



Improving Contractors' Practices of Industrialized Building System (IBS) Implementation in Construction Industry

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Abstract: Nowadays, the Malaysian construction industry is moving forward to roll out technology advantage across project life-cycle for enhancing human development skills. Therefore, the government has adopted industrialized building systems (IBS) to enhance control and balance of workforce supply for overall project performance achievement. However, the challenges faced by the construction industry such as delay the completion of construction projects was due to poor contractors' practices. In addition, there are significant challenges related to contractors' practices for instance shortage of skill, practical know-how, worker capability, and financial difficulties in IBS implementation. Therefore the purpose of this study was to identify current practices and influencing factors of contractors' practices for IBS implementation in the construction industry. This study also determines the improved ways of contractors' practices for IBS implementation in the construction industry. The study was conducted in Johor Bahru, Johor where various development and construction activities are currently active. Quantitative method was conducted by distribution the questionnaires to Grade 7 (G7) contractors as study respondents which involved wide practices of IBS construction projects. Data collected were analysed using the Statistical Package for the Social Science (SPSS) 22.0 software. The study reveals that, the problems faced by contractors in their practices of IBS implementation such as low productivity, management aspects, and financial problems. Therefore, training to labour, IBS instruction guideline and improving finance, and procurement mechanism are the top recommended factors to improve contractors' practices for successful IBS implementation. In conclusion, with the improvement of contractors' practices, the productivity of IBS implementation in the construction industry can be improved.

Keywords: Contractor, construction industry, industrialized building system (IBS), practices

1. Introduction

Construction industry is one of the production sectors that continues to contribute to the economy. Since the 1990s, the contribution of the construction sector to the Gross Domestic Product (GDP) has fluctuated. Although it is relatively stable, it was as high as 4.8% in 1997 and an estimated 2.7% in 2005 (Hamid *et al.*, 2011). The new way of changing the perspective of the construction industry depends on the concept of focusing on improving construction efficiency. The use of industrialized building systems (IBS) modern buildings seem to be one of the construction improvements in Malaysia as IBS is a construction system built using pre-fabricated engineering components (Yahya *et*

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al., 2014). It aims to achieve several improvements within the sector, such as higher productivity levels and better quality construction products. Reports and case studies from different parts of the world have shown that prefabrication and on-site assembly are becoming common practices (Wang & Hubbard, 2017). The main reason for delay the completion of construction projects was due to the poor practice of contractors (Sambasivan & Soon, 2007).

Lack of experience, lack of technical knowledge and lack of skilled labor are very important barriers to successful IBS adoption. There have been cases where buildings were awarded and constructed using IBS system but it contributed to project delays and bad quality (CIB, 2010). Furthermore, there is a lack of proper project management techniques, specifically for IBS, and there is no specific cost control mechanism adopted by contractors in IBS (Kamar *et al.*, 2010). It is very important to investigate the contractors' practices to ensure that their performance is optimal. Their motives and cooperation should be investigated so that they can work in a conducive work environment. The poor practice of contractors can hinder the environment for improving implementation of IBS and reduce the quality of project outcomes. There is a need for better understanding of the influencing factors of contractors' practices to enhance the productivity for IBS implementation. Therefore, the objectives of this study are to identify current contractors' practices, influencing factors and ways for improving practices of contractors' practices for IBS implementation in the construction industry.

2. Literature Review

The used of IBS in the construction industry worldwide has positive perceptions on improving the overall construction industry practice. In addition, the Construction Industry Development Board (CIDB) has been actively promoting the use of IBS in Malaysian Construction Industry since 1998. Unfortunately, the used of IBS for a building project in Malaysia is still limited if compared to CIDB's target (Zawawi, 2009). Therefore, Mohd Amin *et al.* (2017a) stated that the Malaysian government emphasizes making full use of IBS for government projects by incorporating no less than 70% of the IBS component. In addition, the IBS roadmap for 2011-2015 aims to maintain the current momentum of the 70% IBS content of public sector construction projects up to 2015. Based on Saggaff (2017) there are five categories of IBS classifications used in the construction industry as follow.

(i) *Formwork system*

These include tunnel forms, tilt-up systems, beams, and columns molding forms, and permanent steel formworks (metal decks).

(ii) *Pre-cast concrete elements*

Pre-cast concrete columns, beams, slabs, walls, "3-D" components (e.g. balconies, staircases, toilets, lift chambers, refuse chambers), lightweight pre-cast concrete, as well as permanent concrete formworks.

