Public Participation: Enhancing public perception towards IBS implementation

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Abstract

Implementing Industrialised Building System (IBS) to the construction industry has the potential of contributing to sustainable construction development. However, since the introduction of IBS and its promises to improve the current construction method and scenario in Malaysia, the public perception towards its applicability is becoming an issue. This issue is greatly contributing to the low usage of IBS components in the construction industry. Low implementation of IBS will result in the target of achieving sustainable construction is far from being reached. Better public perception will create better understanding and demand of IBS adoption, indirectly contributing to the future sustainability environment.

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1. Industrialised building system (IBS) – an introduction

The worldwide growth of industrialised construction has led Malaysian government and practitioner to introduce the Industrialised Building System (IBS) which covers pre-assembly, prefabrication, Modern Method of Construction (MMC), Off-site Manufacturing (OSM), Off-site Production (OSP) and Off-site Construction (OSC) (Sadafi et al., 2011, Kamar at al., 2011). IBS is defined as a construction system
which components are manufactured in a factory, on or off site, positioned and assembled into structures with minimal additional site work (CIDB, 2003). Lessing et al., (2005) describes IBS as an integrated manufacturing and construction process with well planned organisation for efficient management, preparation and control over resources used, activities and results supported by the used of highly developed components. Kamar et. al., (2011) has created a working definition of IBS as an innovative process of building construction using the concept of mass-production of industrialized systems, produced at the factory or on-site within controlled environments, it includes the logistic and assembly aspect of it, done in proper coordination with thorough planning and integration. The process of IBS construction started with the manufacturing of component off-site or mass production on the site, once completed, the components will be delivered to the construction site for assembly and erection (Hamzah et al., 2010). CIDB (2003)&(2011) has divided IBS into six (6) major classification based on structural aspects. IBS has been classified into precast concrete framing, panel and box system, steel formwork systems, steel framing systems, prefabricated timber framing systems, blockwork systems and innovative product systems.

Table 1. Classification of IBS CIDB (Adapted from CIDB, 2003 & 2011)

| Classification                        | Types                                                                 |
|---------------------------------------|----------------------------------------------------------------------|
| Pre-cast Concrete Framing, Panel and Box Systems | Pre-cast concrete elements such as pre-cast concrete columns, beams, slabs, walls, “3-D” components, lightweight pre-cast concrete and permanent concrete formworks. |
| Steel Formwork Systems                | Tunnel forms, tilt-up systems, beams and columns moulding forms and permanent steel formworks (metal decks). |
| Steel Framing Systems                | Light steel trusses (cold-formed channels) and steel portal frame systems |
| Prefabricated Timber Framing Systems | Timber building frames and timber roof trusses.                     |
| Blockwork Systems                    | Interlocking concrete masonry units (CMU) and lightweight concrete blocks. |
| Innovative product systems           | Solid drywall system and sandwich panel system                       |

Further classification of IBS can be based on its method of prefabrication; prefabrication allows a component to be built anywhere as long as it can be delivered on time. The methods are on-site prefabrication and off-site prefabrication (factory produced) (Kadir et al., 2006). On-site prefabrication method requires casting structural building elements within the site before erecting to the designated construction area. Generally it involves with mass productions of units and ensures cost and time reduction besides improving the quality of work, meanwhile, off-site prefabrication method engages fully transferring building operations from site to factory. Since 2008, IBS is made compulsory in a public building project, where 70% of components using in the construction must contain IBS (Hamid et al., 2008). The obligations to implement IBS are to improve performance and quality in construction and also to reduce the dependency on foreign construction labour (Hamid et al., 2007). The use of IBS will overcome the issues of repetitive part of the building but difficult, time consuming and costly labor at the site. At the same time, IBS also involve onsite casting using innovative and clean mould technologies such as steel, aluminium and plastic (CIDB, 2011b). The philosophy of shifting from the traditional practice of laying brick and mortar into a mechanized and automation prefabricated works makes IBS as an innovative construction technique and had simultaneously, forms a pressure for Malaysian Construction Industry to accomplish the implementation target.

