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An Ecological Study on Enhancing the Malaysian Construction Ecosystem: Readiness Implementation Factors in Industrialised Building System (IBS) Projects

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Abstract

For construction stakeholders to fully embrace sustainability, its long-term benefits and associated risks need to be identified through holistic approaches. Consensus among key stakeholders is very important to the improvement of the ecological performance of industrialized building systems (IBS), a building construction method gaining momentum in Malaysia. Sustainable construction has become an increasing concern in the Malaysian construction industry nowadays. One of the approach by the Malaysian Government to enhance the ecology or sustainability is through the implementation of IBS in the construction projects. IBS has been introduced in Malaysia since year 1960s and many industries players and academics acknowledge the advantages of IBS. Nevertheless, there have several obstacles faced in order to increase the implementation of IBS and most of the obstacles are rooted from the issues of readiness. To change from conventional or traditional method to a modern method of construction or IBS is not an easy to execute. The key point of the change is a readiness and how to ready for change. Therefore, this highlights the factors which are the key readiness factors to improve sustainable construction through the implementation of IBS. This paper used qualitative approach and interview as a research technique in data collection process. Finding from data interview and literature review, there are three key factors that influence readiness in the implementation of IBS. The key factors are suitability, knowledge and ability. The output can also be used as a guideline for construction players towards the betterment of IBS implementation by introducing the factors that should be emphasized to make sure they ready to implement IBS and get advantages from it.

Keywords: sustainability, construction ecosystem, readiness, Industrialised Building System (IBS), Malaysian construction industry, ecological performance

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INTRODUCTION

Nowadays, the rapid growth in the implementation of technology has been a stimulus for the construction industry takes a step towards it. Malaysian government had introduced IBS as the alternative method in construction that favour sustainable development process. IBS is an innovation process in building construction, which is already known among construction players. IBS is based on prefabrication building component with standard shape and dimension which are later transported to construction site. Based on this concept, IBS also has been considered as mass production of building component (Chung and Kadir 2007). As mentioned in (Surat Perkeliling Perbendaharaan Bil 2008), there are several main

purposes of BIM implementation in Malaysia. There are enhancing construction productivity and quality, standardize design, reduce project duration and foreign labour.

IBS has been defined in a number of definitions based on author position and philosophy. For example, IBS has been defined as “a system or method in which the components are manufactured in factories or construction-site which is in control, transported and installed with minimal use of workers on construction sites” (Surat Perkeliling Perbendaharaan Bil 2008). Meanwhile, IBS also be defined as “a mass production of building components, based on the specification with a standard shape and dimensions and to transferring of them to the construction site to be re-arranged to a

certain standard to form a building” (Chung and Kadir 2007). The involvement of mass production, factory or onsite based building component production, and assembly concept in IBS has been considered IBS as an innovative process that lead to proper planning, coordination and enhancing value to end users (Nawi et al. 2011, Ceviz et al. 2017). On the other hands, IBS also has been defined as “a construction process that utilises techniques, product, components, or building systems which involve prefabricated components and on-site installation” (CIDB 2003). For these reason, IBS shared similar characteristics and definition with other approach namely Off-site Construction (OSC), pre-assembly, prefabrication, Modern Method of Construction (MMC), Off-site Manufacturing (OSM), Off-site Production (OSP) Industrialised Building and modularization (Abdullah and Egbu 2010, Mohamed 2017).

Although the advantages of IBS have a good support from Malaysian government, however the acceptance of IBS was not high as expected (Construction Industry Development Board (CIDB) Malaysia 2006, Hamid et al. 2008). In practice, IBS projects are still far from the practical idealism in Malaysia, this is because the response to IBS among construction industry stakeholders is unlikely the readiness in IBS implementation (Baharuddin et al. 2015). There is limited study conducted on IBS readiness in-depth, which findings will be important as a guideline to successful IBS implementation.

READINESS IN IBS

Readiness is one of the barriers in implementation of IBS (Kamar et al. 2009) Considered as a new method in construction, the readiness is important among construction players to change from conventional to IBS. However, the current information of full IBS implementation does not exist. Thus, not all the construction player ready to change, especially the company with less experience in IBS project (Mohamad et al. 2009).