(iii) *Steel Framing Systems*

Steels columns and beams, steel framing systems have always been the popular choice and used extensively in the fast-track construction of skyscrapers.

(iv) *Prefabricated Timber Framing Systems*

Offering interesting designs from simple dwelling units to buildings requiring high aesthetical values such as chalets for resorts.

(v) *Blockwork Systems*

Conventional bricks have been revolutionized by the development and usage of interlocking concrete masonry units (CMU) and lightweight concrete blocks.

2.1 Advantages for IBS Adoption in Construction Industry

According to Jabar *et al.* (2013), there are numerous advantages of adopting IBS had been reported by academicians around the world. The benefits of IBS adoption are summarized in Table 1. These benefits have been a significant driver in IBS adoption to prevail the traditional construction skills shortage, speeding up the construction process, cost certainty and achieving higher quality. Accordingly, it attracted the government to initiate and promote IBS usage in the construction industry. These benefits have been a significant driver in IBS adoption to prevail the traditional construction skills shortage, speeding up the construction process, cost certainty and achieving higher quality. Accordingly, it attracted the government to initiate and promote IBS usage in the construction industry.

Table 1 - IBS Benefits.

No.	Benefits	Explanation
1	Cost and financial advantages	IBS offers cost saving through: a) Earlier completion time b) Repetitive use of system formwork made of steel, etc. and scaffolding c) Less wastage and the usage of building material d) Reducing site infrastructure and overhead e) Increased certainty less risk (Jabar <i>et al.</i> , 2013)
2	Construction speed	IBS construction process is governed by the speed of production and controlled environment of manufacturing facilities (Aburas , 2011), thus the need on fast delivery can easily be met by increasing the production capacity (Jabar <i>et al.</i> , 2013)
3	Reducing labor	Malaysian government aims to reduce the using of foreign labor. The using of IBS component, which is manufactured in a centralized factory, automatically will reduce labor requirements at a construction site (CIDB, 2011).
4	Health and safety measures	IBS application will improve site safety by providing a cleaner and tidier site environment as the site activities become and indirectly reduce construction hazards (Abd Rahman & Omar, 2006).
5	Flexibility	IBS allows flexibility in architectural design, in order to minimize uniformity of repetitive facades. Simultaneously, the flexibility of different system used in IBS construction process produced own unique prefabrication method (Peng <i>et al.</i> , 2003).
6	Waste minimization	All IBS components are manufactured from the factory, resulted in less wastage (Mohamad Kamar, 2011).
7	Improving productivity	The application of IBS will overcome the problems of workers insufficiency, which affected contractor's productivity. At the same time, it enhances productivity by removing difficult operation off-site and less site disruption (CIDB, 2010).

2.2 IBS Contractors' Practice Current Issue

From the perspective of IBS industry, there is a general consensus that contractors in a wide range is the stakeholders and play a very important role in ensuring the success of IBS implementation. Mohamad Kamar (2011), stated that contractors are the main driver of off-site total revenue. In this regard, the efforts taken from the traditional approach to the entire industry of IBS will depend largely on the contractor's readiness and maturity, which will coordinate the processes involved in the life cycle of IBS implementation. However, there is a lack of systematic and rigorous study on the strategic aspect and a lack of identification of the factors that contribute to the success of IBS. A wider understanding of the characteristics and what is involved in IBS is needed to support the transformation of IBS contractors' success. A study by Mohd Fateh *et al.* (2017), revealed that there were five (5) issues related to contractors' practices of IBS implementation.

(a) Cost

The cost incurred for the implementation of IBS was to set up the factory. The IBS contractor needed more than 30% of the up-front payment. The payment was based on work progress for the conventional and it did not applicable when it came to the IBS project. Besides that, there was an issue of high prices in terms of production cost which comprised of buying new equipment, machinery, technology and training for the manpower.

(b) Difficulty in securing timely and adequate financing

The difficulty of financial funding for the IBS contractor was because of the progress work payment. The payment for the IBS contractor could not be treated the same way as the conventional project because the initial cost was not the same. It was essential for the IBS contractor to receive the initial payment from the client to sustain their business.

(c) Lack of integration at the design stage

In terms of the integration at the design stage, respondents mentioned that sometimes it was related to the payment issue to the IBS contractor. At this stage, it was important for each party to be responsible and had good cooperation to ensure that the payment could be made on time based on the right design.

(d) Difficulty to get loans from the financial institution

Some of the respondents mentioned that dealing with the financial institutions for loan application were not the main problem for the IBS contractor. As long as the documents were fully-completed, the financial institution would be able to approve the loans. As for now, there were few financial institutions would be able to provide loans for the construction industry such as EXIM Bank, SME Bank and others.