The application of IBS in the construction process is perceived to offer massive enhancement in productivity and quality of building construction amongst the numerous improvements evolving in the industry (Onyeizu et al., 2011). In line with that, parts of benefits on IBS adoption includes the reduction
of unskilled workers, less wastage, less volume of building materials, speedier construction time, increased environmental and construction site cleanliness, reduced risk by improving health and safety, proper coordination and management. (Kamar et al., 2010, Idrus et. al., 2008, Tam et al., 2007, Pan et al., 2007, Rahman & Omar, 2006). These various advantages have attracted the government to initiate and enforce the IBS implementation in our construction industry. Even though, the uptake of IBS component acknowledged by the construction industry players but the percentage of its application is still below the national target (Hamid et al., 2008; Nawi et al., 2007). This is due to several issues that create a barrier to IBS usage among the stakeholder. This barrier prevents full adoption of IBS in the construction industry. The issues against the IBS implementation can be grouped into technical issues and human issues (Pan et al., 2004). The issues as discussed by several scholars are summarized in figure 1.

**TECHNICAL**
- Site specifics and delivery issues, interfacing problems, lack of opportunities for benefiting from economies of scale (Pan et al., 2004)
- Lack of knowledge among designers (Kamar et. al., 2007) (Rahman & Omar, 2006)
- Poor quality products, Lack of technical know-how, low off-site manufacturing of construction components to guarantee quality, mechanization and standardization (Kamar et. al., 2007)
- Insufficient incentives, sheer cost investment, low components standardization (Hashim et. al., 2011)
- The availability of cheap foreign labour (Hashim & Kamar, 2011) (Idrus, Hui, & Utomo, 2008)
- Inflexibility of IBS components, the weakness of connection and jointing system (Qays et al., 2010)
- The processes employed to construct a facility influence the project duration (Hashim et al., 2011)
- Poor quality control and lack of technical experience caused several defects (Idrus et al., 2008)

**HUMAN**
- Inadequate corroborative scientific research undertaken to substantiate the benefits if IBS system, poor response from the industry players (Thanoon, 2003)
- The need of mindset change with proper education (Kamar et. al., 2007)
- Bad perception of IBS due historical failure (Qays et al., 2010) (Pan et al., 2004)
- The fragmentation and diversity in construction industry sector make it is difficult to organize IBS planning stage (Qays et al., 2010)
- To enabling the workforce/human capacity to appreciate change (Nadim & Goulding, 2010)
- Lack knowledge & exposure to IBS technology (Rahman & Omar, 2006)
- Lack of knowledge on the use and benefits of IBS (Pan et. al., 2007)
- Extensive coordination required prior to construction operations (Haas & Fagerlund, 2002)
- Lack of integration among relevant player (CIDB, 2007)
- Require on-site specialized skills for assembly and erection of components (Kamar et al., 2011)
- Lack skilled worker (Nadim & Goulding, 2010)
- Insufficient training on site levels (Pan et al., 2007)
- Potential for loss of management (Rahman & Omar, 2006)

Fig.1. Technical and human issues
Based on the issues tabulated in Figure 1, it is believed that parts of it formed a negative perception of people involved in the construction industry. This perception will indirectly prevent them from being an IBS user. Even, since the introduction of IBS and its promises to improve the current construction method and scenario in Malaysia, the public perception towards its applicability is becoming one of the issues. A poor perception towards IBS is greatly contributing to the low usage of IBS components in the construction industry. Accordingly, in addressing this issue, it hence an investigation of people’s perception towards IBS that hinder successful IBS implementation. The perception is based on the Malaysian context and supported by worldwide literature. The examination is through a critical review of available relevant literature on the system from various books and article. This study reviewed 50 existing literatures on IBS in Malaysia and worldwide. In order to develop new findings, the limit of this research is from the year 2000 to 2013.

2. IBS as a sustainable tool

The raising sustainability awareness around the world has put the Malaysian construction industry under a great pressure to improve project efficiency and deliverables in order to move into sustainable development. Since (IBS) employed off-site production method, therefore, it has the potential to promote sustainability. Other than off-site production method, adoption of more mechanisation, computer aided manufacturing, intelligent management system, the extensive use of prefabrication, the usage of energy efficient building material, a safer and more stable working environment also contributing to the future sustainable development (Wong et al., 2003; Yunus & Yang, 2013). On the other hand, IBS can be regarded as a sustainable technology as it is one of the informed technology decisions for delivering sustainable buildings and managing technological innovation to sustain competitiveness (Pan, et al., 2012). According to Hamid and Kamar (2012) there are several aspects of IBS that have the potential of contributing to different aspects of sustainability. Some of the major aspects are explained below as per table 2.