Lack of readiness among the construction players are also caused by a lack of experience and knowledge about IBS and this led to lack of interest to implement IBS (Kamar et al. 2009, Rahman and Omar 2006, Thanoon et al. 2003). There are also players who have knowledge of the construction method but did not implement IBS. This is because they lack the ability to implement IBS, such as lack of equipment and skilled worker (Hamid et al. 2008). Such situation can be overcome if they are ready to make a change from the conventional method

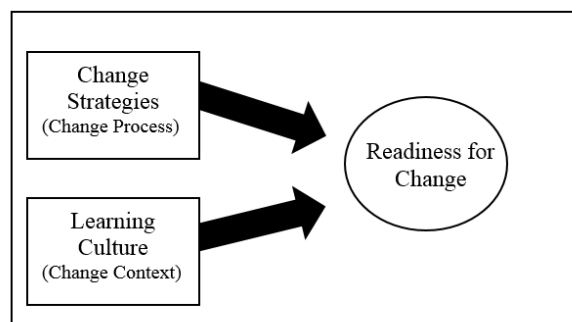


Fig. 1. Concept of Readiness for Change (Choi and Ruona 2010)

to IBS. Therefore, research in readiness issues is very important in order to make the construction industry of Malaysia fully ready to implement IBS successfully.

READINESS FOR CHANGE

Readiness is one of the main foundation for change management process. The implementation of change will be smooth when the organisation is ready (Susanto 2008). This statement supported by (Weiner 2009), the author noted that the change management experts have emphasized the importance of establishing organizational readiness for make the change. The readiness is one of the important element in the involvement of employee as initiatives to support the change (Holt et al. 2007).

Change management is a process, tools and techniques to manage the combination between organisational tools and individual in order to adoption and realization of change and achieve the required business objective (Creasey 2007). Readiness for change is the initial element and this is most important in organizational change. Readiness for change is defined as “the initial state for change that is prepared in terms of environmental changes and challenges that will be faced during the period of the change (Walinga 2008).

According to (Choi and Ruona 2010), many change efforts do not achieve the objective and the changes cannot be sustained. The failure’s implementation always assumes as a factor of the organization’s inability to achieve the objective, rather than flaws innate in the change initiative itself. **Fig. 1** show the concept of change readiness.

Organizational change refers to condition where a normal pattern of an organization is interrupt. In this situation, individuals are actively engage in information seeking, meaning attribution, and assumption making about the change process to make sense of the new environment and to draw conclusions about its possible

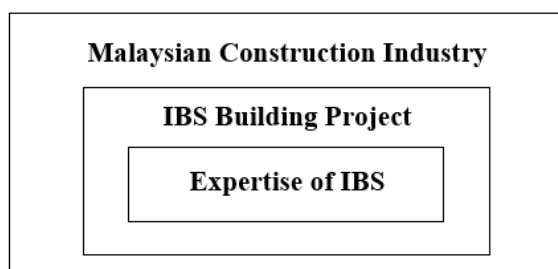


Fig. 2. Unit of analysis

outcomes. However, there are differences between individual and organisation change for readiness. The differences can be recognised in definition and in term of organisation's key infrastructure. Focusing on wider strategies and provide general guidance are significantly important in order to stimulate changes in organisation.

Organisation history is always significantly influence of the process of organisation changes. Thus, learning culture is very significant. For this reason, individuals with high learning culture may understood that the organization is possibly to thrive under changing organizational conditions. This will naturally result in a higher level of individual readiness for organizational change (Choi and Ruona 2010).

The readiness for change covering the content, process, context and the individual (Holt et al. 2007). There are involved the content of what is being changed, the process on how the change is being implemented, the context of circumstances under which the change is occurring and the individual that being ask to change. Readiness for change is always linked to management strategies change. The resistance will occur when people are not ready for change (Walinga 2008).

Readiness for change can be define as "extension on people's beliefs, attitudes, and intentions towards understanding of changes and their perception of individual and organizational capacity to successfully make those changes" (Backer 1995). In addition, readiness for change can be influence by the changing of external or internal circumstances, the introduction of changing type, or the characteristics of potential adopters and change agents.

METHODOLOGY

This research applied the qualitative method for data collection because of the nature of this study is more geared towards a qualitative inquiry of 'what' and 'how' question in order to achieve the research objective. This study seeking for in depth investigation in order to gain

broad perspective in examines the applicability of the proposed model in Malaysia environment. The **Fig. 2** shown the unit of analysis and illustrate the scope of the study.

