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Attraction Factors in Choosing Industrialized Building System (IBS) Method over Conventional Building System

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Abstract

Industrialised Building System(IBS) is defined as a construction system which components are manufactured in factory or offsite. The components then being positioned and assembled into structure with minimal additional site work. This field study was conducted directly between the researchers with 70 respondents, representing 70 IBS companies in Peninsular ofMalaysia. The purpose of the research is to identify the attraction factors that can influence the entrepreneurs and IBS contractors to choose IBS construction method in their constrcution rather than the conventional construction system method. Descriptive analysis are being used and varimax rotated principle component analysis is also being conducted. The research result shows that kaiser Meyer Olkin (KMO) statistical value is 0.861 surpasses the usable legal 0.6 value and Barlett's test of sphericity value is significant at $p<0.001$. The attraction and repellent factors that influence entrepreneur and contractor candidates in choosing IBS as a suitable method compared to conventional method in implementing in their project are obtained from this research.

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Attraction and repellent factors item is acquired through literature review. The research for the factors in determining the IBS method should be continued and evaluated deeper from time to time in future. It would also be helpful in effort to identify interest and IBS trend.

Keywords: Industrialised Building System (IBS); Flexibility; Supply Chain; Construction

1. Introduction

Development in construction industry is undergoing evolution and care is needed to spur the development and nation's growth. This term is referred to base on the needs of the main industrial construction plan that is IBS 2003-2010 and IBS 2011-2015 main plans with the non-fully achieve achievement "Abd Syukor et al.," in [1]. This issue is often being mentioned by many researcher and author, for instance, "Maryam et al.," in [12] (2010); "Nawi et al. in" [13] (2010) and "Abdullah et al.," in [3] they stated that only 15 percent construction project in Malaysia that uses the IBS CIDB Survey method "CIDB" in [6] whereas IBS study for mid-2007 stated that by using IBS only 10 percent project was completed for year 2006, as compared to a target of 50 percent IBS usage in 2006 and 70 percent by 2008 goals "Hamid" in [9]. Whilst, it is found that less than 35 percent from the entire projects in Malaysia uses at least one IBS product in year 2006.

In year 2003, CIDB has done research regarding IBS status in Malaysia and discover there is a 15% increment on of IBS materials usage in local construction. However, there are still contractors and even developers that prioritize sustainable use of conventional construction materials because of the cheaper capital cost to hire labors for the conventional construction rather than IBS intensive cost that is slightly expensive. Not just that, an early stage precast system that was introduced in Malaysia was absolutely not fitted to Malaysia's throughout the year hot and humid climate.

Moreover, problems also arise during the improper installation site has resulted in leakage problems caused by the shortage of specialists and experience workers in the installation of IBS components in the initial phase in the construction industry, IBS "CIDB" in [7]. Indirectly, the problems had tarnished reputation and image of IBS. In addition, many contractors choose to use the conventional construction system as it is cheaper and easier to get foreign workers in Malaysia. Not just that, the local workers too are not interested in joining the industry because of the low salary and the lack of encouragement at work environment, construction development industry main plan CIDB 2006-2015 "CIDB" in [8].

After that, many industry members are also not interested to venture in manufacture and produce of IBS component activities. Majority of them are relevant stakeholders in the construction industry who refuse to switch from conventional systems to the new system. It is likely that some of them did not obtain sufficient information to support the use and implementation of the IBS system "Abd. Hamid" in [2]. Developers and clients have come to appreciate IBS system as it can speed up the construction process, integrate sustainability strategy, reducing waste during construction, minimizing risk and increase the worker's safety level "Hassim " in [10] ; "Kamar" in [11], "Nawi" in [15], "Thanoon" in [16] and "CIDB" in [6]. Besides that, other researcher also agreed like "Nawi" in [14], "Tam" in [17], "Badir" in [4] and "Hassim" in [10].