Table 2. Sustainable aspect of IBS (Adopted from Hamid & Kamar, 2012)

| Aspect                        | Explanation                                                                                                                                 |
|-------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| Controlled production environment | IBS offers a controlled manufacturing environment, with the ability to reach difficult nooks and corners, which are often inaccessible in regular construction. With the availability of production tools and permanent jigs and fixtures, it is easier to control the workmanship of construction, ensuring a tighter construction which results in energy savings due to leakages (thermal leakage). |
| IBS and waste.               | IBS traditionally has been known to minimise waste, with the ability to reuse material from one module or product into another; the sustainability agenda is supported through its use. |
| IBS and building materials   | Several pre-fabricated technologies such as Structural Insulated Panels, etc. offer great potential in terms of fabrication of more energy efficient buildings. |
| IBS and logistics            | Some estimates recently have put the amount of environmental impact from material transportation activities to be one-third of total environmental impact on the entire construction process. IBS offers additional benefits, specifically the ability to order large quantities, thus reducing the number of trips taken. |
| IBS and economic sustainability | Most government’s emphasis on reduction of reliance on foreign labour, and the ability of IBS to deliver this goal is well documented |

Nevertheless, as outlined by Chan,(2009) in relation to the advantages of IBS in contributing sustainability include shortened construction time, lower overall cost, improved quality, enhanced
durability, better architectural appearance, enhanced occupational health and safety, material conservation, less construction site waste, less environmental emissions, and the reduction of energy and water consumption. Therefore, no doubt, It shows that IBS plays an important role in driving sustainability within the construction industry (Yunus, 2010). Enhancing IBS implementation means one step ahead in achieving sustainable development.

3. Perceptions towards IBS

Changing people’s mindset in-terms of their perception towards IBS adoption is one of the critical success factors to enhance the IBS implementation in Malaysia (CIDB, 2010). As addressed by Zawawi (2009), despite its many benefits promoted, the different perceptions among the stakeholders has led to the low usage of IBS components in the construction industry. Nevertheless Onyeizu at al., (2011) stated that since the beginning of the IBS introduction to the Malaysian construction industry and its promises to solve and improve the current construction method and scenario in the country, poor perception amongst the construction stakeholders towards it, is an issue which greatly contributes to the low usage of IBS components. Thus, it led to the term “IBS” being misinterpreted with negative conception. As explained by Rahman & Omar (2006), the reason that contribute to the negative conception of IBS term is past failures and unattractive architecture. These buildings are normally associated with low quality buildings, leakages, abandoned projects, unpleasant architectural appearances and other drawbacks. Due to the poor architectural design, the old pre-fabricated buildings have given the public, the bad impression about precast concrete. Customer rejection is the main fear of clients in implementing the IBS. On the other hand; even the construction professionals are uncertain with IBS technology and relate IBS with potential post-construction problems.

Scholars agreed that the negative perception towards IBS is based on the historical failure of off-site practices to deliver improved performance, technical difficulties (e.g. Site specifics, delivery issues, interfacing problems and cost), lack of opportunities for benefiting from economies of scale, structural requirements associated with social, security, privacy and noise problems and the fragmented structure of the construction supply chain (Blismas & Wakefield, 2009; Idrus et al., 2008; Pan at al., 2004). Additionally, most of the industry stakeholders are reluctant to change to the new construction method as they have to embrace new ways of thinking and working (Nadim & Goulding, 2010). On the other hand, the client prefers the risk averse attitude to avoid any upcoming difficulties related to IBS application. At the same time, most of the contractors are already convenient and familiar with the traditional method since the technology suits them well; changing to industrialized construction means that the additional cost of labour training and new machineries required (Kamar, 2011). Therefore, investment in human capital development is vital in order to gain the experience, enhance the technical knowledge and training on skilled labour (Hamid et al. 2008; CIDB, 2008; Rahman and Omar, 2006 and Thanoon et al. 2003). On the other hand, Aburas, (2011), Hamid et al., (2008), and Onyeizu at al., (2011) stated that the people’s perception also plays an important role to achieve desired IBS adoption. Amongst the example of poor perception in IBS are: IBS is not popular among architects and designers due to misconception that IBS will eventually limiting their creativity in building design and as for building users, IBS buildings are fragile and impermanent structure, IBS building also seen as non-renovated structure (Sadafi et al., 2011). Thus, it makes IBS based building as a non-popular choice in attracting the buyer or tenant in the future. Therefore changing the people mindset and perception in relation to IBS usage is also an important issue to consider.

