidin

To Link this Article: http://dx.doi.org/10.6007/IJARBSS/v12-i11/14806 DOI:10.6007/IJARBSS/v12-i11/14806

Received: *15* September *2022, **Revised:** 16* October *2022, **Accepted:** 29* October *2022*

Published Online: *20* November 2022

In-Text Citation: (Shukri et al., 2022)

To Cite this Article: Shukri, A. I. M., Husin, H. N., Shuib, M. N., Abidin, Z. Z., & Saidin, M. T. (2022). Indicative Level on The Determinants of Tangible and Intangible Cost Elements in Industrialised Building System (IBS) Projects. *International Journal of Academic Research in Business and Social Sciences*, *12*(11), 2232 – 2244.

Vol. 12, No. 11, 2022, Pg. 2232 – 2244

http://hrmars.com/index.php/pages/detail/IJARBSS	JOURNAL HOMEPAGE

INTERNATIONAL JOURNAL OF ACADEMIC RESEARCH IN BUSINESS & SOCIAL SCIENCES
www.hrmars.com
ISSN: 2222-6990

Indicative Level on The Determinants of Tangible and Intangible Cost Elements in Industrialised Building System (IBS) Projects

Alya Ilyani Mohammad Shukri[1], Husrul Nizam Husin[2], Mohammad Nasharudine Shuib[3], Zaiwannizar Zainal Abidin[4], Mohamad Tajudin Saidin[5]

[1,2,3,4,5]Department of Built Environment Studies and Technology, Faculty of Architecture, Planning and Surveying, Universiti Teknologi MARA,Perak Branch, 32610 Seri Iskandar, Perak, Malaysia, [1]Gabungan Strategik Sdn Bhd, D-33-G, Jalan Teknologi 3/9, Bistari De Kota, Kota Damansara, PJU 5, 47810 Petaling Jaya, Selangor.
Corresponding Author's Email: husrul820@uitm.edu.my

Abstract
Construction industry contributes to the economic growth output in Malaysia by an improvement in wider economic activity, variety tools and technologies. One of the prominent tools or systems includes the adoption of Industrialised Building System (IBS) for construction. Industrialised Building System (IBS) is defined as a construction made of components manufactured either on or off site, then positioned and assembled into the structures. In Malaysia, IBS is not a new initiative. The government has launched many initiatives to encourage the practitioners towards IBS implementation, however the rate on the IBS usage is still low. The construction stakeholders are concern on the cost factors as the main issue of its low adoption. It is often neglected that IBS constitutes intangible cost or non-monetary benefits of its adoption, thus, the purchase or initial cost cannot be overemphasized. Hence, this paper aims to identify the tangible and intangible cost elements and analyse the indicative level of its importance toward the IBS construction. Questionnaire survey is used as the research approach where the survey involved 73 nos. of IBS contractors registered in the Perak, Malaysia as the research scope. The data is analysed using Statistical Package for Social Science (SPSS) software version 22. The results revealed that the most significant component of IBS tangible cost is material cost, followed by Transportation Cost, Plant and Machineries Cost, Profit and Overhead, Labour Cost, Verification Cost, Maintenance Cost, Demolition Cost, Functional and Testing Cost, and Energy and Operational Cost. While the most important intangible cost elements is Wastage, followed by Time, Durability and Efficiency, Quality of Components, Sustainable, Levy exemptions, Tax Incentives, and Design. The study recommends that introducing a cost-effective capital would be able to boost the involvement of IBS contractors in the usage of IBS construction.
Keywords: Tangible Cost, Intangible Cost, Industrialized Building System (IBS), Construction Industry, Contractors

Introduction

Construction industry is a significant sector that contributes to the economic growth in Malaysia. Due to cater the demand of rapid development construction in the nation, the Industrialised Building System (IBS) system is introduced and acknowledged to the construction practitioners and industry players. IBS is defined as a construction process that applies techniques, products, components, and building system where the components are produced in a restricted environment (Mohamad et al., 2016). Through the government policies and legislation, IBS is highlighted under the Construction Industry Master Plan (CIMP) 2006-2015 in Strategic Thrust 5. The Construction Industry Transformation Programme (CITP) 2016-2020 in the Strategic Thrust 3 continued to address the significance of IBS where Malaysia is required to increase the IBS implementation to overcome the issue of foreign workers in the construction industry (Ministry of Works, 2016).

