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# STUDY ON THE USE OF INDUSTRIALISED BUILDING SYSTEM IN MALAYSIAN PRIVATE CONSTRUCTION PROJECTS

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**ABSTRACT**

The construction sector based on industry or Industrialised Building System (IBS) is a method of construction using the industrialized building materials at the manufacturing plant. This method can replace the conventional method and is able to; reduces the amount of foreign labor, improve the quality of construction, lower the cost, and reduce construction time. This study is intended to create a guideline that can be used to encourage all private construction projects in the Klang Valley to implement the IBS System in 2015. Therefore, this study was undertaken to assess the level of IBS usage in the building construction. There are about 400 private sector projects in the Klang Valley that have been identified (or taken) as a sample for this study out of which 184 private projects are using IBS technology; achieving ed a score of over 55% . The findings of this study was to identify the perceptions, barriers that exist and the measures to be taken in the implementation and the criteria for developing a business model that can be used as a model concept of IBS in the private sector.

**Keywords:** industrialised building system, private construction, business model.

## INTRODUCTION

Industrialised Building System (IBS) is a term used in Malaysia for a technique of construction where by components are manufactured in a controlled environment, either at site or off site, placed and assembled into construction works. Worldwide, IBS is also known as Pre-fabricated/Pre-fab Construction, Modern Method of Construction (MMC) and Off-site Construction. CIDB Malaysia, through IBS Centre is promoting the usage of IBS to increase productivity and quality at construction sites through various promotion programmes, training and incentives. The content of IBS (IBS Score) is determined based on the Construction Industry Standard 18 (CIS 18: 2010); either manually, web application or fully automated CAD-based IBS Score calculator.

IBS was first introduced in mid-sixties with the Circular Road Flat construction project that used pre-cast concrete; this was government's beginning effort to use this smart method in public project (CIDB 2003). CIDB had placed the target to achieve a minimum IBS score that totalled 70% IBS content in public projects which involved state tender acquisition (Treasury 2008).

Malaysian Government, through CIDB, has launched Road Map IBS 2003-2010 and 2011-2015 aimed to encourage IBS usage that can reduce construction industry's reliance to on foreigner workforce (Nawi *et al*. 2012; Azman *et al*. 2011). IBS effectiveness study for government project carried out aims to assess IBS effectiveness on the use of foreign workers to that does not exceed 15% level towards year 2010 (CIDB 2010). IBS usage will put high standards in construction field through building material quality control (Nawi *et al.* 2011). As such, cases involving usage of low quality material and sub-standard construction practices would be reduced with the increased use of IBS.

IBS is a construction system built by using prefabricated components; where component manufacturing is systematically performed using machinery, molds and other mechanical equipment (Azman, Ahmad, *et al.* 2012). Component that have been produced and completed off-site or in factory are sent directly to building site for installation (Rahman and Omar 2006; Azman, Ahamad, *et al*. 2012). Among advantages seen in IBS include; improved quality, cost effectiveness, health and security, waste reduction, efficiency and productivity (Nawi *et al*. 2014; Abedi and Fathi 2011). IBS is said to be able to replace the conventional labor oriented method (Hassim and Jaafar 2009). IBS usage in Malaysia is still at a lower scale and usually used in concentrated works like bridge construction and tunnel (Bakar 2009).

Due to this, basically this study is to provide a guideline to industry especially in private construction project regarding several important aspects that contribute to counter negative perception and other obstacles that hinder IBS use of system in private construction projects in this country. This study will also identify steps needed to develop business model that can facilitate implementation of IBS concept for projects in private construction sector.

**Definition and Classification 'Industrialised Building System' (IBS)**

In going through construction industry challenges, designers and contractors should be attentive to latest technologies usage. Of lately, Malaysian government through CIDB body (Construction Industry Development Board) is seriously promoting usage of 'Industrialised building system' (IBS) in construction sector. IBS is believed to be able to prepare a construction system which promises better quality product with rapid and cost effective construction. 'Industrialised building system' (IBS) is defined as whole component of a building including wall structure, floor, roof, ladder and so on that has been constructed in a factory or on project site with supervision that is strict on product quality and assures reduced activity on building site (Badir *et al*. 2002).