(e) Increment of material prices

The high cost of material would increase the initial cost of production that made difficult to sustain the equilibrium of the profit of contractor that forced him to spend more money in initiation stage.

2.3 Influences Factors of IBS Contractors

IBS is a potential method to improve overall construction performance. With over 50 years of laissez-faire in Malaysia, IBS has not been widely accepted and used. In order to accelerate the adoption of IBS, it is necessary to determine the important factors for IBS contractors. As studied by Mohamad Kamar *et al.* (2010), the critical influencing factors to the implementation of IBS are highlighted as follows.

- (a) Good working collaboration will solve the problem related to complex interfacing between systems and ensure efficient process sequence in the manufacturing plant and at the site (Lu and Liska, 2008).
- (b) Effective communication channel across the supply chain needs to be established in order to coordinate the process and deal with critical scheduling from the beginning until the project completion (Pan *et al.*, 2008).
- (c) Continues improvement and learning can develop company understanding on the processes and the principle behind it as the knowledge will multiply as experience mount up (Neala *et al.*, 1993).
- (d) Key decisions on strategy, application, design, logistics, and detail unit should be made as early as possible between all parties involved (Blismas, 2007).
- (e) The team members should be involved during the design stages, working with the designers, to ensure that the design is not taken to a stage where it restricts the benefits that can be brought through the use of this method (Blismas, 2007)
- (f) Successful implementation requires an experienced workforce and technical capabilities in design, planning, organizing and controlling function with respect to production, coordination, and distribution of components (Warszawski, 1999).
- (g) Information and Communication Technology (ICT) is vital and reliable support tool to improve tendering, planning, monitoring, distribution, logistics, and cost comparison process by establishing integration, accurate data and effective dealing with project documents (Mohamad Kamar *et al.*, 2010).
- (h) Extensive planning and scheduling of activities in advance are critical in which lead to better project performance, coordination, better scope control and ensure smooth project sequence (Mohamad Kamar *et al.*, 2010).
- (i) Improvement in procurement strategy and contracting is important in order to achieve long term success (Pan *et al.*, 2008).
- (j) Risk Management strategy is important when to offsite to deal with late design changes, late payment and contract problem (Hassim *et al.*, 2009).
- (k) Products are documented in systematic ways to ensure that everything is repeated in the same manner for installation (Mohamad Kamar *et al.*, 2010)
- (l) High demands will be raised on the management of supply chain and logistics activities to full control of the process with the intention for improving efficiencies and competitiveness (Mohamad Kamar *et al.*, 2010).
- (m) It also depends on 'top-down' commitment and corporate motivation to ensure the right motivation and commitment from the whole team (Mohamad Kamar *et al.*, 2010).
- (n) Skilled labor which is supported by quality training at all level is essential to the success of offsite as it is in a more traditional form of construction (Wah *et al.*, 2003).

Based on the type of project and demographics, there are different stages in the construction of IBS buildings. Bari *et al.* (2012) described the five processes of IBS, namely initial work, factory component production, transportation to the construction site, installation and finishing. At each stage, key success factors are categorized according to management factors, government policies and initiatives, design and construction, and technical factors. IBS contractor is involved in mentioned stages accordingly, In contrast to the management process of IBS, each beam, column, wall or plate is systematically installed after the components are successfully produced. These factors include good cooperation, effective communication channels, team members involved in the design phase, extensive planning and scheduling, risk management, supply chain and logistics management, top-down commitment, strategy and business approach, and industry marketing strategy (Bari *et al.*, 2012)

3. Methodology

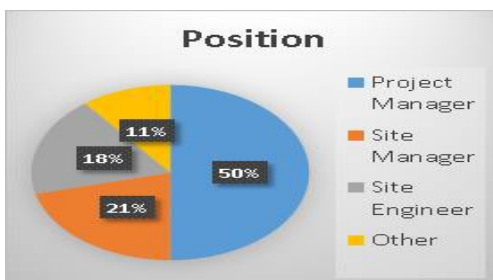
The research methodology adopted to achieve the study objectives associated with literature review and quantitative method. The literature review is done by reviewing academic research journals, textbooks, and ultimately the information available on the internet to compare the current contractors' practices of IBS implementation in construction projects, identifying contractors influencing factors and current improving ways. The quantitative method by the distribution of the questionnaire was chosen as the data collection method. The questionnaire survey has been designed (i) to study the current contractors' practices of IBS implementation in the construction industry, (ii) to identify influencing factors for contractors' practices of IBS implementation in the construction industry and (iii) to recommend ways for improving practices of contractors for IBS implementation in the construction industry. Target respondents are the construction industry players, namely Grade 7 (G7) contractors registered with the CIDB. Contractor G7 was chosen because they are the main contractor with unlimited tendering abilities. There were about 230 questionnaires distributed to the targeted respondents consisted of a project manager, site manager, site engineer, and others. A total of 76 questionnaires were gathered from a total of 230 contractors of G7 distributed at Johor Bahru and this constitutes a sum of 33.04% response rate. According to Samiaah *et al.* (2011), the normal usable response rate is ranging from 25% to 35%. Therefore, the total response received is considered sufficient for the purpose of this study.