The recent Twelfth Malaysia Plan (2021-2025) also highlighted the importance of IBS towards the economic growth and Gross Domestic Product (GDP) output, where several strategies to increase the use of sustainable, durable, biodegradable and recycled construction materials will be promoted through the application of the IBS concept and technologies. As stipulated in the Twelfth Malaysia Plan (EPU, 2021), the requirement for Pre-Approved Plan (PAP) and IBS in government projects were enforced to expedite project implementation. At the end of the Eleventh Plan (2016-2020), the number of available PAP increased from 19 to 28 categories with 180 designs. All government projects valued RM10 million and above are required to comply with the minimum IBS score of 70%. Thus, it shows the commitment of government in ensuring the IBS applications continually implemented.

Therefore, it is clear that IBS is demarcated as prominent initiatives in the construction industry towards sustainable environment. IBS has been introduced in Malaysia since 1960 and it is an innovation made by the government since there is an increase in the awareness of the environmental pollution, natural resources depletion, and sustainable development (Bari et al., 2012). There are many initiatives introduced and promoted by the government in developing the IBS in Malaysia; including the IBS Roadmap 1 (2003-2010), Construction Industry Master Plan (CIMP) (2006-2015), the IBS Roadmap 2 (2011-2015), Construction Industry Transformation Programme (CITP) (2016-2020), and continued to the National Construction Policy (NCP2030) by Ministry of Works. All of these initiatives were carried out to increase the usage of IBS implementation in building construction in Malaysia. Hence, it is significant to explore the benefits of IBS in terms of tangible and intangible elements that can foster the transition towards sustainable construction and green purchasing processes.

Problem Statement

According to Saad et al (2022), the development in the conventional construction sector dropped by 44.9 percent in the second quarter of 2020 based on the Malaysian Department of Statistics. It is aligned to the challenges highlighted by EPU (2021) that the economic sectors continue to face issues that affect competitiveness and hinder the sectors from achieving their full potential. One of the highlighted issue that Malaysia lags behind most regional peers is low productivity growth in the construction sector due to slow adoption of Industrialised Building System (IBS) (EPU, 2021), especially in private projects. As extracted from the mid-term review of CITP 2016-2020, the adoption rate of IBS in the public projects was 85% in 2020, exceeding the 80% target. However, the IBS adoption rate in private projects was 41%, below the 50% target (as shown in Figure 1). Even the government is serious in promoting IBS, the percentage of IBS usage is still low from the objective or target especially in private sector (Mohamad et al., 2016).

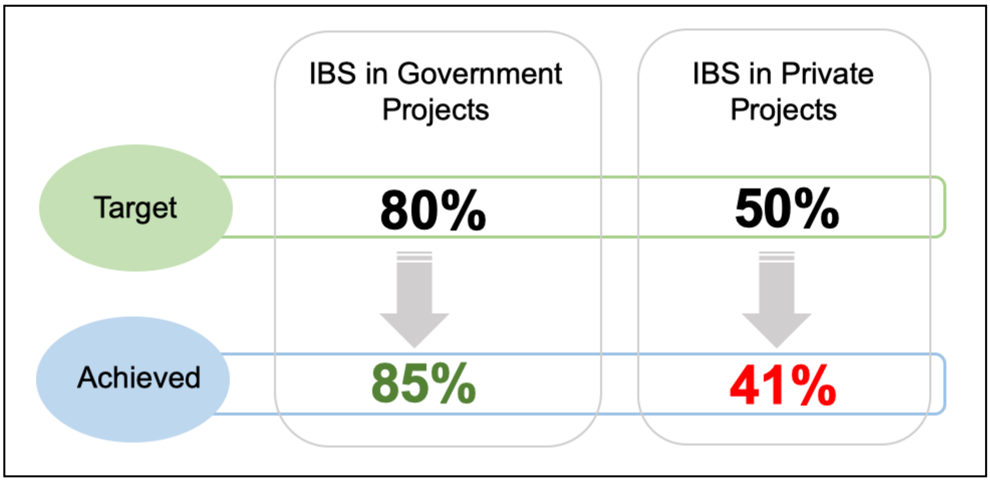

Figure 1: The adoption rate of Industrialised Building System (IBS) in the Malaysian construction projects in CITP 2016-2020
(source: Ministry of Works, 2020)

The critical justification on the low adoption of IBS in private construction projects is due to the lack of demand and higher initial cost (Mohd Amin et al.,2017; CIDB, 2018; The Edge Markets, 2017). As shown in Figure 2, this is aligned to the data from IBS Centre (2016) that revealed the projected IBS usage in Klang Valley in private sectors in 2016 was only 46% while the remaining 54% still preferred to use conventional method for the construction. Data from Malaysia Equity Research (2014) shows that IBS was not a preferred options as it resulted in increasing of construction cost to 10% higher as compared to the conventional method.

