

Research Article

Obstacles and Drivers in Steering IBS towards Green and Sustainability

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Abstract: The aim of this study is investigating IBS potential solution for achieving its prospective in the area of green construction and sustainability. Malaysia has embarked on initiatives for sustainable development consistent with global concerns on the environment and sustaining the world resources for the future generations. The issues of sustainability and green construction have been duly highlighted in the Construction Industry Master Plan (2005-2015) as being of significant importance for the Malaysian construction industry. In this regard, industrialized construction has the unique characteristics to respond well to the sustainability challenge facing the construction industry. Industrialized construction assist adopters in term of cost and time certainty, attaining better construction quality and productivity, reducing risk related to occupational safety and health. But, despite all those capabilities most of the construction work in Malaysia is still applying conventional methods which are not often sustainable. Thus, this study tries to explore obstacles and drivers in steering IBS towards the agenda of green and sustainability.

Keywords: Construction industry, green construction, IBS, Malaysia, sustainability

INTRODUCTION

Construction industry has a major role on generating wealth through a constant growth in GDP's contribution and influenced in the development of social and economic infrastructures and buildings, but its total energy and resource consumption and carbon emission raise a growing awareness regarding this industry. The issues of sustainability also have been strongly highlighted in the Construction Industry Master Plan (2005-2015) as a significant importance for the Malaysian construction industry. In this regards, the Malaysian Green Building Index (GBI) has been developed recently in order to promote sustainability in built environment.

On the other hands, the industry is under a constant pressure to deliver and to tackle issues on performance, safety, shortage of labour, environment and sustainability, dependency on Malaysian construction industry has been urged to use innovative construction technique and to shift from traditional practice to Industrialized Building System (IBS) construction. Unfortunately, against all attempts the level of IBS usage in construction was only 15% in 2003 (CIDB, 2003b) and reached 10% in 2006 which is less than one

third of total completed construction project using at least one IBS products (CIDB, 2007). While, unique characteristics of IBS in terms of cost and time certainty, attaining better construction quality and productivity, reducing risk related to occupational safety and health, alleviating issue on skilled workers and dependency on manual foreign labour and achieving ultimate goal of reducing overall cost of construction suggest its contribution in the sustainability challenge facing the construction industry. Thus, the main objectives of the study are determining main issues in green and sustainable construction through IBS and then investigating the role and contribution of IBS in green and sustainable construction in order to identify potential solution for IBS to achieve its prospective in the area of green construction and sustainability.

Malaysian construction industry: Construction industry in Malaysia has played a major role on generating wealth through a constant growth in GDP's contribution and influenced in the development of social and economic infrastructures and buildings. In this regard, Malaysian construction output is estimated to be approximately RM 50 billion. This represented 3-

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5% of Gross Domestic Product per annum (CIDB, 2007). Simultaneously, the industry also provides job opportunities for almost 1.03 million people which represented 8% of total workforce (CIDB, 2007). But, against these benefits the construction industry in Malaysia, compared to other sectors, suffers from low productivity, safety and quality control. In this regards, traditional labour-intensive practices and 3D Syndrome (Dirty, Difficult and Dangerous) underlined as the main problems (IBS Survey, 2003). Accordingly, the local workforce and new graduates were reluctant to join the industry due to the 3-D syndrome (dirty, difficult and dangerous) which has been long associated with the construction industry. Subsequently, foreign labour dependency increase in this sector. According to Construction Industry Development Board (CIDB) Malaysia, 69% (552,000) out of total 800,000 of registered workers as in June 2007 are foreign workers (Malaysian Construction Outlook, 2008). More over the social problems associated with foreign workers that aggravate the situation, they are not usually skilled when they first arrived in Malaysia and this impacted the productivity and the quality of the construction industry as well.

On the other side, as conventional construction requires many wet trades on site such as skill carpenters, plasterers and brick workers, the process usually hamper by quality issue, unfavourable site condition, skilled labour shortage and bad weather conditions. Therefore, the industry is under a constant pressure to deliver and to tackle issues on performance, safety, shortage of labour, environment and sustainability, dependency on foreign labour and demand in affordable housing. To cope with these challenges, Malaysian Construction Industry has been urged to use innovative construction technique and to shift from traditional practice to Industrialised Building System (IBS) construction.