Definition that is more detailed on 'IBS' had been described by Kamar (2011) =. He states 'IBS' refers to construction industry where it involves building components including under construction, planning and deliveries to site build. 'IBS' system is equal merger between software components (software) and hardware (Badir *et al*. 2002).

Software component involves system design; it also involves current market analysis, component development according to fixed standard, manufacturing system development and process and installation – benefiting the end user. Apart from that, it also involves material resources identification and building definition or construction according to form designer view. Meanwhile hardware component on the other hand involve three major groups namely; framework, beam, columns, panel system and box system (box system).

'IBS' classification on the other hand is divided into two main classes namely; open system, and closed system. In open system all of necessary components are standardized and it offers diversity in design and flexibility while in closed system on the other hand, element are made in factory and are need specific. IBS is further categorized into two methods; prefabricated and cast. It is mould system method of use under construction. Mold defined as wooden mold or made from other materials such as steel, where concrete mixed at construction site is poured into the mold and waited on till the concrete is hardened. Based on this system structure aspect, 'IBS' can be divided into five key aspects namely; prefabricated panels, steel framework system, steel mold system, prefabricated wooden framework system, and block system (CIDB 2003). Clearly, in general IBS category in Malaysia is divided into four categories according to the usage (Thanoon *et al.* 2003); see Table-1.

**Table-1.** Utilization system IBS.

| No. | Utilisation System IBS |
|---|---|
| 1 | Formwork system - table form, half - tunnel form |
| 2 | Frame system – precast concrete and precast steel |
| 3 | Panel system – sandwich panel, half-slab, hollow slab |
| 4 | Block system – interlocking block, hollow block, lighweight block |

**METHOD**

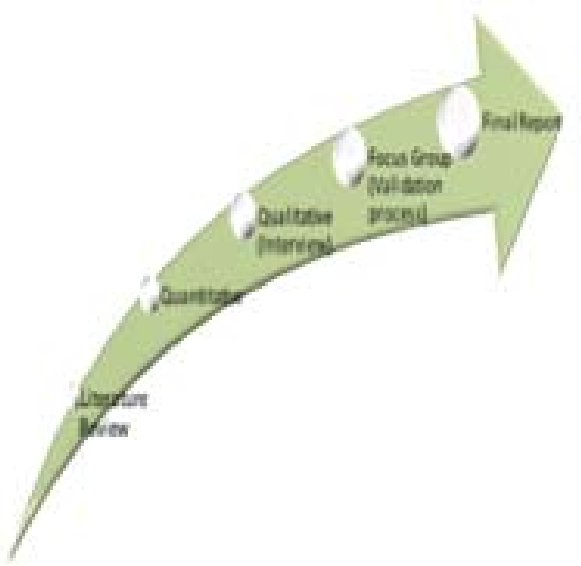

**Figure-1.** Method of study.

Based on Figure-1: this study method involved survey research (survey) including; quantitative, qualitative and Focus Group for confirmation (validation) and survey result; Quantitative research which uses questionnaire form technique among building contractor in the Klang Valley, was used. From January 2011 to August 2012 (where this study started) a total of 400 private projects in the Klang Valley were identified as sample for the study. Meanwhile qualitative study, on the other hand, falls into two parts namely; conducting IBS consumption level study, and perception and challenges faced in IBS project implementation. Data collection technique used included interviews that involved 10 respondents from some organizations. After that the study is also aiming to get data source for business model development process for IBS project implementation.

Qualitative approach was used to validate the retrieved quantitative results through focus groups. Focus Group methods were implemented in two levels. First Focus Group was held in Hotel Thistle, Johor to discuss

obstacle factors proposal by CIDB in IBS project implementation in private sector. Second Focus Group was held in Hotel Sunway, Penang to discuss problem and to get industry perception on IBS implementation. This session also discussed business model that is suitable to be exercised to an IBS project.