1.1. IBS Benefits.

"Nawi" in [14], "Tam" in [17], "Badir" in [4], and "Hassim" in [10], stated the benefits of IBS as follows:

i. Optimize the use of materials, repeated use of the mold and can reduce waste of construction materials

ii. The production from the factory is able to produce better quality products, rational and efficient, better skilled workers, as well as repeated procedures and quality supervision and manageable.

iii. The duration of the construction work is shorter: be able to halve the time frame of precast construction 'in-situ' method.

iv. Construction operation is not affected during bad weather because construction components is produce fabricated in the factory and delivered to the construction site.

v. Manufacturing work is carried out centrally at the plant and can reduce the total number of workers on construction sites compared to many conventional methods that require the involvement of many workers.

vi. Opportunities are wide open for architectural contractors to be more innovative and creative when IBS system provide various opportunities for designers and builders to explore creative design in adapting the method of fabricated IBS.

vii. IBS method in construction activities use environmentally friendly building materials to reduce the effects of pollution on the environment as well as minimize waste on construction sites.

viii. IBS system is able to reduce unskilled and less productive workers.

ix. IBS is proven to reduce the total number of foreign workers in the construction sector (in the case of Malaysia), which previously is there is a large increment in social problems and crimes due to the increase of foreign workers in the country which brings to a very serious and worrisome level.

x. IBS can reduce overall construction costs, as well as the material and labor costs more effectively through practical and large-scale production for the production of construction components of IBS.

xi. Supervision and monitoring become better in improving the quality of products fabricated IBS components.

xii. Practical methods of IBS in construction site has resulted in a more organized, orderly, safe, and clean construction site environment compared to conventional methods.

xiii. IBS is able to boost the image, integrity design of the building, and construction to greater heights.

2. Research Method

Research has been done using questionnaire, the questionnaire form has been distributed to the leaders and contractors of IBS companies This field study was conducted directly between the researchers with 70 respondents, representing 70 IBS companies in Peninsular of Malaysia covering the states of Perlis, Kedah, Penang and northern Perak, while the remaining study areas taken into account were the southern states including Selangor, Kuala Lumpur (Klang Valley), Negeri Sembilan and Malacca. A list of IBS companies were obtained from the IBS Centre located in Kuala Lumpur (CIDB).

Descriptive analysis are being used and varimax rotated principle component analysis is also being conducted.

2.1 Unit of Analysis

The unit of analysis for this study was compiled and data were collected from practitioners as well as the leaders of IBS. They consist of manufacturers, suppliers, developers, contractors and consultants from selected areas in Peninsular Malaysia.

2.2 Research Instrument

The instrument used in this research is in the form of questionnaire. A questionnaire was designed based on three core flexibility challenge factors namely capabilities, organizational capability and capacity of relationship.

A set of question is divided into five parts, namely A, B, C,D and E. Part A covers questions related to demographic and basic information of respondents who chose the IBS industry. Part B contain questions related to knowledge of issues related to IBS. These questions are to test respondents' understanding and knowledge related to IBS problems as well as reasons why they chose IBS. Finally, Parts C to E contain questions related to research variables. The views and perceptions of the respondents were measured using a 7-points Likert scale. After the implementation of the research, the acquired data were processed using SPSS (Statistical Package for the Social Science) version 18.0. The analysis method for this research uses effectiveness IBS practises variables with seven variable research items as analysing factors. Descriptive analysis are being used and varimax rotated principle component analysis is also being conducted.

2.3 Limitations Of The Study

The scope of this research covers the entire IBS supply chain starting from the manufacture of IBS components up to the stage where component of the project is ready to be installed onsite. It also covers the effectiveness of using IBS. The research focuses on the manufacture of IBS components or manufacturers, developers and contractors in Peninsular Malaysia which has been taken as respondents for the research. The researcher obtained a list of companies and manufacturers from IBS Centre, Kuala Lumpur. Researchers have successfully obtained the results of the questionnaire from 70 company respondents.

3. Result and Discussion

Below are the results of the analysis carried out on the research conducted.

The results of the screening questionnaire obtained by 70 representatives who are experienced in IBS was chosen as respondents in this research. 52.9% is from companies based in the Klang Valley, Kuala Lumpur.In fact, 38.6% of companies have less than five (5) years' experience in the construction of IBS compared to 37.1% of companies have experience of five (5) to 10 years in the construction of IBS. While around 24.3% of companies with more than 10 years of experience in the construction of IBS.