The unit of analysis is one of the main entities that will be analysed in the study undertaken. The analysis that the researcher planned will determine what unit will be involved in investigating the research issue. The unit of analysis for a case study can range from an individual, to a group of people, to a process or relationships (Tobi 2010). Therefore, this study involves an in-depth investigation into real life based on different theories, current practices, and obtaining expert opinions on theory building as well as examine applicability of the proposed model in a Malaysian context. To achieve the objective of this study, interviewing is selected as a research technique for data collection.

Therefore, the main objective of the interview is to provide insight into the perceptions based on experience and it gained from various IBS practitioners in Malaysian construction industry. It focuses on the readiness issues during IBS construction project and the key factor of readiness to improve current practice in Malaysian IBS projects. The interview participants are selected among the multidisciplinary IBS practitioners. Several criteria were used for the selection of the respondents in this interview. The respondents should have at least 5 years working experience involving Malaysian IBS construction project.

Besides that, the respondents were selected with dispersed geographical background and various divisions such a planning, design, construction and manufacturing. This is for generating different opinion between respondent. As highlighted earlier, the respondent represented various disciplines in Malaysian IBS construction project, such as contractors, designers (or consultants), manufacture and academic researchers. Due to issues of confidentiality, it was decided that the name of respondents in this study would not be disclosed. Instead codes (e.g., R1, R2) will be used to identify the respondents.

FINDING AND DISCUSSION

To assess the extent to which the issue of readiness in IBS, a few questions have been asked to the respondents. From the first question of interview session, the entire respondent was agreed that the readiness issues are one of the barriers in

implementation of IBS in Malaysia. As highlighted by the respondent:

“Yes, readiness is one of the issues in implementation of IBS in Malaysia. Everything in this world was started from the mentality of readiness. When you are ready, then the game will play smoothly. It is same going with IBS in Malaysia. When the industry was ready to implement IBS, then IBS will be success implementation.”- R1

“For me personally, I think the readiness issues is one of the barrier in IBS implementation because whatever you want to do you must ready on that technology. If not, it will be problem in the next step or process.”- R3

On the other hand, R4 believed that, the issues of readiness in IBS was not a big issue in industry but this issues were very important and give impact in order to increase the implementation of IBS in Malaysian construction industry. The statement was supported by R2:

“Actually readiness is not a big issue but it very important that should be highlighted before start any process or activities. The lack of readiness will affect the process involved.”- R4

“For the readiness issues in the Malaysian IBS, I agree this issue is one of the barriers in IBS implementation. This is because, we can see if stakeholder of IBS was ready to implement IBS, so I think that will reduce other problem. For example, ready in term of knowledge, mentality and risk. Then, whatever probabilities happen in the future, they will ready to faced and find the solution.so, we can say that readiness will increase the implementation of IBS.” -R2

In order to achieve the objective of this study which is to explore the key factor of readiness in IBS implementation, the findings obtained from interview sessions and literature review are combined to get the best result. From the finding in previous section, the factors that cause a lack of readiness in the implementation of IBS and the improvement to overcome the IBS problem on readiness issues are identified. From there, the factors of readiness are grouped into three key factors. The key factors are suitability, knowledge and ability.

Ready in term of Knowledge to Implement IBS

IBS is the method that needs high construction precision. Unfortunately, level of technical knowledge and experience in operating IBS among local

professional and contractor are still at minimal stage (CIDB 2003, Hamid et al. 2008, Kamar et al. 2009, Nawi et al. 2010). This also supported by (Baharuddin et al. 2015), the IBS framework system usage is low popularity if compared to the conventional framework method because of the lack of skill, knowledgeable manpower and exposure to IBS technology among stakeholder. Because of the lack of knowledge among industry player, therefore IBS is not being a popular choice among the design consultant (Hamid et al. 2008). For example, an insufficient knowledge of structural analysis and design in prefabricated component among Malaysia civil engineers. Theoretically, the implementation of IBS method required high skill workers compare to conventional method. In connection with that, R4 add:

“Based on my experience, I noticed that industry have a lack of expertise consultant in IBS. For example, knowledge and experiences among consultants, either engineer’s consultants, quantity surveyor or architect is one of the challenges faced in order to increases the implementation of IBS project.”- R4

From the interview session, respondents believe that to involve in IBS project, the stakeholder must have enough knowledge in IBS. This is because if not, it will affect the overall process flow of the project. For an example, when architect give traditional drawing, the drawing must be redesigned and converted to IBS drawing. It will take the additional time and cost to do it. Therefore, knowledge in process flow IBS project is very important to make sure no repetition process during the project.