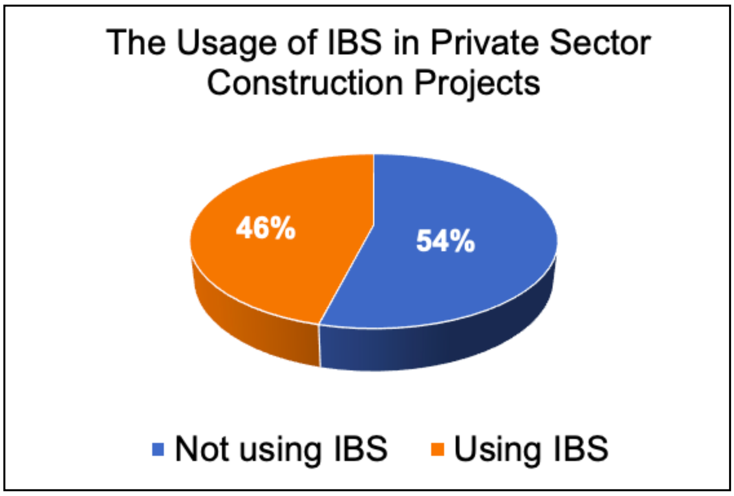

Figure 2: Percentage of private sector project implementing IBS
(source: IBS Center, 2016)

Jabar et al (2013) mentioned that the higher capital cost for IBS is comprise as the developers' reason in refusing the IBS application. This is supported by Mohamad et al., (2016) and Nasrun et al (2015) that cost and other factors such as low awareness or knowledge of IBS among construction parties contribute to the low adoption of IBS. According to Ogunde *et al.*, (2018), the perception on IBS among the industry players is that IBS is expensive. The cost is often viewed simply as the purchase price of the system or products and it is often treated as a commodity. The element of cost is also known as tangible or monetary cost where it defined as tangible or direct expenditure that associated to a specific product, devices or system (Abd Rashid et al., 2019).

According to Khalil et al (2021), costs and considerations for systems or products for construction should be looked through overall life cycle and not merely on the initial cost. As IBS is in operation for years, it is important to consider the intangible or non-monetary benefits will be over time. Intangible cost elements are known as the "costs" that are not directly accountable or quantified, where intangible cost can have an impact towards the product manufacturers or users. However, Abd Rashid et al (2019) stated that the research in primary benefits of IBS are still lacking in the aspect of economics that focusing on the intangible or non-monetary indicators. Hence, this paper provides the findings on the identification of the IBS implementation in terms of tangible and intangible cost elements.

Overview on the IBS Benefits and Challenges in Malaysian Construction Sectors

According to Shamsuddin et al (2017), IBS is one of the innovative methods in the construction sector that perceived as an effort from the Malaysian construction industry. IBS is defined as a construction system or process that consists combination of manufactured components on-site or off-site, where it will be positioned and assembled into a structure (Abd Rashid et al, 2019). The benefits of IBS proven through many studies (Saad et al, 2022; Mohamed et al., 2016; Nasrun et al, 2015; Shamsudin et al, 2017; Mohd Amin et al, 2017; Anuar et al, 2014) which includes produce minimal wastage, provide cleaner and safe environment, reduce the materials on site, less labors on site, controlled product quality, speed up the project completion, neat and safer sites, and lower the construction costs.

However, along with the benefits highlighted, the usage or implementation of IBS in Malaysia still does not reach the satisfaction level as the usage is still low compared to the conventional system, especially in the private project sector (Nasrun et al., 2015; Abd Rashid et al., 2019). According to Anuar et al (2014), among the constitute factors are due to the availability of foreign labors in which the rate of labors is low compared to the rate of erecting the IBS, lack of knowledge on IBS and contractor's unwillingness to switch from conventional method to IBS, and bad reputation on IBS project such as delays and bad qualities which resulted in unacceptance of using IBS in the construction sector (Anuar et al., 2014). Previous researchers addressed that cost is the main factor that contributed to less usage of IBS in the construction (for example: Shamsudin et al., 2017; Abd Rashid et al., 2019; Abd Rahim & Qureshi, 2018; Amin et al., 2017). IBS costs are about 12-13% higher than the conventional methods. This is due to the high prices of IBS components that can be broken down to the purchase of new imported machinery, mold production, tax and machinery from abroad as well as the expense of training staff to mount components and operate various high-tech machinery (Malaysia Equity Research, 2014). The costs involved in IBS include the tangible cost and intangible cost.