4. Results and Discussion

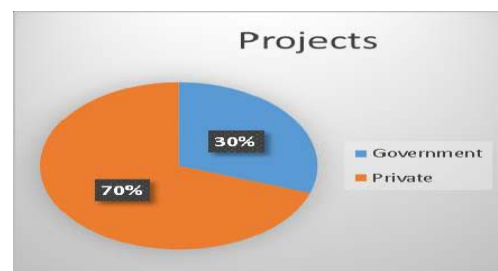
4.1 Respondents Background

Fig. 1 shows the respondent's background. From 76 of the respondent, the highest respondent that answered the survey was project manager, which are 50.0% of the total percentage while the second highest is site managers with 21.1%, then site engineer with 18.4% and lastly others with 10.50% of total respondents. Besides that, only 30.3% of projects type was a government project. While the majority of the project is private type within 69.7% from the total percentage. In addition, most of the respondents have been in the construction industry within the range of 7-15 years which 56.6%. Only 9.2% of the respondents have been in the construction industry within the range 16 years and above. However, the respondents have been in the construction industry within range 3-7 years reflect 17.1% and the rest are in the range of 0-3 years with 17.1% of the total percentage.

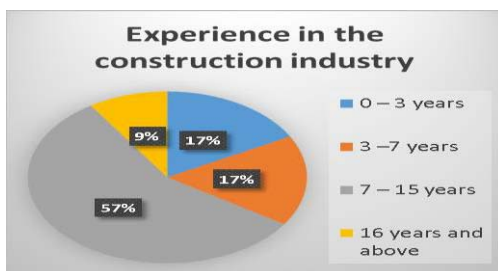
While, the respondents have been using IBS in the construction industry with more than 10 projects are with 38.2% from total percentage and for the respondents of using 6 - 10 IBS projects reflect 21.1%. However, for the range of 3-6 IBS project with 15.8% and the respondents who use IBS in less than 3 projects has 25% of the total percentage. Finally, the respondents who faced less difficulty in facing IBS give the highest percentage with 65.8%. That indicate of less difficulty of IBS adaption in construction projects. While respondents who said moderate difficult indicated, 31.6% and only 2.6 % of the respondents reflect of facing very difficult using IBS.



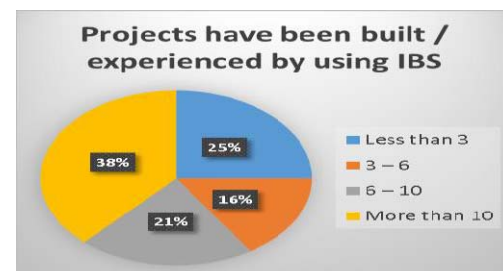
(a)



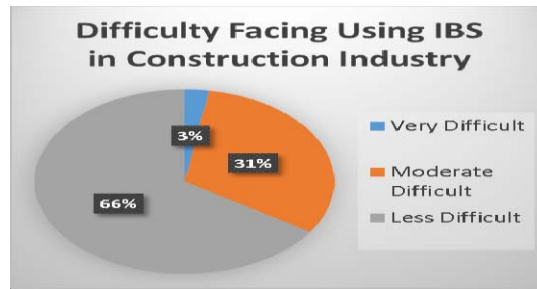
(b)



(c)



(d)



(e)

Fig. 1 – (a) Position; (b) Projects; (c) Experience in the construction industry; (d) Projects have been built/experienced by using IBS; (e) Difficulty facing using IBS in the construction industry.