The selection of respondents involved are various contractors (57.1%), manufacturers (28.6%), suppliers (4.3%), developers (8.6%), and consultants (1.4%). Indirectly, variety selection of respondents will allow researchers to obtain diversity in data and information from the perspective of each specialist field. Thus, the advantages and disadvantages that occur can be overcome with the various information and at the same time can accommodate the needs of users. After analyzing the expertise of a company, the researchers found that 54.3% of companies with special expertise in the field of pre-cast concrete system, while 18.6% have expertise in the blocks system field, 14.3% have expertise in the field of steel framework, and 11.4% have expertise in reference system field and 1.4% have expertise in timber frame system.

Enhancement and stability of the company can be determined by how long a company has been in a particular field of expertise. About 2.9 per cent (less than 2 years), 24.3% (3 to 5 years), 21.4% (6 to 10 years), and 51.4% (more than 10 years) companies involved in the field of their expertise. While in terms of a company's income is, as much as 28.6% of companies with an annual income of less than RM100 million, 28.6% of companies with annual revenue of RM10 million to RM30 million, 21.4% of companies with annual revenue of RM31 million to RM100 million, 8.5 per cent of companies with annual revenue of RM101 million to RM200 million, and 12.9% of companies with annual revenue of more than RM200 million. Annual revenues which increase from year to year in the company symbolizes the success and good relationships between companies and other contractors as well as with the developers and users. Consumer confidence to a company's developers will indirectly help a company to rise among other companies and other developers.

The scale measures for this effective IBS practices variables contains seven (7) items. The analysis factor with varimax rotated principal components was used on the variables. The result is tabulated in Table 1. The research result shows that kaiser Meyer Olkin (KMO) is 0.861 surpasses the usable legal 0.6 value and Barlett's test of sphericity value(Barlett,1954) is significant at $p<0.001$. The total variance contribution is reported to be 51.79%.The scale measures for this effective IBS practises variables contains seven (7) items. The analysis factor with varimax rotated principal components was used on the variables. The result is tabulated in Table 4.3. The research result shows that kaiser Meyer Olkin (KMO) is 0.861 surpasses the usable legal 0.6 value and Barlett's test of sphericity value "Barlett" in [5] is significant at $p<0.001$. The total variance contribution is reported to be 51.79%. The scale measures for this effective IBS practices variables contains seven (7) items. The analysis factor with varimax rotated principal components was used on the variables. The result is tabulated in Table 4.3. The research result shows that kaiser Meyer Olkin (KMO) is 0.861 surpasses the usable legal 0.6 value and Barlett's test of sphericity value "Barlett" in [5] is significant at $p<0.001$. The total variance

contribution is reported to be 51.79%.

3.1 IBS Selection Factor Analysis as an Attraction Method.

Table 1: Analysis of Variable Selection for IBS Practices

Construct/ Item	Loading Factor
Factor 1: Effective IBS Practises Variables	
1. Rapid construction completion method	.681
2. Minimize the risk of loss	.576
3. Less workers needed at construction sites	.649
4. The quality of the construction	.842
5. Have the knowledge of skills and expertise (IBS)	.825
6. Customer Requirements	.637
7. Better than conventional construction systems	.782
Eigen value	*3.625*
Variance percentage	*57.971*
KMO	*0.861*
Bartlett's Test of Sphericity	*171.529*
Sig.	*0.000*

From this research it can identify the attraction factors that interest contractors to choose IBS. The main factor respondents chose this method because the quality of the construction result with the load factor of 0.842, followed by factor having knowledge of skills and expertise in IBS with the the capacity of 0.825. Knowledge and skills are important in determining the confidence of respondents to choose IBS in the implementation of their construction projects. The next selection is due to the factors they believe that IBS construction system is better than conventional with the load factor of 0.782. Followed in fourth is a factor which is the rapid construction completion method of IBS compared to conventional with the loading factor of 0.681.The fifth factor is that IBS can minimize the risk of loss to with a load factor of 0.576. Finally IBS is chosen for the factor as it follows customer requirements with a load factor of 0.637. Based on the result, it can be conclude that the decision of the leaders and contractors prefer IBS is because of the quality of the construction. This is because IBS components produced and manufactured with strict controls to meet the quality standards of the highest quality.