Green and sustainable construction: Malaysia has embarked on initiatives for sustainable development pace with global concerns on the environment and sustaining the world resources for the future generations. Accordingly, in June 1999, the CIDB had established a technical committee to look into developing good environmental practices in the construction industry. In June 2006, the Construction Industry Master Plan 2006-2015 (CIMP, 2007) was published to chart the way forward for Malaysian construction. And, the issues of sustainability and green construction have been highlighted in the Construction Industry Master Plan (2005-2015) as being significance for the Malaysian construction industry. National Green Technology Policy (NGTP) was launched in 2009 to demonstrate the government's seriousness in implementing "green" initiatives for the country. These

include among other things intensification of green technology research and innovation towards commercialization, promotion and public awareness of green technology. In parallel the Malaysian Green Building Index (GBI) was developed in 2009 by the Association of Consulting Engineers Malaysia (ACEM) together with the Malaysian Institute of Architects (Pertubuhan Arkitek Malaysia or PAM) to promote sustainability in built environment.

But, despite the rapid advancement in the construction industry and emphasizes on steering construction towards sustainability, most of the construction work in Malaysia is still applying conventional methods which are not often sustainable. However, the unique characteristics of IBS have the potential to respond well to the sustainability challenge facing the construction industry. According to researches, application of IBS offers benefits to adopters in term of cost and time certainty, attaining better construction quality and productivity, reducing risk related to occupational safety and health, alleviating issue on skilled workers and dependency on manual foreign labour and achieving ultimate goal of reducing overall cost of construction.

IBS importance: The IBS agenda in Malaysia began in the early 1960's when the officers of the Ministry of Housing and Local Government of Malaysia visited a number of European countries and evaluated their housing development programmes (Thanoon *et al.*, 2003a). Following their visits and recommendations, the government initiated an IBS or "prefab" (known then) pilot project in 1964 aiming to speed up the delivery time in the building of quality "low-cost" or affordable houses. IBS is defined as a construction process that utilises techniques, products, components, or building systems which involve prefabricated components and on-site installation (CIDB, 2001). The components of IBS are manufactured either in a factory, on or off site, positioned and assembled into place with minimal additional site work (IBS Roadmap 2003-2010, 2003).

The importance of IBS also is highlighted under the Strategic Thrust 5: Innovate through R&D to adopt a new construction method in the Construction Industry Master Plan 2006-2015 (Construction Industry Master Plan, 2006-2015) which has been published as means to chart the future direction of the Malaysian construction industry (CIMP, 2007). In this regards, CIDB strongly supports the use of IBS in order to reduce the dependency on foreign labour and increase productivity, quality and safety in the local industry (IBS Survey, 2003). CIDB, also in 2003 had published the roadmap to guide the practitioners and decision makers in IBS implementation in Malaysia. The roadmap has been endorsed by the parliament of

Table 1: Prominent barriers in IBS implementation in Malaysia

Barriers	Authors
Cost and financial issues	Nawi <i>et al.</i> (2011), Kamar <i>et al.</i> (2009), Nawi <i>et al.</i> (2007a), Haron <i>et al.</i> (2005) and Thanoon <i>et al.</i> (2003a)
Poor skill and knowledge	Nawi <i>et al.</i> (2011), IBS Workshop (2011), Kamar <i>et al.</i> (2009), CIMP (2007), Nawi <i>et al.</i> (2007a), Nawi <i>et al.</i> (2005), Thanoon <i>et al.</i> (2003a) and CIDB (2003b)
Lack of assessment	Hamid <i>et al.</i> (2008), Hussein (2007), Nawi <i>et al.</i> (2007a), Nawi <i>et al.</i> (2005) and Thanoon <i>et al.</i> (2003a)
Lack of code and standards	Kamar <i>et al.</i> (2009), Hussein (2007), Thanoon <i>et al.</i> (2003a), IBS Workshop (2011) and Warszawski (1999)
Resistance from customers	Kamar <i>et al.</i> (2009), Nawi <i>et al.</i> (2007a) and Nawi <i>et al.</i> (2005)
Planning and supply chain	Kamar <i>et al.</i> (2009), Hussein (2007), Faizul (2006) and Nawi <i>et al.</i> (2005)
Lack of government incentives	IBS Workshop (2011), Nawi <i>et al.</i> (2007a) and CIDB (2003b)
Lack of research R&D	CIMP (2007) and Nawi <i>et al.</i> (2005)