Tangible costs are expenses which can be specifically identified with a particular supported activity and which can be directly attributed with a high degree of accuracy to such activities. Tangible costs are also costs that are relatively easily identified and with a high degree of accuracy and these costs directly attribute and chargeable to a specific project (Walters, 2016). While, intangible costs are those incurred for specific or shared purposes and cannot therefore be directly linked to a particular project, but contribute to the total cost (Khalil et al., 2021). These costs can have a direct impact to the users, developers or manufacturers as they are like the hidden costs in IBS that can either provide benefit to the IBS itself or the other way around.

Based on the initial identification of tangible and intangible cost elements from the literature review, there are ten (10) cost elements contributed to the tangible cost and eight (8) intangible cost elements. These cost elements are listed as initial list of cost elements associated to the IBS projects from the perspective of tangible and intangible. The tangible cost constituted to the IBS adoption are *Material Cost, Transportation Cost, Labour Cost, Plant and Machineries Cost, Profit and Overhead cost, Energy and Operational Cost, Verification Cost, Maintenance Cost, Functional and Testing Cost,* and *Demolition Cost* (as compiled from: Saad et al., 2022; Abd Rashid et al., 2019; Walters, 2016; Khalil et al., 2021; Yunus et al., 2021, Sangale, 2015; Shamsuddin et al., 2017). All of these costs can be directly seen when implementing IBS construction. While for intangible aspects, the cost elements are classified as *Time, Quality of Components, Levy Exemptions, Tax Incentives, Wastage, Sustainability, Design, Durability* and *Efficiency* (as compiled from: Abd Rashid et al., 2019; Walters, 2016; Khalil et al., 2021; Yunus et al., 2021, Shamsuddin et al., 2017). As supported by Walters (2016), intangible cost is a cost that cannot be seen directly while carrying out a project but these costs are crucial in order to complete the works. The importance of these tangible and intangible cost elements are further explored through the responses from the industry and construction practitioners in determining reasons towards the low IBS adoption.

Methodology

This research adopts quantitative method as the research approach. The responses and rate of importance level are retrieved from the population of registered IBS Contractors in Malaysia as the survey respondents. Hence, purposive sampling is used as the sampling method for this research as it concentrates on common characteristics of a population of interest. Due to large sampling of IBS Contractors in Malaysia, therefore, this research focuses the population in the state of Perak as there is still low adoption of its application in this state, as compared to other states. This is also to align with the Perak Development Policy 2040 that highlights on the sustainable development and physical structure with enhancement of IBS viability. The sampling population of IBS contractors was extracted from the list of IBS Contractors indicated in the Construction Industry Development Board (CIDB) Orange Book (2018). Based on the list, there are 154 nos. of IBS contractors registered in Perak, therefore, the survey was disseminated to contractors via email for data collection. The survey has received 73 responses, (or 47.4% response rate) and it was finalised for data analysis. The Statistical Package for the Social Sciences (SPSS) version 22 was used to produce the statistical data. Descriptive data analysis was carried out in for this research and presented in the frequency analysis, percentage analysis, mean score value and standard deviation.

Results and Discussions

The analysis begins with the reliability analysis of the survey. Pilot test to 10 respondents was conducted in retrieving the reliability and validity of the questionnaire items, using Cronbach Alpha. Hair et al (2010) stated that the acceptable Alpha value is at least 0.7 and above. The attained Alpha for reliability analysis is 0.8424, thus indicate that the items are reliable, measurable and valid.

i) Demographic Background

As mentioned previously, a total of 73 respondents had answered the survey. Table 1 shows the demographic result of the respondents, in terms of gender and experience in IBS projects. It was found that the respondents are dominated by male contractors (73%) and the rest 24.7% respondents are female contractors. In terms of years of experience in IBS projects, majority or 43.8% respondents have less than 5 years involvement in IBS projects, followed by 39.% respondents with experience between 6 to 10 years, while the least 16.5% have more that 10 years' experience.