3.2 Analysis Factor in Choosing IBS as Attraction Method because of the IBS Advantages Itself

Table (2) below shows the analysis results for the descriptive test in verifying the respondent's view on IBS advantages. The descriptive result obtained shows a high level of agreement for the statements given. Item B13 (*capable to resolve issues in the construction and fulfilling the demand of the users of the national construction sector*) shows the highest agreement, with a min score=5.69, followed by item B14 (*IBS makes construction*

convenient and able to satisfy customers) with a min score=5.53 and B16 (*The main reason for the problem in the flexibility of the IBS supply chain is due to the broadened gap between the coordination and the communication of the IBS suppliers with customers*) achieve a min score=5.53 and B15 (*Inflexible supply chain is the main reason why the master plan of IBS 2003 to 2010 still cannot be achieved*) have a min score=5.23.

Table 2: Descriptive test for Advantages of IBS

Item	Percentage							Min
	1	2	3	4	5	6	7	
	(VSD)	*(D)*	*(SD)*	*(SA)*	*(A)*	*(SA)*	*(VSA)*	
B13	1.4	-	-	10.0	22.9	47.1	18.6	5.69
B14	-	1.4	2.9	10.0	24.3	50.0	11.4	5.53
B15	1.4	-	4.3	11.4	41.4	34.3	7.1	5.23
B16	-	-	4.3	12.9	28.6	34.3	20.0	5.53

Scale 1: Very Strongly Disagree (VSD), 2: Disagree (D), 3: Slightly Disagree (SD), 4: Slightly Agree (SA), 5: Agree (A), 6: Strongly Agree (SA), 7: Very Strongly Agree (VSA).

From the analysis obtained majority of respondents agreed that the capable to resolve issues in the construction factor and fulfilling the demand of the users of the national construction sector factor are the main advantages factor in choosing IBS to be implemented in their project as compared to other advantage factors like IBS makes construction convenient and able to satisfy customers comes second, followed by the main reason for the problem in the flexibility of the IBS supply chain is due to the broadened gap between the coordination and the communication of the IBS suppliers with customers in third, whereas the advatage factor of inflexible supply chain is the main reason why the master plan of IBS 2003 to 2010 still cannot be achieved comes fourth.

3.3 Recommendations.

Recommendations in improving the flexibility of the supply chain are as follows:

(i) Continuous Research: Researchers suggested that ongoing research to be conducted on all factors that challenges and limits the implementation of perfect IBS supply chain flexibility concept.

(ii) Government's Role in Improving IBS Supply Chain System: The government should do more campaigns in order to promote awareness of the perfect IBS component supply system concept as well as promoting the techniques of using IBS.

(iii) IBS Lead Role: They are encouraged to provide sufficient funds or provisions that are related to the innovation and research. In addition, they can also contribute in the form of training to students in relevant fields when conducting field studies or research in terms of IBS supply chain.\

(iv) Role of Non-Governmental Organizations (NGOs): Non-governmental organizations (NGOs) have to step up their efforts to help the government in realizing this effort as such by organizing programs of social or community development. As example, campaign at institutional technical education level to the target

group (students) to understand and know the importance of IBS supply chain system.

3.4 Advantages of the research.

i) Generation of Coordination Model along the Supply Chain – The Need for a Project Coordinator in an IBS Chain.