When decide to used IBS, it must to understand the extensive coordination required prior to construction operations, for instances coordination of design, transportation, tracking, and installation to ensure successful implementation and also adjustments in the work breakdown structure, terminology, drawings, progress measurement, scheduling for materials management and supply chain scheduling should also take into consideration (Laili Jabar et al. 2013). For IBS project, the implementation of supply chain and logistics management with just in time (JIT) is very useful in all stage of IBS process include the initial works, component production at factory, transported to construction site, installation and finishing (Ismail et al. 2012).

Find out the Suitability of Project

According to (Abdullah and Egbu 2010), the perspectives on selection criteria for choosing IBS for

housing project is structure and materials design, site orientation, health and safety, client perspectives, environmental issues and sustainability and organizational issues. From the interview sessions, two of the respondent said that the most important thing that must be highlighted before decide to use the IBS method is the suitability. Suitability can be defined as the quality of being right or appropriate for a particular person, purpose, or situation. In this study, several aspects must be emphasized to predict whether the project is suitable or not before implementing IBS. Finding form interview session, three of the respondent highlighted the important of the criteria project before make decision to use IBS method.

“As we all know, IBS is the good technology and highly recommended in our Malaysian construction industry but not all the project suitable to implement IBS. There have several aspects should be emphasized before decision making. For example, the aspects can answer of some questions; where is the location of the project, what is the project cost and what is the type of design of the project.”-R1

The location the project is one of the most important aspect before the decision is made either to choose IBS or not. The suitable location for IBS project will give more advantages to stakeholders. It should be appropriate to the project activity and taken into consideration of other factors such as transportation cost. Should the project site location be far from factory; as an example in the island or villages, where it is not suitable for implementing IBS and will lead to further problems and indirectly will increase the costs of project if IBS is used.

In order to increase the implementation of IBS, the construction industry faced the challenges with contractors who normally aim for high marginal profit to cutting cost, just because IBS request high initial cost and pose as a financial barrier for the stakeholders (Baharuddin et al. 2015). IBS in some ways could be cheaper method of construction if to compare with conventional method. The saving should come from lower number of worker, life costing of the building, direct cost saving in materials and construction overhead and also indirect cost saving occurs due to faster delivery of building. However, there is still have mistaken in the selection for type of the project and how to manage the financial, the benefits of implementing IBS will not be obtained and will instead increase the existing cost. Looking at the suitability of the cost project, where is not all projects have the appropriate

cost to use IBS approaches. In addition, stakeholders should also choose the appropriate procurement type to use throughout the project as an example Design and Build (D&B) and Integrated Project Delivery (IPD).

In terms of the suitability of the design for the IBS project, stakeholders should be aware of the appropriate design types if they choose the IBS method. This research highlighted that not all the construction design appropriate to use the IBS. IBS method is more suitable for projects whose design is simpler, less complex and uniform. Based on characteristic of IBS, there have two type of IBS design, which is open system and closed system. Open system is allowing greater flexibility of design and maximum coordination the designer and manufacture. Meanwhile, close system is based on client's design and manufacturer's design. The selection of design is very important to ensure there can minimize problem or issues during construction stage. From the finding of interview session, respondent agreed that important thing that should be ready before implement IBS is in selection of the design project. This is because most of the barrier in IBS implementation is in design stage and this lead to others barrier such as cost increase and overrun project schedule.

Ability to Provide the Skilled Worker, Financial, Technology and Other Equipment Need in IBS Project

For this element, the ability of skilled worker is an important aspect that should be prepared by the organisation in order to be ready for the IBS implementation. If to compare the level of skilled worker between conventional construction methods, IBS is more demanding and there is still a lack of skilled workers in Malaysia (Nawi et al. 2010). Unlike conventional method, skill and well trained worker is very crucial in IBS construction project. The skill refers to design, coordination, installation and information technology. Furthermore, specialised skill in IBS required time and investment in training (Thanoon et al. 2003). Training at all level management is a needs to ensure smooth process from conventional towards IBS method. All the respondent agrees that to implement IBS, the ability to provide skill worker is the thing that should take seriously before decide to implement IBS because one of the barrier in implementation IBS nowadays is lack of IBS skilled worker.