Literatures have identified and grouped the perceptions into 4 major stakeholders which are client/developer, contractor, designer (architect and engineer) and the buyer. The details for each group is depicted in table 3.
Table 3. Perceptions towards IBS

| Stakeholder | Perceptions |
|-------------|-------------|
| Contractor  | • Unfamiliar method of working, thus resist any changes (Idrus et al., 2008)  
• High initial cost, IBS is not perceived to be a system which can provide cost reduction compared with traditional in-situ construction, lead to financial failure (Idrus et al., 2008) (Hassim, 2009)  
• Difficulties in applying changes in the middle of site work (Sadafi et al., 2011)  
• Potential for loss of management control when large proportions of project works are being undertaken off-site  
• Require a huge volume of works to break even on the investment (Pan et al., 2007)  
• Cost of transportation has reduced the margin of profit, logistic cost is perceived to be expensive (Nadim & Goulding, 2011)  
• The process employed to construct a facility influence the project duration  
• Difficulties in the production facility logistics and stock management  
• Skill worker requirement (Nadim & Goulding, 2011)  
• Lack of knowledge on the construction process of IBS, lack of experience and requirement of new technical knowledge (Pan et al., 2007) (Hamid et al., 2008)  
• Required high coordination (Kamar et al., 2012) |
| Buyer       | • IBS will spoil the authentic ‘traditional’ house image (Edge et al., 2002)  
• Low quality of building materials and poor workmanship (Pan et al., 2004)  
• IBS can only produce monotonous design (Hussein, 2007)  
• Unattractive modular buildings, bad architecture (Kamar et al., 2009)  
• Issues of renovation (Nawi et al., 2007) (Sadafi et al., 2011) (Qays, 2010)  
• Leakage and crack problem (Sadafi et al., 2011) |
| Client      | • Perceive perception in terms lack flexibility, low quality finishes, leaky accommodation, unfamiliar materials etc. (Hamid et al., 2008) (Nawi et al., 2011)  
• IBS restrictive and unable to deliver customer desires (Boyd, et al., 2012)  
• IBS is rigid and not flexible enough in both form and dimension to meet all the variable demands of construction (Hussein, 2007)  
• Poor quality product available in Malaysia (Philipson, 2001) (Kamar et al., 2009)  
• Technology transfer in IBS is a failure and conventional in-situ system is more attractive as compared to IBS (Idrus et al., 2008)  
• Maintenance problem (Sadafi et al., 2011)  
• IBS is a fragile and impermanent structure (Aburas, 2011)  
• High risk process and not contributing to any benefit to the building owner (Kamar et al., 2009) |
| Designer    | • Design philosophy issue, clashes with the idea of the building being an expression of the individualised self (Gibb, 2001) (Madigan, 2012)  
• Issue of adaptability, customizability, flexibility, quality of interfaces for buildings (Nadim & Goulding, 2011)  
• Not flexible enough to meet architectural design (Sadafi et al., 2011)  
• Applicability in design (Onyeizu et al., 2011)  
• Potential of post construction problems (Rahman & Omar, 2006) |

4. Creating a better perception of IBS

Better customer perception will create a better understanding and demand and will definitely encourage the IBS implementation. The awareness program should be held to overcome the problems by focusing on the major stakeholders in the Malaysian construction industry. The discussions on how to create a better perception for the major categories of stakeholder as follows:

4.1. Contractor

Even the adoption of IBS in Malaysian construction industry started as early as 1960’s, but it’s still need support from the government to improve the construction sector to move from the conventional
system and use IBS (Qays et al., 2009). The contractors should be provided with guidance on the project decision-making process and the site integration of IBS (Pan et al., 2007). On the other hand, the government should initiate a forum on a regular basis of academics and associated practitioners active in IBS for exchange of information and experience, development of new techniques and advice on promotion and implementation of IBS to the contractors (Hamid, et al., 2011). According to Haas & Fagerlund (2000) the contractor should be made understand that the skill level required for prefabrication and pre assembly workers is no different from traditional stick-build construction. Apart from that limiting the number of foreign workers who work at the construction site also can be one of the efforts to encourage the contractors in learning and adopting IBS. In overcoming the issues of low quality product, delay and cost overrun, implementing contractor’s earlier involvement in the project life cycle is the best solution. Besides, it ensuring the contractor got involved and able to express their opinion as early as in the design stage to enhance their understanding on the construction using IBS (Nawi et al., 2009).