## FINDINGS AND DISCUSSIONS

### Standard IBS and Consumption Level

Figure-2 shows a survey that was conducted on 400 private projects around Klang Valley; 46% of them had used IBS technology. It encompasses private construction projects like commercial building construction, housing, office, utility tower, and factory. Research showed from 186 private projects which used IBS in the Klang Valley, majority of them achieved IBS score of over 55% as evident in Figure-3. Study also found that industrial and commercial construction projects had the highest IBS usage based on the average score, followed by housing, institution and utility acquiring 55% average score, respectively. In firefly algorithm, there are two important variables, which is the light intensity and attractiveness. Firefly is attracted toward the other firefly that has brighter flash than itself. The attractiveness is depended with the light intensity.

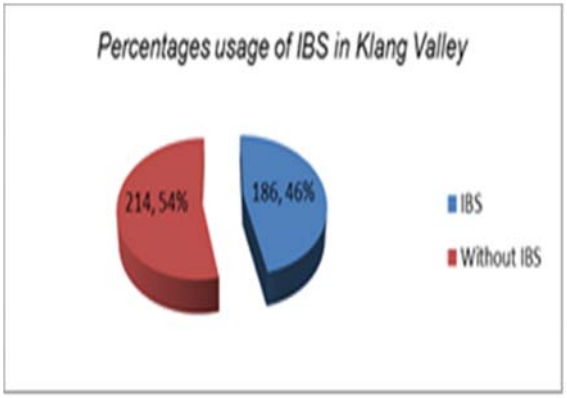


**Figure-2.** Percentage usage of IBS in Klang Valley.

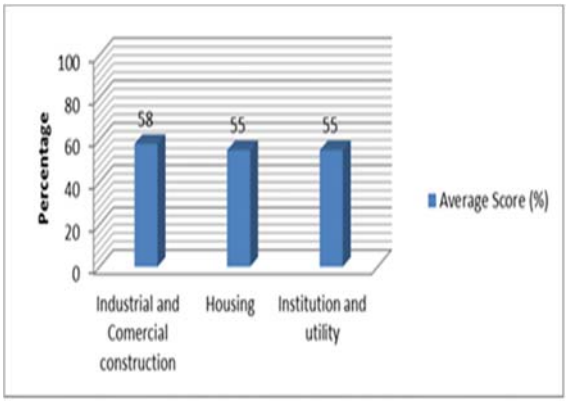


**Figure-3.** Mean scores of IBS.

**Table-2.** IBS project percentage according to type of building.

| Type of Building | Industrial and Comercial | Housing | Institution and Utility |
|---|---|---|---|
| IBS building percentage (%) | 30 | 9 | 7 |

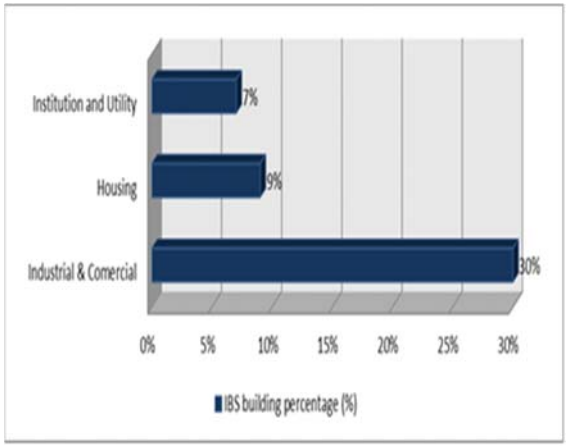


**Figure-4.** IBS percent of the buildings.

Figure-4 shows study findings that housing construction project is the private construction project type that used the most developed IBS System, followed by industrial and commercial building, institution building, and utility. Housing construction project included 30% of the private construction projects' total amount which used IBS System in the Klang Valley.