4.2 Contractors’ Practice in IBS Implementation

The result of the data analysis as shown in **Table 2** with the ranking of current contractors’ practices of IBS implementation in construction projects from highest to the lowest mean value. The highest ranking has the mean of 4.71, while the lowest ranking is 4.12 with 0.59 differences in mean value. It is obvious that the average mean of all answers is 4.47, which is located under the “Agree” category of the mean. This finding gives a positive view that Malaysia contractors are familiar with IBS adaption in the construction industry. Cleaner environment in IBS implementation as a tremendously substantial element in contractors’ practices since it is one of the most essential factors to adapt IBS in construction projects. Neater and safer construction sites is also a very important issue in contractors’ practices for IBS implementation. In addition, it has been admitted that controlled quality in IBS implementation is achieved in the construction project at Johor Bahru. Apart from this, Mohd Amin *et al.* (2017b) stated that IBS implementation provides an insignificant surplus, environmentally friendly, good quality, and lesser overall construction project budgets.

Moreover, the finding of faster project completion in IBS implementation is declared strongly agreed that most of the contractors have been practiced at Johor Bahru construction projects. The study finding also highlighted that fewer site materials in IBS implementation were positively indicated where most of the respondents agreed that construction project at Johor Bahru has been practiced, which has been stated early by Mohd Amin *et al.* (2017b) and Mohamad Kamar (2011). Additionally, the finding of minimal wastage in IBS implementation was also positively where most of the respondents were strongly agreed to this statement. This the same fining of Taksiah *et al.* (2011), who said G7 is able to minimize wastage more than the other contractors were able to undergoing the paradigm shift from using conventional technology to a more systematic and mechanized system.

In another matter, it has been found that contractors agreed of reduction of site labor in IBS implementation, therefore, will lead to lower total construction costs in IBS implementation (Mohamad Kamar *et al.*, 2009; Mohamad Kamar, 2011). Finally, the finding of the current contractors’ practices of planning and scheduling of IBS implementation was also positively where most of the respondents agreed to this statement of contractors’ practices. Besides, in this study findings, the respondents also completely agreed that there is important to coordinate design, manufacturing, transportation and installation process which is highlighted in Mohamad Kamar *et al.* (2010), the study of critical success factor to IBS contractors.

Table 2 - Current Contractors’ Practice of IBS Implementation.

No.	Question	Category	Mean	Rank
Q5	Cleaner environment in IBS implementation	Strongly Agree	4.71	1
Q7	Neater and safer construction sites	Strongly Agree	4.66	2
Q6	Controlled quality	Strongly Agree	4.64	3
Q8	Faster project completion in IBS implementation	Strongly Agree	4.62	4
Q4	Fewer site materials in IBS implementation	Strongly Agree	4.61	5
Q3	Minimal wastage in IBS implementation	Strongly Agree	4.58	6
Q2	Reduction of site labor in IBS implementation	Agree	4.42	7
Q1	Lower total construction costs in IBS implementation	Agree	4.36	8
Q1	Awareness of IBS implementation	Agree	4.33	9
Q1	Planning and scheduling of IBS implementation	Agree	4.17	10
Q9	Coordination of design, manufacture, transportation, and installation process	Agree	4.12	11
Average			4.47	

4.3 Influencing Factors for Contractors' Practice

The second objective of this study is to identify influencing factors for contractors' practices of IBS implementation in the construction industry. The influencing factors for contractors' practices of IBS implementation in the construction industry at Johor Bahru as shown in **Table 3** with ranking number 1 until number 10 from highest to the lowest mean value. The highest ranking has the mean of 4.39, while the lowest ranking is 3.58 with 0.46 differences in mean score value. This ranking provides an indication of influencing factors for contractors' practice of IBS implementation in the construction industry, which faced during implementation of IBS at Johor Bahru construction projects. The highest ranking of influencing factors for contractors' practices is the financial problems on implementing IBS in construction projects. However, there is a constraint among small contractors to implement IBS in construction project due to financial capability. Nawi *et al.* (2015) supported that, in order to overcome the financial funding problems, some of the contractors essential to have a financial bond from the creditor as an assurance. In addition, the finding regarding the coordination problems with others was also positively given which most of the respondents were agreed to the statement, this finding to this problem supporting research by Mohamad Kamar (2011).

Furthermore, the finding concerning the problem of equipment and tool shortage on site was also positively indicated which most of the respondents agreed to the statement given. Most contractors agreed that there is a problem on equipment and tool shortage on site on implementation IBS which supporting previous research by Abramson (2011). In addition, the finding of low productivity of labor was also positively agreed as well where most of the respondents agreed. Lack of experience, lack of technical knowledge and low productivity of labor are very important barriers to successful IBS adoption (Abd Hamid *et al.*, 2011). Regarding problem on poor site conditions, it was also positive where most of the respondents agreed that construction project at Johor Bahru faced this kind of problem during implementation of IBS. This support previous research by Kamarul Anuar (2011). Moreover, the finding of the problem with transportation delays was also positive as well as previous factor problems. Most respondents agreed that construction projects at Johor Bahru faced a problem on transportation delays where this finding supported by previous research by Mohamad Kamar *et al.* (2009).