Malaysia in October 2003 involved government and inter-ministry actions towards greater adoption of IBS in Malaysia. Besides, the government in order to create a spilt-out effect on IBS usage in the private sector, pledged to construct 100,000 units of affordable houses using IBS, announced back in 2005 and 2006 Budget. As an incentive to private sector's adopters, construction projects that utilized IBS components in 50% of the building works, will received an exemption of construction levy (Hamid *et al.*, 2008). Also, the new circular by the Ministry of Finance (MOF) emphasized on the full utilization of IBS for all government's projects. The circular emphasized that the use of IBS components in government projects should not be less than 70%. As in 2009, 320 government projects worth RM 9.43 billion have been identified to be carried out using the IBS (BERNAMA). Moreover, the government will establish new policy to reduce 50% of current 320,000 foreign workers registered with the sectors and CIDB has been allocated RM 100 million to train skilled workers in IBS (BERNAMA, 2009).

Obstacles in IBS application: Despite the all documented benefits and strong support of the government, unfortunately application of IBS due to some criteria did not take off as planned. In order to understand the poor effective implementation and distribution of the IBS some researchers have investigated and identified a number of obstacles which among them lack of knowledge and awareness identified as the most prominent ones (Table 1).

Cost related issue is one of significant barrier in IBS project execution. Based on IBS Steering Committee (2006), most of IBS construction (especially pre casters) requires high initial investment capital to purchase new machinery, mould, importing foreign technology and wages of skilled workers for installation process. Moreover a specialized equipment and machinery (Thanoon *et al.*, 2003a; Nawi *et al.*, 2005) a Research and Development (R&D) centre, support services and testing labs are also needed by an IBS company in the private sector (Nawi *et al.*, 2007a). This situation has made the IBS business more risky as all these facilities need continual funding or extra capital investment compared to the conventional labour-intensive method.

Lack of knowledge among the approving authorities has resulting misunderstanding and misinterpreting of IBS and its relation to the current building regulation. Contractors in Malaysia suffer from lack of past experience in IBS and their professionals have lack of technical knowledge in this area (Hamid *et al.*, 2008). And, this problematic issue among the designers contributes to the project delays due to the extra time taken to produce details drawing (Hazreeni *et al.*, 2010). This shortage of perception also affects customers and their demands so that IBS product is still perceived by them in terms of lack of flexibility, problematic accommodation such as leaks and faults, low quality finish and use of unfamiliar materials (Nawi *et al.*, 2007b). All these factors create a dilemma among clients or designers to apply IBS to their housing projects because of a fear of customer rejection (Kamar *et al.*, 2009). And, this has hindered building approval and caused unnecessary delay in the development process. While, familiarity with IBS will expedite design approval and it is vital to ensure successful IBS project (CIMP, 2007).

On the other hands, Malaysia still lacks skilled workers generally and particularly in IBS projects. Under IBS system the demand for on-site manual labourers become less, but the skill level of IBS workers is more demanding compared to the conventional construction methods. Therefore, more intensive training programmes are needed in the specialized IBS skills. As this need requires more time and investment (Thanoon *et al.*, 2003a; Rahman and Omar, 2006); therefore, contractors prefer to stick to the traditional construction method and not to practice IBS (Thanoon *et al.*, 2003a; Nawi *et al.*, 2007a).

In addition, lack of R&D, low IT adoption and limited technology availability as another main difficulty that have generally discourage IBS take up (Hamid *et al.*, 2008). In other words, as most of the machineries and materials used in fabricating IBS components are imported from developed countries and this made local contractors dependant very much on foreign expertise and technology (IBS Workshop, 2011). So, in order to be competitive R&D works in the IBS should be made available for practitioners to customize the process. However, in this regard the CIDB has embarked initiatives such as establishment of Construction Research institute of Malaysia (CREAM)

and the IBS Centre to assist local contractors in the R&D works.

Absence of planning and assessment also is found as another difficulty (Hamid *et al.*, 2008; Hussein, 2007; Nawi *et al.*, 2007a, b, 2005, 2003a). The overall IBS project from components' manufacture, transport and assemble are connected and any delay in every stage has severe impact on the project delivery. Hence more coherent structure of process planning and control from start to end of the project in order to reach the goals and reduce defect and errors (Warszawski, 1999; Gibb, 2001) is necessary.