Table 1
Demographic Background of Respondents

Demographic Criteria	Items	Percentage
Gender	Male	75.3%
	Female	24.7%
Years of Experience in IBS Projects	Less than 5 years	43.8%
	6 -10 years	39.7%
	Above 10 years	16.5%

ii) Mean Score on the Important Level of Tangible and Intangible Cost Elements

In this section, the respondents were asked in terms of the importance level on the components of tangible and intangible cost involved in IBS projects. The results are presented in Table 3 and Table 4. The importance level are measured using five (5) numerical Likert-scale, where the scale is range from 1 (Very unimportant) to 5 (Very important). Mean score ($\overline{x}$) for each cost elements are clearly presented to indicate the rank of importance. The interpretation of the perceived mean score is shown in Table 2:

Table 2
Mean Score Interpretation Scale

Score Range	Interpretation
4.50 – 5.00	Very Important
3.50 – 4.49	Important
2.50 – 3.49	Moderate
1.50 – 2.49	Unimportant
1.00 – 1.49	Very Unimportant

Table 3
The Importance Level and Perceived Mean Score on the Tangible Cost Elements involved in IBS

No.	Elements of Tangible Cost	Scale of Importance (Frequency = n)					Mean Score	Sd	Rank (based on Mean Score)
		/ery ınimportant 1)	Unimportant (2)	Moderate (3)	Important (4)	Very Important (5)			
1	Maintenance Cost	0	2	11	36	24	4.12	0.7185	7
2	Transportation Cost	0	0	2	30	41	4.53	0.5409	2
3	Plant and Machineries Cost	0	0	0	35	38	4.52	0.7708	3

4	Functional and Testing Cost	0	49	10	12	2	2.55	0.6145	9
5	Material Cost	0	0	0	18	55	4.75	0.8776	1
6	Profit and Overhead	0	0	0	41	32	4.44	0.7123	4
7	Labour Cost	0	4	5	35	29	4.22	0.6331	5
8	Verification Cost	0	4	3	40	26	4.21	0.7432	6
9	Demolition Cost	0	36	2	25	10	3.12	0.4108	8
10	Energy and Operational Cost	0	45	24	4	0	2.44	0.4766	10

Based on the results shown in Table 3, it was found that the highest mean score on the most important tangible cost elements for IBS is material cost (mean=4.75). It is inferred that the costs involved in IBS are quite high during the initial stage due to the higher material cost, transportation cost also the plant and machineries cost. This is parallel with the study by Nasrun et al (2015) that mentioned the material cost became higher due to less demand made from the industry, thus, it caused the production to become less and since the productivity is less, so, the product cost will be higher. This is also supported by Sangale (2015) that the manufacturing cost for IBS components is higher compared to manufacturing of the material for conventional methods. The survey concludes that the manufacturing cost for IBS is worse compared to conventional as it is pricier. However, other tangible costs are depending on the situation of the project itself such as the transportation cost and maintenance cost.

The second important tangible cost element is transportation cost (mean =4.53). While transportation cost depends on the distance to deliver the components and maintenance costs depend on the situation during the maintenance. This is parallel to a study conducted by Holla et al (2016) that pre-cast concrete provides cost-effectiveness with durability, flexibility and sound durability. Therefore, the maintenance costs are also lower. It is also stated that IBS has better quality control or assurance, thus reducing the risk of building defects as well as preventative maintenance and repairs (CIDB, 2018).

The next tangible cost element that important to IBS projects Plant and Machineries Cost (mean=4.52), ranked at the 3rd most important element. Plant and machineries costs are high because IBS requires a lot of plant and machineries in order to install the IBS components. Anuar et al (2014) stated that lack of investment in heavy equipment and construction mechanisms due to high investment in capital could slow down the adoption of IBS. High capital costs associated with IBS would result in inadequate capacity for contractors to secure the project. It is becoming a challenge as the project costs will be high due to the use of specialized cranes to handle factory-built parts on both manufacturing yards and construction site and this will have an additional costs on it (CIDB, 2018).

Next, the most important tangible cost element is profit and overhead cost (mean=4.44). Overhead cost is defined as a cost incurred by the contractor to support the work that is not a part of the actual construction work. In the calculation of construction, overhead costs are extremely important. Neglecting the overhead has driven many contractors out of business, as these costs represent a significant portion of the total construction costs. Thus, controlling the overhead costs is critical (Bhangale & Patil, 2014).

