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An Investigation on Benefits and Future Expectation of Industrialised Building System (IBS) Implementation in Construction Practices

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Abstract: Industrialised Building System (IBS) is well known in many developing countries due to the benefits that can be derived from its applications in construction projects. However, the low percentage of IBS usage may be due to lack of awareness and knowledge about IBS among many professionals. There may be factors that contribute to a lack of interest from the client towards IBS. The aim of this study is to improve the application of IBS particularly in private construction projects in Malaysia by determining the benefits and expectation on application of IBS in private construction projects. This study adopts a quantitative method using questionnaires that were sent to 35 construction firms as a sampling frame. Finally, the finding of this study hopefully could assist professional parties in construction industry in providing a better ground knowledge for improving decisions making to achieve the success of IBS construction projects implementation and also this study will achieved the project objectives in terms of predetermined objectives that are mostly within the time, specified budget and standard quality.

Key words: ***Industrialised Building System (IBS), Client Perspective, IBS Application, Private Projects, Success Criteria***

INTRODUCTION

Industrialised Building System (IBS) is the terminology to represent the prefabrication concept in the Malaysian construction industry. IBS is a construction process that uses standardised building components mass produced in a factory or on the site the transported an assembled into a building structure with minimal workers on site with proper planning and integration. The construction industry has started to embrace IBS as a method of attaining better construction quality and productivity, reducing risks related to occupational safety and health [1];[2] the ultimate goal of reducing the overall construction cost. More significantly, it also can reduce the construction waste [3] and protect the environment due to factory production and increase human safety on site and at the factory [4]. Thanoon, Peng, Kadir, Jaafar, and Salit, [5] indicated several country have been successfully adopted industrialised building system. The experiences in some developed countries such as Japan, Germany and United Kingdom indicate that there are great potential for IBS to progress in Malaysia as evidenced by their growing market share. Beside economic factor, IBS adoption will present several benefit to Malaysia construction industry. IBS Survey [6] indicated IBS adoption will avoid quality issues, unfavourable site condition, skilled labour shortage and bad weather conditions. However, the main reason why Malaysia eager to move into Industrialised construction is due to influx of foreign workers working in construction industry which apparently more related to conventional method of construction [6]. The recent statistic shows that currently there are almost 2 million foreign workers who are working in Malaysia in various sectors. Thus, this situation needs to be controlled by implementation of IBS which will diminish the dependency on foreign workers by reducing the wet-trades [7].

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Although IBS was established for a long time ago and the related technologies increase every year however in Malaysia, enforcement through policy to encourage IBS adoption is important. IBS is compulsory to be used in public projects worth RM 10 million and above with the minimum IBS score of 70 as issued by the Treasury Circular Letter now referred as SPP 7/2008. All Malaysian government agencies directing them to increase the IBS contents of their building development projects to a level not less than 70 IBS score and in that sense IBS and in that sense IBS must be incorporated as part of the contract document for tender. Other on-going enforcements are to change the requirements for the public projects, from RM 10 million to RM 5 million, to used IBS with IBS score of 70. Future enforcement is to make IBS compulsory for private projects with the value exceeding RM 50 million with the minimum IBS score of 50 by the year 2020 [8]. Besides that, according to Abdul Hamid, [9], CIDB in cooperation with local authorities to ensure that the private developers to use at least 50% of materials from IBS, which involves projects worth over 50 million by 2018. As at May 2016, about 69 of government projects used IBS, while the adoption rate by the private sector is still low at around 14%, according to CIDB's study in 2014 [10].

According to Pan, Gibb, and Dainty [11], the team members for IBS project should involved at the early staged as soon as possible notably during design stage. This practice will allow manufacturers; contractors and M&E specialist to get involve and share their knowledge with the design team early during design stage [6]. The success of IBS also required the good coordination of design, manufacture, transportation, and installation process between the parties involved. Therefore, it can be show that how important the relationship between each involved parties especially design team, contractors, and manufacturer/supplier to ensure the success of IBS project. At this juncture, it could be concluded that IBS requires partnership and close relationship between main contractors with suppliers and sub-contractors.

CURRENT IBS APPROACH IN MALAYSIA

A holistics, mechanised, industrialised and sustainable approach needs to be adopted in the current IBS approach in Malaysia.