The IBS implementation also needs more incentives and promotions. In other words, motivations for widespread IBS implementations either from the Government or private agencies in Malaysia are still inadequate. However, the importance of IBS is highlighted under the Strategic Thrust 5: Innovate through R&D to adopt a new construction method in the Construction Industry Master Plan 2006-2015 (CIMP 2006-2015) and CIDB also in 2003 had published the roadmap to guide the practitioners and decision makers in IBS implementation in Malaysia, but since the IBS Roadmap endorsement by Government, there are still no specific IBS building regulations or standard guidelines for contract documents or procurement systems in terms of tendering, design, construction and operation of a project and the only main references or guidelines for IBS are IBS Catalogues published by CIDB (Kamar *et al.*, 2009; Hussein, 2007). Besides, the government in order to create a spilt-out effect on IBS usage in the private sector, pledged to construct 100,000 units of affordable houses using IBS, announced back in 2005 and 2006 Budget. And, as an incentive to private sector's adopters, construction projects that utilized IBS components in 50% of the building works, will received an exemption of construction levy (Hamid *et al.*, 2008). Also, the new circular by the Ministry of Finance (MOF) emphasized on the full utilization of IBS for all government's projects. The circular emphasized that the use of IBS components in government projects should not be less than 70%. But against all those efforts, the level of IBS usage in construction was only 15% in 2003 (CIDB, 2003b) and reached 10% in 2006 which is less than one third of total completed construction project using at least one IBS products (CIDB, 2007).

METHODOLOGY

For achieving the objectives of this study, first of all initial discussions and extensive preliminary literature review regarding IBS, its components and applied material, as well as green and sustainable construction from both primary and secondary sources including books, papers, web pages was performed. After reviewing literature and finding variables, a

survey questionnaire was applied among those who are somehow related to building procedure including: client, designer, supervisor, consultant, contractor, supplier and manufacturer. The questionnaire covered three main areas of enquiry: The first section, examined the respondents' back ground such as their role and experience in construction, their understanding about IBS and Green and sustainable construction as well as the number and type of cases they experienced in this regard. This section also concerned respondents' opinion regarding experts who could have maximum effects in steering IBS towards green and sustainability as well as aspects that this collaboration could occur. Second and third sections concerned the drivers and obstacles which could contribute in implementing IBS towards green and sustainability. Questionnaires first were undertaken via electronic facilities such as email, but due to lack of corporation they were distributed manually by hand and respondent had time (almost one day) to fill the questionnaires. Descriptive statistic was used to analyze the obtained data. Descriptive statistic was used to analyze the obtained data.

RESULTS

Respondents in this study were those who somehow are related to construction procedure. However, construction projects come in various shape and size and these qualification (size, complexity and type of project) allow significant variation in the type of people involved. In total 48 respondents from various fields of construction took part in questionnaire survey. The sample include: 14.6% client (n = 7), 35.4% designer (n = 17), 12.5% supervisor or consultant (n = 6), 16.7% contractor (n = 8), 12.5% supplier (n = 6) and 8.3% manufacturer (n = 4).

Respondents' experience in construction, green and IBS project: Respondents' experience in construction was ranged from <5 to >15 years. However, the percentage of respondents who had more than 15 years' experience was low (2.1%), but over half of respondents (60.4%) had around 10 years' experiences in construction process.

Another inquiry was related to respondents' experience in IBS and Green projects. Based on the results (Fig. 1) 72.9% of respondents experienced around ten cases IBS projects, while 45.8% of respondents experienced this number of green projects. Besides, the percentage of respondents who never experienced green project (54.2%) compare to IBS projects (8.3%) was very high and considerable.

Type of project experienced as green and IBS project: For better understanding about type of projects respondents participated in construction as IBS or