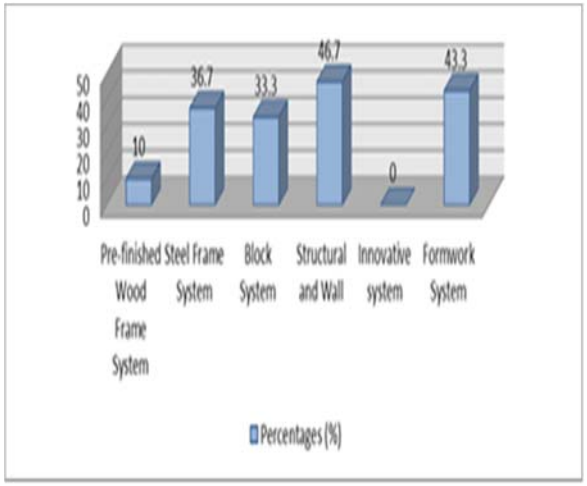


**Figure-5.** IBS system percentage that commonly used in private projects.

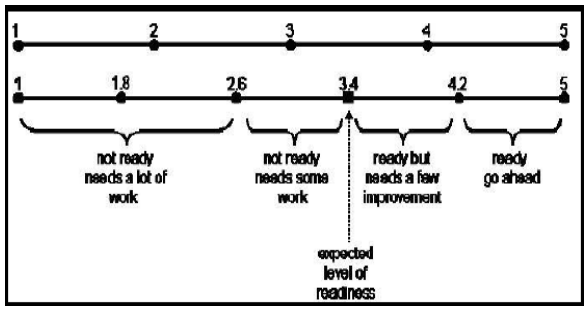


**Figure-6.** The level of readiness process and technology (Aydin and Tasci, 2005).

Statistics show that the majority of respondents were prepared in terms of staffing and skills involved in the field of project management and engineering (Figure-7). While in production, design and technical operations, they are still at the moderate level, as shown in Figure-8.

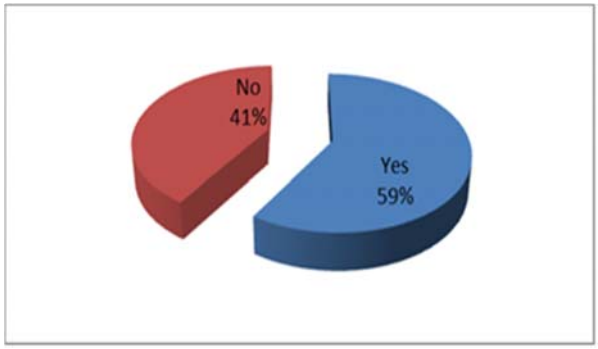


**Figure-7.** Percentage level of readiness project manager and Engineer IBS.

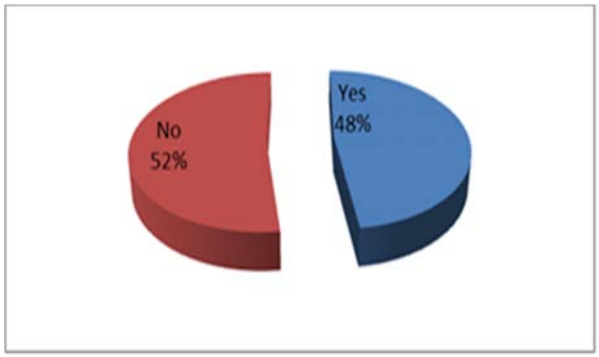


**Figure-8.** Percentage level operator installation readiness.

Referring to Table-3, from the perspective of process and technology, the industry average of IBS in the Klang Valley is ready to implement IBS involving aspects such as project planning and scheduling, financial source, work coordination and supervise, site installation and logistic, supplier management, storage management, and last is facilities. However, matters involving the use of the latest technology and human skills development program including the preparation of the organization's internal courses or aspects of the training of the staff, the industry is not yet fully prepared, as shown in Table-4.

**Table-3.** Industry readiness level in implementing IBS.

| No | Process and Technology | Mean |
|---|---|---|
| 1 | Project Planning and schedule | 3.73 |
| 2 | Financial source | 3.68 |
| 3 | Work coordination and supervise | 3.67 |
| 4 | Site installation and logistic | 3.65 |
| 5 | Supplier management | 3.64 |
| 6 | Storage management | 3.60 |
| 7 | Facilities | 3.49 |

**Table-4.** Level unwillingness Industry in implementing IBS.

| No | Process and Technology | Mean |
|---|---|---|
| 1 | The ability to use latest technology (ICT) such as CAD, CAM and BIM | 3.37 |
| 2 | Development program in IBS such as training | 3.19 |

**Perception, Barriers and Recommendations for Implementation of IBS**

Among obstacles faced in implementing IBS include monitoring method consumption side and conventional payment. Payment for components delivery to IBS projects requires immediate payment. High Cost factor is another obstacle which involves cost for the

purchase of new machinery, mould manufacturing, tax for machinery and equipment imported from overseas and employee retraining cost. Weak Communication process and coordination among project team members also contributes to this problem (Tables 5 and 6).