1. Better understanding on IBS

For the Malaysian construction industry players such as owners, consultants, contractors, manufacturers and other players to have a better understanding on IBS, the industry requires change management and business engineering to encourage new mind set and increase awareness on the adoption of IBS. Guidance on the best practices and success factors to adopt IBS construction is also needed. IBS should be handled as a holistic process rather than just a collection of technology solutions. Established skill training centre and institute for construction industry such as Akademi Binaan Malaysia (ABM) needs to introduce IBS training or installer programme to increase the availability of the local skill workers or installer for IBS.

2. Sustainable aspect in IBS

Utilising IBS will likely only have an impact on construction cost, which is roughly 40% of the price of a new property. Hence, the main objective of IBS is mainly to reduce dependency on foreign labour, creating a safer and clear construction environment, better quality control and organised construction site [12]. In addition, sustainability involves innovation and the adoption of modern method of construction through industrialisation such as IBS. It is centrally organise, mechanised and automated production operations and focuses on mass production [13]. Using IBS as a platform in pursuing the sustainability agenda can also be immensely rewarding because it can offer organisations and players potential benefits [4].

3. Technical issues in IBS

Solutions for technical issues in IBS such as joint, standardisation, dimension, certification and other related technical issue are essential to avoid discouragement amongst the Malaysian construction industry players to adopt [14]. Guidelines or catalogue for every system and new construction methods need to be established as a reference for the Malaysian construction industry players and to encourage open IBS system.

4. Risk management in IBS

Acceptance of IBS does not well in the construction firms because of the failure to deal with risks in the IBS projects. Failures to keep in cost estimate in the IBS projects are still common in Malaysia and it is one of the reasons that limit the development of IBS. In fact that there are risks in IBS such as technical risk and quality risk that cause aesthetic and functional faults, like cracks, blemishes, moisture penetration and poor thermal insulation in completed buildings. To reduce risks, a valid and working risk strategy needs to be developed. The contractor can attempt to own the prefabrication technology by devising a special relationship with one or more prefabrication subcontractor or manufacturer, through the project-based joint venture, vertical integration or even internalisation.

5. Availability of IBS expertise

Lack of expertise is another reason why IBS is not being used extensively until now. Consequently, this may lead to poor design, plant management and production, and erection practices. On the perspective of manufacturers, lack of competence can cause failures in the production stage that in turn may cause delays in the erection schedule. These affect not only the manufacturer but also the contractor, because they avoid contractor from gaining profit through short construction period. While, lack of expertise on behalf of the contractor can cause delays in the erection schedule, even if the components are delivered to site on time [15]. Regarding to that matters, the CIDB developed the IBS Ecosystem in enhancing expertise and professional in IBS. Until December 2016, there are 8,234 IBS contractors and 245 manufacturers registered with CIDB. Also, there are 1809 IBS Professional that consists of engineer, architect and quantity surveyor trained by CIDB. Furthermore, there are 49, 765 IBS installers trained by CIDB. These resources will fulfill the demand of IBS and to enhance the adoption of IBS in Malaysia [16].

OBJECTIVES OF THE RESEARCH

This study attempts to improve the application of IBS in Malaysia Construction Industry. The improvement involves construction industries players expectation on the future IBS application, benefits of IBS and success criteria of IBS according to a clients' opinion. In order to achieve the aim of the study, the objectives of this study are as follows:

i. To determine the benefits of IBS application in private construction projects
ii. To determine the expectation of IBS application in future private construction projects

SURVEY METHODS

Data collection was carried out through questionnaire survey in person. Thirty Five experience respondents were selected from contractor G5 in Melaka state for participation in this survey. The respondents were asked to rank the significance level of factor affecting construction cost. A five point likert-scale of 1 to 5 was adopted to assess the degree of significance of each cause where 5= extremely significant, 4= very significant, 3= moderately significant, 2= slightly significant, 1= not significant. The reliability of 5-point Likert scale was determined by using Cronbach's alpha coefficients. Ideally, the Cronbach alpha coefficient of a reliable scale should be greater than 0.70 [17]. The Cronbach alpha for the used Likert scale is 0.831. This indicates that the data collected for the analysis is interrelated and consistent.

All collected data is analysed using frequency method to get the findings of the research and achieve the research objectives. The data collected were analysed using factor analysis technic of Statistical Software for Social Science (SPSS) version 21.