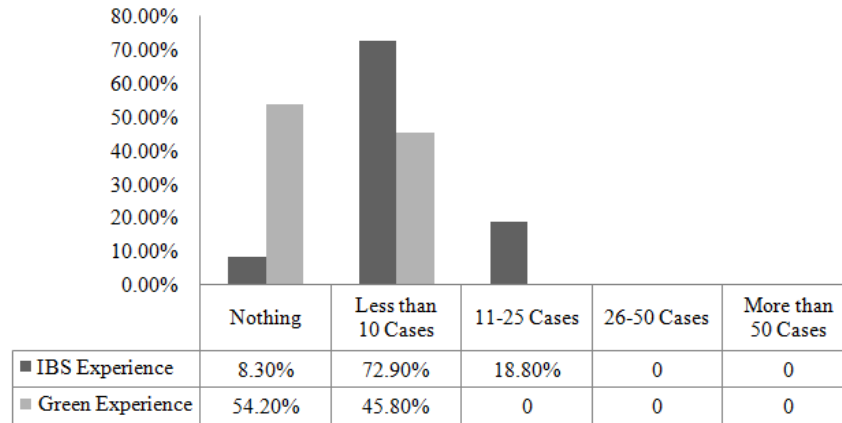


Fig. 1: Respondents' experience in green and IBS project

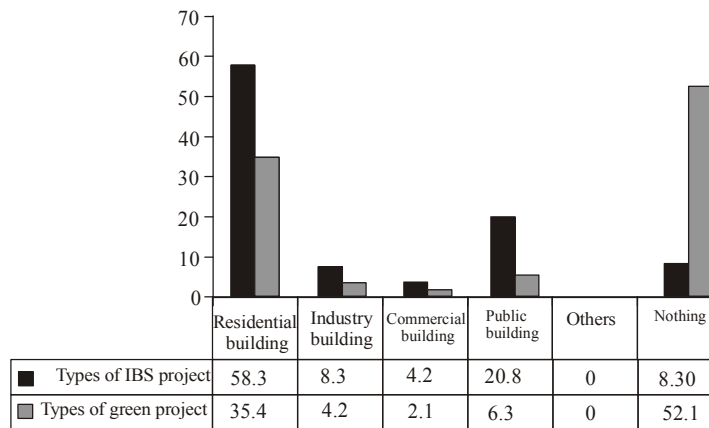


Fig. 2: Type of project respondents' experienced as green and IBS

Green the following options were given: “residential building, industrial building, commercial building, public building, other and nothing”. Frequency distribution of the results (Fig. 2) revealed that respondents who had IBS practice mostly obtained this experience through involvement in residential building construction projects (58.3%). The second most frequent type of project experienced as IBS was public building which constitutes 20.8% of the responses. Other types of projects including industrial building (8.3%) and commercial building (4.2%) followed in decreasing frequencies. Regarding green construction, a part of half of respondents who had never experienced this type of projects, the most frequent experience was related to residential type of buildings. Around 35.4% of respondents obtained green experience through involvement in construction of residential buildings. Green experience in other types of building construction was not remarkable.

Respondents' knowledge and understanding about IBS and green constructions: Respondents also were asked to specify their level of knowledge and understanding about Industrial Building System (IBS)

and Green and sustainable construction. Based on the results (Fig. 3) respondents' knowledge and understanding about IBS and Green Construction was not too much, but it seems that outstanding for IBS. Findings revealed that at least 10.4% of respondents knew a little bit about IBS; while half of the respondents knowledge and understanding about green and sustainability was too less. Around 27.10% of respondents had a moderate understanding about Green and Sustainability construction; while 35.4% of respondents know IBS fairly or much (29.20%).

IBS, green and sustainability integration: For better understanding about integration between IBS and Green and Sustainability, respondents were asked about people who could have maximum effects in steering IBS towards green and sustainability as well as aspects that this collaboration could occur. Based on the results 79.2% of respondents believed that this integration would not lead to any problem. Besides, frequency analysis revealed 37.5% of respondents believed that designer has a significant role in steering IBS towards Green and Sustainability (Fig. 4). Based on respondents' opinion client (35.4%), manufacturer (25%) also could have an important role in this regard.



Fig. 3: Respondents' knowledge and understanding about IBS and green constructions

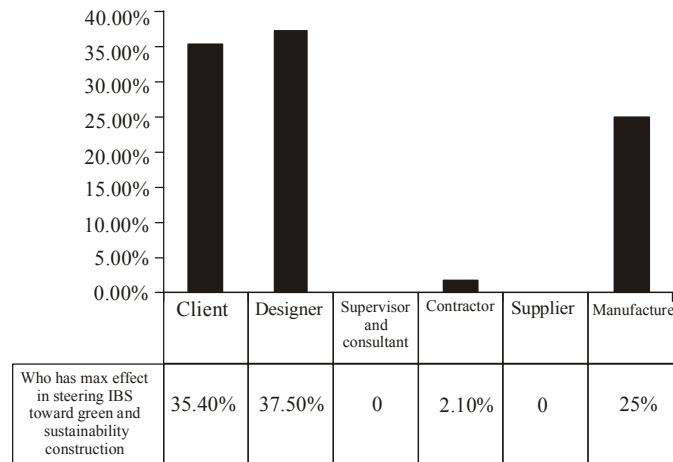


Fig. 4: People who could have maximum effects in steering IBS towards green and sustainability