A proper training among IBS workers is importance particularly for those who involved in handling, positioning and erecting the finished pre-fabricated and pre-assembled products. Whenever innovative or

unfamiliar methods and material is used, operative should be trained in the application preferably by the supplier or manufacturer before the installation begins. It is also worth noting that the reduction of skilled labour in IBS is offset by the need to develop new skills and competencies among the IBS workforce (Kamar 2011). In addition, respondent also pointed the importance of ability to ready financial need in IBS project.

“The financial problems mostly occurred to new contractor or a small company. This is because, progress payment procedures for IBS project and conventional project is a different. For IBS project, majority of client make payment after seeing the results of its work while the contractor should make a payment to the manufacturer before it. Therefore, for smaller companies, they are difficult to ‘roll’ the capital.”- R3

In the interview session, mostly respondent highlighted the importance of readiness in technology needs in IBS project. That statement was supported by readiness model developed in (Khalfan and Anumba 2000) study, technology is element as the key factor in readiness. There are few factors that contribute to technological ability that should be highlighted to make the organisation ready for IBS implementation. Most contractors adopted appropriate, simple and flexible technologies with low capital investment due to a project-by-project cost strategy. There are no real benefits to implementing the latest construction technologies, without considering their capability and readiness to embrace in it. The lack of available technology in IBS is also negative influence the number of IBS implementation (Hamid et al. 2008, Kamar et al. 2009). The contractors prefer matured technologies which have been proven and technologies which are not heavily dependent on the volume of works. One such option is to adopt flexible and adjustable moulds, a mobile factory and onsite casting (Kamar 2011).

The lack of ability to provide investment on heavy equipment and facilities could hamper the implementation of IBS and this leads to insufficient capacity of contractor to secure project. According to (Kamar et al. 2014), for IBS project, contractors thus need several forms of government intervention and assistance, such as well as provision of large-scale projects, that would justify the capital investment required to implement IBS and therefore several contractors seek large design and building contracts from the government because the large design and building contracts will enable the successful

development of unique technical capabilities and present innovation opportunities in IBS, which otherwise would be almost an economically inappropriate choice.

CONCLUSION

A systematic strategy to improve IBS ecological performance through decision support to the design phase is presented. In order to increase the implementation of IBS among Malaysian construction industry players, they need to ready to change first from the conventional or traditional method to IBS. As discussed before, readiness is important element to support the change process. In parallel with that, finding from literature review and supported by respondent in interview session, they strongly agree that some of barriers in implementation of IBS are rooted from the lack of readiness among the industry players. To reduce the issues, this research come out with the factor of readiness for change in implementation of IBS. The factor is industry players must ready in term of knowledge to implement IBS, find out the suitability of project and must have ability to provide the skilled worker, financial, technology and other equipment need in IBS project

The suitability refers to the suitability of project characteristics to the nature of IBS itself, which emphasizes more about the location, cost and design of the project. The location chosen should be appropriate to the implementation of the project activity and to solve the relevant problems that became the reason IBS was chosen as the method of construction of the project. While in terms of cost, the cost of the project must be compatible which are not injurious if IBS is selected for the project. In terms of project designs, it is important to note that not all projects are suitable to use IBS methods, especially if it involves complicated designs and if still wish to use the IBS method, it will affect cost and time in project implementation. In this case, it will be not advisable to use IBS method.

The factor of knowledge was highlighted in this research in which is knowledge is very important in every starting of the implementation of a new technology to make sure that the benefits of that technology are obtained. The knowledge that is emphasized in this study is knowledge on design stage, process flow and the importance of expertise consultant. Moreover, the factors of ability meant the ability of the organisation to provide what is the needed for the project when decision was made to use IBS method. The ability that is highlighted in this study is ability in

term of financial, skilled worker and facilities and equipment. This is to make sure that the project will be conducted smoothly and the problem can be minimized.

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