The 5th ranked tangible cost element that important to IBS projects is labour cost (mean=4.22). It is undoubted that labours should be trained as skilled workers because IBS workers should be substantially more quality-conscious than the untrained workers who do manual jobs in the traditional construction industry which led to higher cost compared to conventional method. Sangale (2015) described that the cost for labor is higher as compared to conventional methods in terms of off-site shop prefabricators, on-site prefabricators, on-site preassembly crew, and the in-place installers for IBS components. Mohd Amin et al (2017) described that the demand for on-site manual labor particularly carpenters, bar benders and concreters become less.

The other tangible cost elements that is ranked as least important to IBS projects are Verification Cost (mean=4.21), Maintenance Cost (mean=4.12), Demolition Cost (mean=3.12), Functional and Testing Cost (mean=2.55), and Energy and Operational Cost (mean=2.44); ranked at 5th to 10th important tangible cost element, It was not surprised to found that energy and operational cost constitute the least important tangible cost element due to less energy consumption produced during the IBS construction process at site. As described by Ahmad Bari et al (2012), using IBS supports the sustainable concept in construction and less harmful to the environment degradation.

Apart from tangible cost, it is significant to present the intangible costs and non-measurable items contributed to the benefits of IBS to foster the transition towards sustainable construction and green purchasing processes. The next section provides the entailed result on the importance level of the intangible cost in implementing IBS project (as shown in Table 4). The rank of the most important intangible cost element was arranged based on the perceived mean score for each element.

Table 4
The Importance Level and Perceived Mean Score on the Intangible Cost Elements involved in IBS

No.	**Elements of Intangible Cost**	**Scale of Importance (Frequency = n)**					**Mean Score**	**Sd**	**Rank (based on Mean Score)**
		Very unimportant	**Unimportant**	**Moderate**	**Important**	**Very Important**			
1	Levy Exemptions	0	0	4	38	31	4.37	0.6331	6
2	Time	0	0	0	19	54	4.74	0.7632	2
3	Quality of Components	0	0	0	35	38	4.52	0.8102	4
4	Durability and Efficiency	0	0	3	24	46	4.59	0.6896	3
5	Wastage	0	0	0	15	58	4.79	0.775	1
6	Sustainable	0	0	0	41	32	4.44	0.7764	5
7	Tax Incentives	0	10	8	37	18	3.86	0.6442	7
8	Design	0	28	6	22	17	3.38	0.38751	8

As depicted in Table 4, the results obtained from the survey showed that the most important intangible cost element based on the highest mean score is Wastage (mean=4.79) . The adoption of IBS in construction that result in lower materials usage and lower wastage levels including off- site manufacture and use of pre-assembled process. This is parallel to

Holla et al., (2016) that stating prefabricated concrete or IBS can help minimize on-site waste by up to 50% of a building compared to in-situ cast construction.

The second ranked of the most important intangible cost element is Time (mean=4.74). Previous research by Abdul Rahim & Qureshi (2018); Rahim & Ismail, (2011) and Marsono et al., (2006); also agreed that IBS or prefabrication method is good as it reduces construction time. The precast method consumed less time compared to traditional method, as the prepared materials and elements are delivered just in time and placed on site which reduces unnecessary handling and use of equipment. This is supported by Abdul Rahim and Qureshi (2018) that conventional construction involves complete on-site work and is unsustainable as it is associated with poor quality and productivity, high risk of worker safety and high dependency on labours. Implementation of IBS also helped other trades to start work earlier, speeding up the building process and making it more economical with less disruptions to the local area (Holla et al., 2016). IBS makes the construction cycle shorter as a result of quick installation and erection of components aside from lower chance of project completion delays due to quicker turnaround time and weather-related adversity secure (CIDB, 2018).

The third ranked important cost element is Durability and Efficiency (mean=4.59). Better quality of IBS components leads to increased performance, especially when inputs are used efficiently and effectively (Saad et al., 2022; Khalil et al., 2016). The use of IBS obviously offers a stronger quality assurance mechanism. The next ranked intangible cost element is Quality of Components (mean=4.52), ranked at 4th most important intangible cost element. Quality is a certain guaranteed elements for IBS projects as the manufacturing is in the controlled environment. This is supported by Abd Rahman and Omar (2006) that by adopting IBS, proper coordination and management, precision, innovative and quality will be appeared as new attributes to be associated with the construction industry. However, a good maintenance of IBS buildings is needed to maintain the quality. Ismail et al (2016) stated the high quality of IBS building maintenance works level and the long life span of services required an efficient management to maintain the building structure and facility at the IBS building.