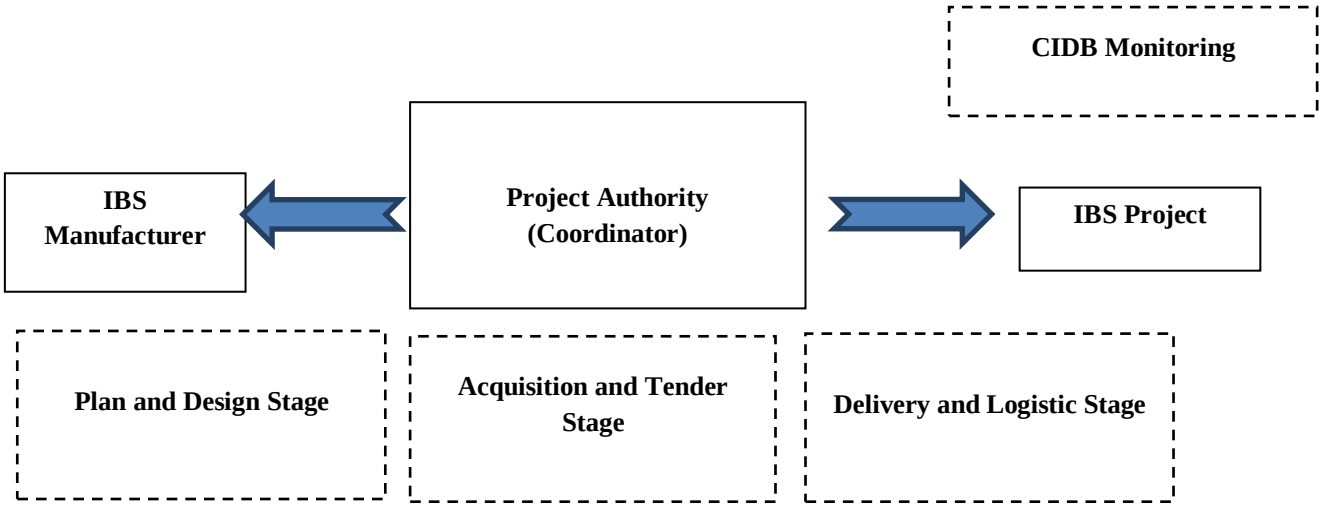

Figure 1: Coordination Model along the Supply Chain

The findings from the analysis shown that the relationship ability factor, integration factor and strong relationship factor determines smoothness of IBS supply chain system. Respondents claims that there is a necessity of an authority who acts as project coordinator or coordinators in charge of coordinating the supply chain in each cycle of a project. Respondents also expressed the need for monitoring and enforcement carried out by CIDB itself as the authority to ensure the implementation and achievement of such policy for instance usage of 70% of IBS components in a project.

ii) This research provide information to assist the authorities to update and make improvements to IBS existing policies and encourage developers, contractors, and consultants to undertake the development of the Industrialised Building System (IBS) further seriously. This corresponds to the government encouragement in promoting the development of the Industrialised Building System (IBS) along with the policy of sustainable construction technology, which has been launched by the government. Exploration means that the study is not based on theory or previous findings. It should be public. However, its contribution to the field of relevant knowledge [contribution to the relevant knowledge] is clear. Exploration also gives an implication that a review on this research subject is something new or novelty.

iii) The importance of the research on the academic field is as a pioneer and a catalyst for further research related to the improvement of the supply chain of the Industrialised Building System (IBS) in the future. The

study also highlight the importance to start on subjects specifically related to IBS supply chain is most concerned primarily in the centers of public and private higher education.

4. Conclusions

The research result shows that kaiser Meyer Olkin (KMO) is 0.861 surpasses the usable legal 0.6 value and Barlett's test of sphericity value "Barlet" in [5] is significant at $p<0.001$. The total variance contribution is reported to be 51.79%.From this research it can identify the attraction factors that interest contractors to choose IBS as a suitable method over the conventional method. Based on the result, it can be conclude that the decision of the leaders and contractors prefer IBS is because of the quality of the construction. This is because IBS components produced and manufactured with strict controls to meet the quality standards of the highest quality. From the analysis obtained majority of respondents agreed that the capable to resolve issues in the construction factor and fulfilling the demand of the users of the national construction sector factor are the main advantages factor in choosing IBS to be implemented in their project as compared to other advantage factors. The research for the factors in determining the IBS method should be continued and evaluated deeper from time to time in future. It would also be helpful in effort to identify interest and IBS trend. The repellent factors also need to be identified and analysed to verify and find the cause respondents lack of interest in choosing IBS in their project implementation. This tpe of research is also helpful in gathering useful information in order to promote and enhance the development of IBS industry and country's development to a greater height.

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