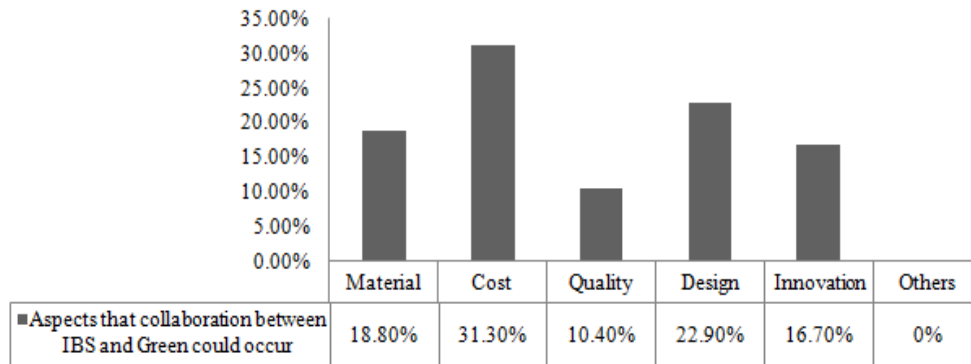


Fig. 5: Aspects that collaboration between IBS and green could occur

Regarding the aspects that integration between IBS and Green construction could occur (Fig. 5) cost related aspects chose as the most frequent one (31.3%) and it followed by other aspects such as design (22.9%), material (18.8%), innovation (16.7%) and quality (10.4%).

Drivers: Another research inquiry is identifying major drivers in implementing green and sustainable initiatives in IBS. After reviewing literatures the following issues were determined: D1: legislation and

policy, D2: Reduction or removal of taxes, D3: financial incentives, D4: emphasizes on Green and Sustainability, D5: role of education and academia, D6: knowledge and its transfer. The issues were presented in one part of questionnaire and respondents were asked to evaluate their importance as driver of IBS towards Green and Sustainable construction.

Figure 6 presents the importance of identified drivers for steering IBS towards Green and Sustainable construction. According to the obtained results, D1 (role of legislation and policy) ranked as too much