Next, the 5th ranked important intangible cost element is Sustainable (mean=4.44). IBS is acknowledged as technology that supports the sustainable construction. Yunus (2012) asserted that IBS can be seen as an alternative option to maintain sustainability in construction as it can generate more controlled human resources and cost, shorten the construction period and increase the quality of buildings. Hence, the industry players have to shift their paradigm from conventional construction to IBS in coping with the sustainability agenda for construction works.

The result also showed that the least important of intangible cost elements are Levy exemptions (mean=4.37), Tax Incentives (mean=3.86) and Design (mean=3.38). Inevitably IBS is not flexible in terms of design changes due to prefabrication of the items, hence, design is not favourably important. This is supported by Ismail et al (2016) The practices of conventional methods for maintenance management in Malaysian Industrialised Building System (IBS) building faced many issues due to IBS component aesthetic and structural defects which occurred repeatedly compared to building maintenance on conventional building, no integration between maintenance systems, lack of co-ordination between design and construction.

Conclusion

The findings of this study contribute a basis of indicative approach in changing the stakeholder's mindset on the higher cost of IBS adoption. Based on the results of the survey, recommendations are made to increase motivation and the involvement of IBS Contractors for IBS projects. The study also provides viability of IBS in the context of intangible benefits to the stakeholders and users. It is recommended to standardize the cost of skilled workers at reasonable cost. Harmonizing taxes incentives for the whole IBS market including towards IBS Contractor could lead to increase the awareness and adoptions of IBS projects, especially among private project developers. Other than that, introducing soft loans to promote the establishment of new start-ups to reduce the burden on contractors who have to pay in advance for IBS product procurement can be seen as a good incentives. This is due to the high initial cost to start up the IBS project which makes IBS is less favourable adoption. Thus, introducing a cost-effective capital would be able to boost the involvement of IBS contractors in the usage of IBS construction

Acknowledgement
The authors wished to thank the UiTM Research Ethics Committee, Universiti Teknologi MARA Perak Branch on the approval of research ethics for the data collection process.

Corresponding Author
Sr Dr. Husrul Nizam Husin
Department of Built Environment Studies and Technology, Faculty of Architecture Planning and Surveying, Universiti Teknologi MARA, Perak Branch, Seri Iskandar Campus, 32610 Seri Iskandar, Perak, MALAYSIA
Email: husrul820@uitm.edu.my.

References

Abd. Rahman, A. B., and Omar, W. (2006). Issues and Challenges In The Implementation Of Industrialised Building Systems In Malaysia. *Proceedings of the 6th Asia-Pacific Structural Engineering and Construction Conference (APSEC 2006)*, 5 – 6 September 2006, Kuala Lumpur, Malaysia

Abdul Rahim, A., & Qureshi, S. L. (2018). A Review Of IBS Implementation In Malaysia And Singapore. *Journal of the Malaysian Institute of Planners*, 16 (2), pp. 323 - 333

Abd Rashid, S. N. A., Khalil, N., & Isa, M. H. (2019). Conceptual Model Of Cost-Benefit Analysis For Monetary And Non-Monetary Items In Industrialised Building System (IBS) Project. *Journal of Building Performance*, 10 (2), pp. 85-92

Anuar, K., Kamar, M., & Azhari, M. N. O. R. (2014). IBS Survey 2010: Drivers, Barriers, and Critical Success Factors in Adopting Industrialised Building System (IBS) Construction by G7 Contractors in Malaysia. *Journal of Engineering Science and Technology*, 9(4), 490–501.

Bari, A. N. A., Abdullah, N. A., Yusuff, R., Ismail, N., & Jaapar, A. (2012). Environmental Awareness and Benefits of Industrialized Building Systems (IBS). Procedia - Social and Behavioral Sciences, 50, 392–404.

Bhangale, P. P., & Patil, S. S. (2014). “ Overhead Cost in Construction Industry,” 4(2), 1–6.

CIDB. (2018). IBS: Prospect & Challenges. Retrieved on , from http://ibsportal.cidb.gov.my/system_files/CMSController/56c14d3c-1a71-494d-81e7-ba663eb95f1c.pdf

EPU. (2020). Twelfth Malaysia Plan 2021-2025. Economic Planning Unit, Malaysia

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2010). Multivariate Data Analysis. Vectors (7th ed.). Upper Saddle River, NJ: Pearson Printice Hall.