Table 1: Sampling Frame of Contractor registered with CIDB [18]

Item	Descriptions	Potential Populations		Sample Size suggested by [19]
1	Number of Melaka contractor G5 registered with CIDB	Registered	Active	86
		148 (100%)	114 (77%)	

As indicated in the table 1, Chua, Y. P. [19] suggested that minimum sample size is 86. However, as recommended by Delice, A. [20] the acceptable sample sizes for survey based research are between 30 and 500. Waris, M., Liew, M. S., Khamidi, M. F., & Idrus, A. [21] emphasized that a response rate in the region of 20% to 30% were acceptable as the feedback from the construction industry. Therefore, due to time limitation and accessibility to respondents; 114 questionnaires were distributed with an aim of 35 responses and constitute about 30% were collected by the cut-off date for data analyses. Furthermore, the purpose of this research is to get a snapshot on the subject matter regarding IBS application in construction projects. More extensive research is expected for more valid findings.

SURVEY RESULTS AND ANALYSES

Demographic respondents

A total of 35 respondents were interviewed and managed to fill in the questionnaire. The respondent is made up of agencies/construction companies participated in this survey. The respondents of this survey has extensive experience and already engaged in long periods in the construction industry. 94% of respondents have experience between 10 to 35 years. In addition, most of the respondents have a Bachelor Degree which 65.7% followed by Master Degree 20% and otherwise is a Diploma.

Objective 1: To determine the benefits of IBS application in private construction projects

The Benefits of IBS

The questionnaire was analysed from the contractors' viewpoints to identify the important factors that may give benefits of obtained by applying IBS in private construction projects (table 2). The most significant benefit that can be derived from implementing IBS is viewed to environmentally-friendly, which require less formwork and produce less waste, with an average index of 4.17. This has been supported by Zabihi, Habib, and Mirsaeedie, [12]; Wisam Mohamed S. Masod. [22], for the environment issues, the IBS usage will rise due to it being the best option to increase the existing productivity of construction output. IBS construction sites have been proven to look tidier and more organized due to cast in factory as compared to the wet and dirty conventional construction method sites. Also wastage of temporary works such as timber formworks and props, which are normal in conventional construction, is not there or is reduced if an IBS construction method is used instead [23].

Hence, enhance efficiency of the construction process (systematic way) with an average index of 4.00. According to Richard [24] the global organisations can have the continuous production using the same methods, knowledge and experiences, which have the possibility of reducing the involved cost and enhance efficiency of construction process. Although some may think that the critical investment in the early process is very high, once the break-even point is attained, the benefits from the industrialisation will significantly increase with the number of units produced [25];[26];[27]. Besides that, IBS training and short course should provide for contractor which could guide them in enhance competencies of construction process on IBS components. It's supported by Majid, Azman, Zakaria, Yahya, Zaini, Ahamad, and Hanafi, [28] suggested that the government should obligate most of the IBS stakeholders to attend in IBS training. In fact, they added the responsibility to educate and build up the awareness should be carried out by government as well as policy maker as to increase the implementation of IBS product.

The least significant benefit indicated by respondents, IBS is economical and lower overall construction cost with an average index of 3.14. IBS DIGEST [16] stated that advantages of IBS usage in construction environment are the cost saving is achieveable through mass production and the repetition of the same process to produce standard products, materials and components.

Cost is undoubtedly the most important concern in any business endeavour, not least in the construction industry. Poor cost performance in construction projects has become a major concern for both contractors and clients [29];[30]. In order to control construction costs, it is important to exercise foresight of the various project-related determinants and address the magnitude of their effects. Elhag, Boussabaine, and Ballal, [31] agreed that realizing and understanding cost-determinants will enrich the cost estimator's competence, hence, adequately delivering a more sustainable and reliable cost modelling and estimating technique.