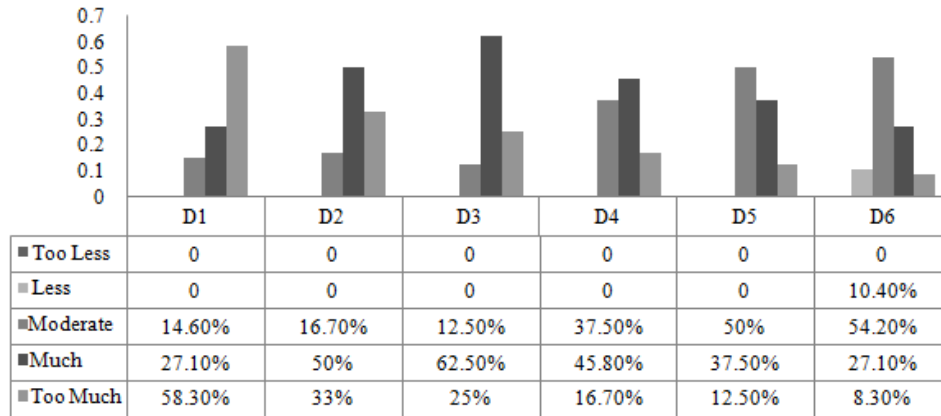


Fig. 6: Drivers in implementing green and sustainable initiatives in IBS

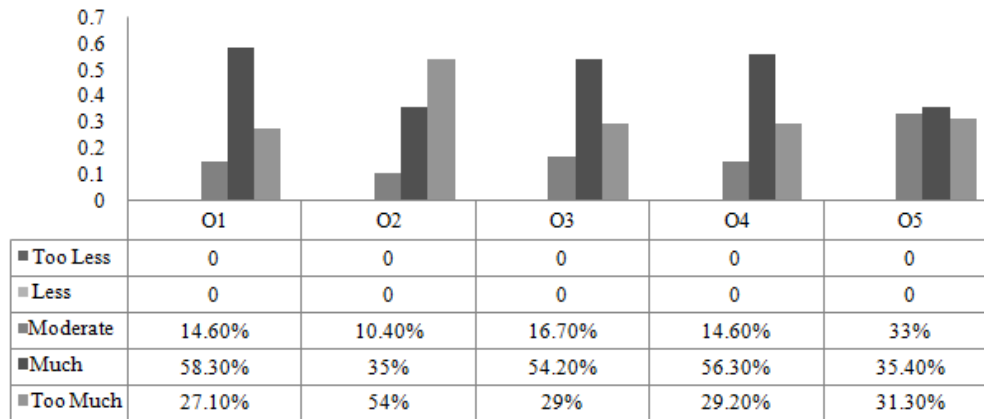


Fig. 7: Obstacles in implementing green and sustainable initiatives in IBS

important driver (58.3%). And, drivers such as D3 (62.5%), D4 (45.8%), D5 (37.5%) ranked and considered as much important. Around half of respondents evaluate D5 and D6 as moderate drivers.

Obstacles: Identifying obstacles in implementing green and sustainable initiatives in IBS was another research inquiry. In this regard the following criteria after reviewing literatures were found and their importance were evaluated through respondents in questionnaire survey. Identified hindrances including: O1: policy implementation shortfall, O2: cost, O3: lack of knowledge, O4: lack of expertise, O5: lack of understanding about Green and sustainable issues.

Figure 7 demonstrates respondents' assessment regarding the importance of obtained obstacles and their effects in integrating IBS to Green and Sustainable construction. Based on the results, O2 or cost issue ranked as the most significant hindrance with too much impact (54%). Other obstacles such as: O1 (58.3%), O4 (56.3%) and O3 (54.2%) evaluated to have much impact in steering IBS towards Green and Sustainability and it followed by O2 (35%) and O5 (35.4%) with a decreasing percentage.

DISCUSSION

The study of IBS conducted in various field during the last decades. This study examined IBS and its contribution in Green and Sustainable construction. The study emphasized on the role of IBS and its potential to respond well to the sustainability challenge facing the construction industry. Application of IBS offers benefits to adopters in term of cost and time certainty, attaining better construction quality and productivity, reducing risk related to occupational safety and health, alleviating issue on skilled workers and dependency on manual foreign labour. Moreover, IBS has capabilities in steering construction toward green and sustainability through application of special materials (e.g., non-toxic, renewable, recycle, etc.) and a proper integration between design and innovation which seeks collaboration among all stack-holders.

First of all the findings of this study revealed lack of knowledge and expertise is the main hindrance in steering IBS toward Green and Sustainability. In other words, understanding and experience of professions and people who are involved in construction process regarding IBS is not too much and this issue regarding to Green and sustainable Construction is worse.

In addition, cost related issue and policy implementation shortfall also found as most significant obstacles with too much impact. And, for driving IBS toward Green construction legislation and policy and financial incentives ranked as significant one and it followed by the role of education and academia and more emphasize on Green and Sustainability in society. More over the cost related issue, the study found design, material and innovation as the areas that could integrate IBS to Green and Sustainability. And parallel, among people who are involved in construction, designers outstand and their role ranked too much important and it followed by the role of client and manufacturer.

The major outcome of this research is that material, design and innovation have important role in steering IBS toward Green and Sustainable construction and in this regard there is a need of more corporations among all stockholders.

CONCLUSION

Based on what emerged from the study some conclusive remarks can be achieved. The study proposed IBS as a vital pillar in assisting and steering construction toward Green and Sustainability. Accordingly, the study underlines the role of government. It is important for the government to exploit their foresight regarding this transition to maximize its potential benefit through policies supporting and supply of activities which meet this agenda. However, in this regard Malaysian government has created green jobs roadmap through integrating skills training standard in National Competency Standards (NCS) and National Occupational Skills Standards (NOSS) and other green initiatives (i.e., GBI, Green Technology and Sustainable Agenda. etc.), but it seems that implementation of those entire policies shortfall and is considered by time lag. Besides, for migrating to a sustainable “mentality” it requires a lot of change in attitude, innovation, creativity, research and support from many stakeholders. The strategic direction, implementation strategies and research and development have to be driven in harmony. It is envisioned that all initiatives need to be taken forward simultaneously. Also, corporation from all stakeholders is necessary. Every stakeholder involved must stand together and react as a team not as individual champion.

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