Holla, B. R. K., Anant, S., & Mohammad, M. A. (2016). Time , Cost , Productivity and Quality analysis of Precast Concrete System. *International Journal of Innovative Science, Engineering & Technology*, *3*(5), 252–257.

Ismail, Z. A., Mutalib, A. A., and 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(S3) 28-35

Jabar, I., Ismail, F., & Mustafa, A. A. (2013). AicQoL 2013 Langkawi Issues in Managing Construction Phase of IBS Projects. *Procedia - Social and Behavioral Sciences*, 101, 81–89.

Khalil, F. D. A. A., Aziz, F. N. A. A., Hassim, S., & Jaafar, M. S. (2016). A Review on Industrialized Building System Issues in Malaysia. *MATEC Web of Conferences*, 47, 04019

Khalil, N., Bohari, A. A. M., Rashid, A. F. A., Shamsudin, S. M., and Husin, H. N. (2021). Key Approaches in Life Cycle Cost in Green Government Procurement for Green project. *Planning Malaysia: Journal of the Malaysian Institute of Planners*, Vol.19(20), pp.27-38

Marsono, A. K., Tap, M. M., Ching, N. S., & Makhtar, A. M. (2006). Simulation of industrialized building system components production. In *Proceedings of the 6th APSEC (pp. 87-96)*. Kuala Lumpur, Malaysia

Malaysia Equity Research. (2014). Construction IBS - Practical solution to rising costs. Kuala Lumpur: Amanah Investment Bank Berhad.

Ministry of Works. (2020). Construction Industry Transformation Program (CITP) 2016-2020. Kementerian Kerja Raya Malaysia (KKR): Malaysia

Mohammad, M. F., Baharin, A. S., Musa, M. F. (2016) The potential application of IBS modular system in the construction of housing scheme in Malaysia. Procedia Social and Behaviorial Science, 222, 75–82

Amin, M. A., Abas, N. H., Shahidan, S., Rahmat, M. H., Suhaini, N. A., Nagapan, S., and Abdul Rahim, R. (2017). A review on the current issues and barriers of Industrialised Building System (IBS) adoption in Malaysia’s construction industry. *IOP Conf. Series: Materials Science and Engineering*, vol. 271

Nasrun, M., Nawi, M., & Baluch, N. (2015). Study on the use of industrialised building system (IBS) in Malaysian private construction projects, *Journal of Engineering and Applied Sciences*, 10(17):7368-7374

Ogunde, A. O., Ayodele, R., Joshua, O., Nduka, D. O., Ogunde, A., Ogundipe, K. E., Ajao, A. M. (2018). Data in Brief Data on factors influencing the cost , time performance of the Industrialized Building System. *Data in Brief,* 18, 1394–1399.

Rahim, A. A., & Ismail, Z. (2011). *IBS towards open building system in Malaysia*. Kuala Lumpur, Malaysia: IIUM Press.

Saad, S., Alaloul, W. S., Ammad, S., Altaf, M., Qureshi, A. H. (2022) Identification of critical success factors for the adoption of Industrialized Building System (IBS) in Malaysian construction industry.*Ain Shams Engineering Journal*, 12(2), pp.1-13

Sangale, Y. (2015). Construction Cost Comparison Between Conventional and Industrialized Building System. *International Journal of Modern Trends in Engineering and Research*, 2(7), 720-725

Shamsuddin, S. M., Zakaria, R., Hashim, N., & Yusuwan, M. N. (2017). A Framework of Initiatives for Successful Application of Life Cycle Costing (LCC) in Industrialised Building System (IBS) in Malaysian Construction Industry. *MATEC Web of Conferences*, 138, 1–9

The Edge Markets. (2017). "IBS Adoption is still low - survey". Retrieved from https://www.theedgemarkets.com/article/ibs-adoption-still-low.

Walters, A. (2016). Understanding Indirect Costs in Construction Projects -- and Strategies for Keeping Them Under Control**.** Retrieved on 12 August 2020, from https://blog.gppcpa.com/blog/enewsletters/article/understanding-indirect-costs-in-construction-projects-and-strategies-for-keeping-them-under-control

Yunus, R. (2012). *Decision Making Guidelines for Sustainable Construction of Industrialised Building Systems*. PhD Dissertation, Australia: Queensland University of Technology