Moreover, the problem on the shortage of materials on site was found that respondents answer positively. The finding of a shortage of materials on site problem support previous research that discusses the same factor for IBS implementation of Abd Hamid *et al.* (2011). The last finding of contractors' practices influencing factors of IBS implementation in the construction industry at Johor Bahru is construction mistakes and defective work, which still positively where the respondents were agreed of this statement. This finding is similar to previous research stated that contractors to avoid construction mistakes and defective work is another crucial factor to project success (Yunus *et al.*, 2016).

Table 3 - Influencing Factors for Contractors' Practice.

No.	Question	Category	Mean	Rank
Q4	Financial problems	Agree	4.39	1
Q1	Coordination problems with others	Agree	4.34	2
Q6	Equipment and tool shortage on site	Agree	4.29	3
Q9	Low productivity of labor	Agree	4.25	4
Q7	Poor site conditions	Agree	4.20	5
Q3	Poor skills and experience of labor	Agree	4.17	6
Q8	Transportation delays	Agree	4.16	7
Q5	Weak site management	Agree	4.13	8
Q2	Shortage of materials on site	Agree	4.04	9
Q1	Construction mistakes and defective work	Agree	3.58	10
Average			4.	

4.4 Improvement Ways of Contractors' Practice

The third objective of this study is to recommend ways to improve contractors' practice of IBS implementation in the construction industry. The result of the data analysis shown in **Table 4** with the ranking of recommended ways factors for improving contractors' practices from highest to the lowest mean value. The highest ranking has the mean of 4.59, while the lowest ranking is 4.14 with 0.26 differences in mean score value. This ranking provides an indication of contractor perception of recommending ways factors to improve contractors' practices of IBS implementation in construction projects at Johor Bahru. Based on this study, a series of professional recommended review of respondents have to be adapted to improve contractors' practices of IBS implantation in construction projects. The first point of this section was about training to labor on implementing IBS such as (using new tools, equipment, and techniques) would be used in IBS projects. Many professionals in the Malaysian construction industry suggest this recommendation. It is

necessary, however, to emphasize that there are relatively far fewer workers that still need the training for appropriate skills to IBS adaption (Saggaff, 2017, Mohamad Kamar *et al.*, 2010). Provide guideline of instructions on using the IBS proper equipment / tools would avoid any loss, injury or delay in work. Supporting this is also recommended to the study of the effectiveness of industrialized building system (IBS) implementation (Zawawi, 2009). The training to labor should be the first focus to improve contractors' practices in the implementation of IBS.

Improve the timely and adequate financing payment is the third accepted recommended solution. The practices of a progress payment to the contractors in IBS project might not be paid in a similar method as a traditional project since the preliminary budget is unequal. Therefore, it is crucial for the contractor to obtain the preliminary payment for project sustainability and this recommendation is suggested by many researchers such as Dzulkalnine (2016) and Mohd Amin *et al.* (2017a). Provide procurement mechanisms and strategy for IBS adaption should be adequately and updated on all relevant project documentation. As mentioned in the previous study, adopting IBS requires further improvement of procurement management for the overall traditional supply chain. Construction procurement for IBS project is slightly diverse from conventional methods, where it is required to include purchasing IBS components in the initial stage of the project (Mohamad Kamar, 2011).

Involving the contractor in the design stage of IBS practice is an important recommendation. However, the most significant management-related factors towards the effective execution of IBS projects in Malaysia which are full participation from all parties for excellent working collaboration and effective communication channel during the design stage (Ismail *et al.*, 2012). Finally, the respondent's opinion was focused on providing campaigns and seminars to IBS contractors to improve incentive and awareness as it will help to improve contractors' practices in the implementation of IBS in the construction industry which recommended by previous research. To get more efficient contractors trained in IBS, more efficient education awareness on IBS through courses, campaigns, and seminars (Razak & Awang, 2014).

Table 4 - Recommend ways for Improving Contactors' Practice.