Table 2. The benefits of IBS application towards IBS construction project

Benefits of IBS	Frequency of respondents					Total (N)	Mean index	Average Index indicator	Rank
	1	2	3	4	5				
1. Environmentally-friendly (Less formwork required, less wastage)	0	0	6	17	12	35	4.17	High	1
2. Produce cleaner, neater and safer site environment	0	0	7	18	10	35	4.09	High	2
3. Enhance efficiency of the construction process (systematic way)	0	1	5	22	7	35	4.00	High	3
4. Repetitive system, faster completion of project	0	1	8	17	9	35	3.97	High	4
5. Produce a better product (e.g. smooth surface finishes, higher quality, etc)	0	0	13	13	9	35	3.89	High	5
6. Better quality control, produce higher quality of end product	0	2	11	11	11	35	3.89	High	6
7. Reduce on site labor requirements (e.g. carpenters, barbenders, etc)	2	1	8	15	9	35	3.80	High	7
8. Construction activities not affected by adverse weather condition	0	2	16	14	3	35	3.51	Moderate	8
9. Flexible design of components	1	5	13	11	5	35	3.40	Moderate	9
10. Economical and lower overall construction cost	3	6	13	9	4	35	3.14	Moderate	10

Objective 2: To determine the expectation of IBS application in future private construction projects

Expectation of IBS Application in future private construction projects

From the analysis for construction industry players expectation on the future IBS application (table 3), respondents as a whole agreed that application of IBS in private construction projects should be improved with an average index of 4.11, such improvement are modular coordination usage.Governmental departments such as the Public Works Department and local authorities are responsible for introducing modular coordination and IBS through the building regulations and specifications.The execution of modular coordination through legislation is very important to gain success in industrialised building programmes. The implementation of modular coordination into Uniform Building By-Law (UBBL), planning standards and building specifications needs to be compulsory [16].

Next, respondents as a whole agreed that the application of IBS in private construction projects can be improved by the driven by the client with an average index of 4.03. This statement suggests that the client should play their role to insist the IBS should be implemented in their construction projects [4];[32]. Moreover, clients, among the wide range of industry players, hold a very important position to ensure the success of IBS adoption, especially among private sector, because the adoption of IBS is hugely dependent on readiness and maturity of clients to move from existing contracting role into IBS system integrator. If more of the clients from private sector can be convinced to adopt IBS, an overall higher level of Industrialised construction industry can be achieved.

Other than that, the respondents as a whole agreed with the statement that IBS may not be popular in private projects because of lack of exposure and knowledge of the client regarding IBS with an average index that quite high which is 3.94. With no insistence by the client, normally consultants, contractor and other construction player in a team of the project will have no intention and encouragement to implement IBS in the projects [33]. This has been supported by Shari and Soebarto [34]; Thanoon, Peng, Kadir, Jaafar, and Salit, [5], who found that IBS implementation has been heavily criticised by lack of coordination among parties involved.

Table 3. Construction players expectation on IBS the future application

Expectation on IBS the future application	Frequency of respondents					Total (N)	Mean index	Average index indicator	Rank
	1	2	3	4	5				
1. Application of IBS in construction should be improved	0	0	7	17	11	35	4.11	High	1
2. Client also needs to attend professional course and seminar regarding IBS	1	0	8	13	13	35	4.06	High	2
3. Client's role is important to improve the application of IBS in construction project	0	0	8	18	9	35	4.03	High	3
4. IBS may be not popular in construction projects because of lack of exposure and knowledge of the client regarding IBS	0	0	10	17	8	35	3.94	High	4
5. All the construction players are ready to implement IBS in construction projects once it is requested by the client	0	1	11	15	8	35	3.86	High	5

CONCLUSIONS

Successful and effective implementation of IBS in Malaysia construction industry can offer various benefits compare to conventional in-situ systems. Those are; the speed of construction, less wastage of materials which means cost savings, reduction of unskilled workers, better quality control of construction, increased site cleanliness and safety in construction projects. These are very important aspects in achieving the efficient and effective construction industry which will enhance the market share of construction industry as well as contributing to the Malaysian economy.This research are focusing on issues related to the;

i. Benefits of IBS application such as *environmentally issues, construction process, quality aspects, labour requirements, flexibility design, and construction cost.*

ii. Expectation on IBS the future application such as *improvement of IBS in construction, professional course and seminar, roles of clients and knowledge of clients regarding IBS* were highlight as a key driven on the succesful factors of IBS usage in Malaysia. This variable are require for further investigation in order to confirm its validity.

The results of the main research will hopefully provide the basis of a guideline to support and enhance the Malaysian construction industry's move into positive transformation aimed in the near future.

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