4.2. Buyer

The buyer often skeptical with IBS building due to the quality issue (leakage and crack problem), unattractive past design and inflexibility of renovation. Thus, to improve the perception of low quality, it is recommended to improve training in installation techniques by addressing interfacing and tolerance issues and avoiding any faulty during the installation process (Pan et al., 2004). At the same time, manufacturers must ensure that, the components of IBS design should pass the quality control measures/department before sending to the site. The installer should be an expert or experienced (Nawi et al., 2007). In terms of inflexibility of renovation, the buyer should be explained about the availability of a hybrid system that caters for them who often renovates but at the same time keeping the structure intact. This system offers less wastage and provides speed to the contractor at no costs and extra headroom, a consistent finish and flexibility for renovation (Nawi et al., 2007).

4.3. Client

Client with good knowledge and awareness of IBS benefit will surely encourage designers to design a building according to IBS (Kamar at all., 2009). Nevertheless according to the IBS Roadmap Review (2007) report, the adoption of IBS in Malaysia is a client driven. Thus, the client plays an important role in decision making whether to use IBS or not, indirectly it will contribute the percentage of IBS adoption in the Malaysian construction industry. In line with that, comprehensive awareness program and showcases of best practices for the client and decision makers should be held, in order for them to get the correct information on IBS (Aburas, 2011; Kamar et al., 2009; Rahman & Omar, 2006). The advantage and disadvantages of adopting IBS should be more objective in briefing the client (Pan et al., 2004). On the other hand, associated agency such as CIDB should test and demonstrate that IBS can deliver as good or better performance than traditional methods (Pan et al., 2007).

4.4. Designer

Designer perception about IBS is on the applicability in the design which they think IBS is not flexible for architectural design (Onyeizu et al., 2011; Sadafi et al., 2011). Therefore, the designers should be informed about the varieties of product ranges and options that they can adopt in their design rather than relying to the solutions offered to them. Once the designer had clear options on what they can choose and how much it costs it hence their better visibility in design of IBS building (Nadim & Goulding, 2011).
Other than focusing on these major stakeholders, other general recommendations to enhance the stakeholder perception on IBS also should be taken into consideration. Amongst others are educating all the stakeholders in IBS from the policy makers and decision maker to consumers about the use of IBS and its benefits as a key starting point (Aburas, 2011). Apart from that, Abdullah & Egbu, (2010) suggested that the negative connotations and the perception of IBS need to be conquered, for more information to decision makers to make a consideration of IBS implementation. As stated by Jabar et al., (2013), identification of the issues will provide a better understanding and a clearer picture on problems that hinder the full adoption of IBS in Malaysia. At the same time, Rahman & Omar(2006) advised that IBS should be branded as a value for money solution with quality, whole life cycle costing, and environmentally friendly to change the customer’s perception of past failure and bad architecture. In short there is an urgent need to change people mindset regarding IBS through promotion, awareness programs and education.

5. Conclusion

Changing people mindset is one of the critical success factors in IBS implementation. In order to shift the mind paradigm, the issues that lead to the negative perception are investigated. The stakeholders are identified and categorized into four major groups consists of contractor, buyer, client and designer. Their perceptions towards IBS are examined. Based on Table 1, literature research shows that, among the stakeholders, contractor holds many negative perceptions towards IBS usage. This is due to the facts that the contractor is the main actor in a construction project, and there are many things that they have to consider before changing their method of working and thinking. Besides that, a real usage of IBS only can be seen during the construction phase which handled by the contractor; thus it required them to give more judgement on IBS. Identification and categorizing the perception of the stakeholders will help the respective parties, such as CIDB to take necessary actions in overcoming the situation. Enhancing and giving better public perception towards IBS will create a better understanding and demand for IBS adoption, indirectly contributing to the future sustainability environment.

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