No.	Question	Category	Mean	Rank
Q6	Training to labor on implementing IBS such as (using new IBS tools to implement IBS building, involving in IBS projects, etc.)	Strongly Agree	4.59	1
Q5	Provide guideline of instructions on using the IBS proper equipment / tools to avoid any loss, injury or delay in work	Strongly Agree	4.58	2
Q4	Improve the timely and adequate financing payment	Strongly Agree	4.58	2
Q3	Provide procurement mechanisms and strategy for IBS adaption	Strongly Agree	4.57	3
Q1	Involving contractor in the design stage of IBS practice	Agree	4.33	4
Q2	Providing campaigns and seminars to IBS contractors to improve incentive and awareness.	Agree	4.14	5
Average			4.	47

5. Conclusion

In this research, a total of 33.04% rate of respondents have been collected through the survey of contractors' practices of IBS implementation in the construction industry in Johor Bahru, Johor, Malaysia. Contractors are the major stakeholders in ensuring the success of IBS implementation in construction projects. To the best practice of contractors in IBS adaption, significant recommendation factors are necessary to be considered. This study has identified significant contractors' influencing factors in construction projects and shows recommendation ways to improve contractors' practices. Therefore, training to labor, IBS instruction guideline and improving finance and procurement mechanism is the top recommended factors to improve contractors' practices of IBS implementation. With the improvement of contractors' practices, the productivity of IBS implementation in construction projects would be improved and lead to more success of IBS adaption in the construction industry.

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References

- Abd Rahman, A. B., & Omar, W. (2006). Issues and challenges in the implementation of industrialized building systems in Malaysia. *Proceedings of the 6th Asia-Pacific Structural Engineering and Construction Conference*, (September), C-45-C-53.
- Abd Hamid, Z., Mohamad Kamar, K. A., & Alshawi, M. (2011). *Industrialized Building System (IBS): Strategy, People and Process*.
- Abramson, D. (2011). Mixing cloud and grid resources for many task computing. In *Proceedings of the 2011 ACM international workshop on many task computing on grids and supercomputers - MTAGS '11*, 10, p. 1.
- Aburas, H. (2011). Off-Site Construction in Saudi Arabia: The Way Forward. *Journal of Architectural Engineering*, 17(4), 122–124.
- Bari, N. A. A., Yusuff, R., Ismail, N., Jaapar, A., & Ahmad, R. (2012). Factors Influencing the Construction Cost of Industrialised Building System (IBS) Projects. *Procedia - Social and Behavioral Sciences*, 35(December 2011), 689–696.
- Blismas, N. G. (2007). *Off-site Manufacture in Australia : Current state and Future Directions*. Cooperative Research Centre for Construction Innovation.
- CIB (2010). New Perspective in Industrialised in Construction : A State-of-the-Art Report, CIB Task Group 57, *Swiss Federal Institute of Technology, Zurich, Switzerland*, ISBN 978-3-906800-17-2.
- Construction Industry Development Board (CIDB) (2011). *Transformation of Construction Industry through Industrialized Building System (IBS) Roadmap (2011-2015)*. Available at: http://www.pam.org.my/Library/notes/ibs_roadmap_2011-2015_-PAM_21122010.pdf, 2011.
- Construction Industry Development Board (CIDB) (2010). IBS Roadmap 2011-2015, Kuala Lumpur, 2010. Dzulkalnine, N. (2016). Issues of Payment Procurement Process for Industrialised Building System (IBS) Jurnal Teknologi Issues of Payment Procurement. *Researchgate.net*, (May). <https://doi.org/10.13140/RG.2.1.4770.5202>
- Hassim, S., Jaafar, M. S., & Sazali, S. A. A. H. (2009). The Contractor Perception Towards Industrialised Building System Risk in Construction Projects in Malaysia. *American Journal of Applied Sciences*, 937–942.
- Ismail, F., Yusuwan, N. M., & Baharuddin, H. E. A. (2012). Management Factors for Successful IBS Projects Implementation. *Procedia - Social and Behavioral Sciences*, 68, 99–107.
- Jabar, I., Ismail, F., & Mustafa, A. A. (2013). Issues in Managing Construction Phase of IBS Projects. *Procedia - Social and Behavioral Sciences*, 101, 81–89.
- Lu, N., & Liska, R. W. (2008). Designers' and general contractors' perceptions of offsite construction techniques in the United State construction industry. *International Journal of Construction Education and Research*, 4(3), 177–188.
- Mohamad Kamar, K. A., Abd Hamid, Z., & Alshawi, M. (2010). The critical success factors (CSFs) to the implementation of industrialized building system (IBS) in Malaysia *Track, 18th CIB World Building*, 10–13.
- Mohamad Kamar, K. A. (2011). Critical Success Factors to Industrialised Building System (IBS) Contractor, School of the Built Environment , Faculty of Business , Law and the Built Environment , University of Salford. *Thesis*, (January 2011).
- Mohamad Kamar, K. A., Alshawi, M., & Abd Hamid, Z. (2009). Barriers to Industrialized Building System (IBS): The Case of Malaysia. *Built and Human Environment 9th International Postgraduate Research Conference*, (2009), 1–16.
- Mohamad Kamar, K. A., Abd Hamid, Z., & Alshawi, M. (2010). The critical success factors (CSFs) to the implementation of industrialized building system (IBS) in Malaysia *Track, 18th CIB World Building* , 10–13.

- Mohd Amin, M. A., Abas, N. H., Shahidan, S., Rahmat, M. H., Suhaini, N. A., Nagapan, S., & Abdul Rahim, R. (2017a). A review on the current issues and barriers of Industrialised Building System (IBS) adoption in Malaysia's construction industry. In *IOP Conference Series: Materials Science and Engineering* (Vol. 271).
- Mohd Amin, M. A., Abas, N. H., Shahidan, S., Rahmat, M. H., Suhaini, N. A., Nagapan, S., & Abdul Rahim, R. (2017b). A review on the current issues and barriers of Industrialised Building System (IBS) adoption in Malaysia's construction industry. *IOP Conference Series: Materials Science and Engineering*, 271(1).
- Mohd Fateh, M. A., Mohammad, M. F., & Abd Shukor, A. S. (2017). Review in formulating the standard form of contract for Industrialized Building System (IBS) construction approach in Malaysia. *MATEC Web of Conferences*, 87, 1001.
- Nawi, N., Othuman Mydin, A., Nursal, A. T., Nifa, F. A., & Baharudin, A. Y. (2015). Payment issues in Malaysia industrialized building system (IBS): Literature visit. *Advances in Environmental Biology*, 9(4), 185–188.
- Neala, R., Price, A. & Suer, W. (1993). *Prefabricated modules in construction*. Bournemouth: Bourn Press Limited.
- Pan, W., Gibb, A. G. F., & Dainty, A. R. J. (2008). Leading UK housebuilders' utilization of offsite construction methods. *Building Research and Information*, 36(1), 56–67.
- Peng, W. L., Abdul Kadir, M. R., Jaafar, M. S., & Salit, M. S. (2003). the Essential Characteristics of Industrialised Building System. *International Conference on Industrialised Building Systems*, (January 2003), 283–292.
- Razak, F. M., & Awang, H. (2014). The Contractors' Perception of the Implementation of Industrialised Building System (IBS) in Malaysia. *MATEC Web of Conferences*, 10, 4003.
- Saggaff, A. (2017). Industrialized building system - an innovative construction method. *MATEC Web of Conferences*, 101, 5001.
- Sambasivan, M., & Soon, Y. W. (2007). Causes and effects of delays in Malaysian construction industry. *International Journal of Project Management*, 25(5), 517–526.
- Samiaah, M., Al-Tmeemy, H. M., Abdul-Rahman, H. & Harun, Z. (2011). Future criteria for success of building projects in Malaysia. *International Journal of Project Management*, 29(3), 337–348.
- Taksiah, A. M., Azhari, A. M. N., Syed Zakaria, S. A., Yahya, A. S., Shah Zaini, S., S. Ahamad, M. S., & Hanafi, M. H. (2011). Quantitative Analysis on the level of IBS Acceptance in the Malaysian Construction Industry. *Journal of Engineering Science and Technology*, 6(2), 179–190.
- Wang, H., & Hubbard, B. (2017). A Survey Study on Industrial Construction Project Supply Chain: On Time Performance and Practices of Structural Steel and Pipe Spools. *Procedia Engineering*, 196(June), 653–659.
- Warszawski, A. (1999). *Industrialized and Automated Building Systems*. New York: E and FN Spon.
- Yahya, M. A., Sojipto, S., & Ismail, A. S. (2014). The Needs of Industrialised Building System in Malaysia. *Proceedings of the International Building & Infrastructure Technology Conference*, 54–62.
- Yunus, R., Abdullah, A. H., Yasin, M. N., Masrom, M. A. N., & Hanipah, M. H. (2016). Examining the performance of Industrialized Building System (IBS) implementation based on contractor satisfaction assessment. *ARPJ Journal of Engineering and Applied Sciences*, 11(6), 3776–3782.
- Zawawi, M. (2009). Effectiveness of industrialized building system (IBS) implementation for Malaysian construction industry. *Universiti Teknologi Malaysia*, (November 2009), 1–38.