**Table-5.** Factor which caused IBS less adored by industry.

| No | Barries | Mean |
|---|---|---|
| 1 | Cost of IBS is more higher than convensional method | 3.76 |
| 2 | There is no goverment policy | 3.67 |
| 3 | Policy absence from goverment that compel the use IBS in private projects | 3.67 |

**Table-6.** Obstacle faced when implement IBS projek in private sector.

| No | Barries | Mean |
|---|---|---|
| 1 | Transportation cost that is high | 4.03 |
| 2 | Expensive IBS component cost | 3.87 |
| 3 | Less integration among other parties such as arhitectures and contractors | 3.73 |

Most IBS projects are initially designed using the conventional construction method, but later changed to IBS design. This has resulted in waste of time and cost due to the renovation work, involving nearly 90% modification of the original design plan.

Lack of skilled labour and relating training schemes that are limited are becoming obstacle to carry out IBS system; generally programme or syllabus for IBS design process in higher learning institution level is still limited. So far there is no code uniformity in IBS project design work among the special consultants. Although 'Modular coordination Scheme' (like MS 1064) have been introduced in Roadmap IBS 2003-2010 and 2011-2015, unfortunately this scheme is getting less response from industry. In addition, the practice implemented by most manufacturers of IBS now is their own and they differ from each other in terms of size, type and method of installation. This causes the problem of inconsistencies arising from this making installation work by the contractor at the construction site more difficult.

Among IBS implementation proposal is to impose condition obligatory to use IBS, incentive supply, process approval of development that is fast, and reduction of stamp duty to shoppers. Apart from that, government even should convince consultants to show more interest in IBS compared to where conventional method consultants do not use design that is complex.

Ensuring or compelling usage of 'Modular Coordination (MC)' in component design IBS including introducing 'Open System' in construction sector in Malaysia will enable standardization in design and building component. Company that is capable to play the role of developer, manufacturer and IBS contractor or have function like 'One stop centre' (Rajah 7) need to be created whether from existing company or forming a new company to control company operation and integrate IBS system that is well off released now.

This meaningless 'One stop centre' has created monopoly in existing IBS market that is currently controlled by a large multinational company; on the other hand if given opportunity to small and new companies to have capacity to implement IBS System would enable them to execute the construction projects amicably as evidenced in Table-5 and Table-6 in the preceding paragraph.

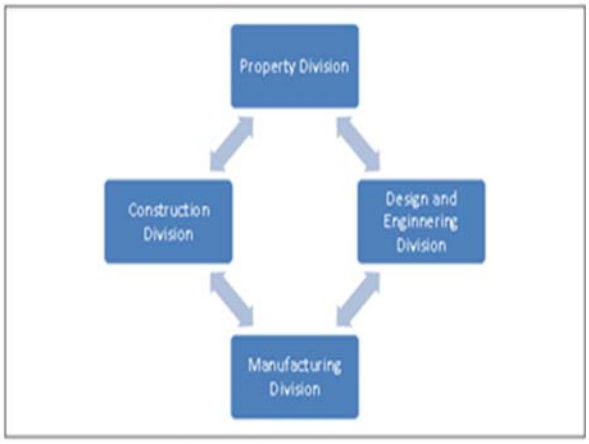


**Figure-9.** Business model centralized *(One Stop Center)*.

The key concept of this operation is to work together under one roof (co-location). Most of this approach is practiced by private developers who have long been involved in the construction of IBS in the Klang Valley such as SP Setia, Sunway Construction and Development Sdn Bhd Sri Pajam. Design, production and assembly are carried out in-house to improve profit margins. These companies typically created by developers through the process of Merger and Acquisition (M and A) with existing small companies.

Integration of all the parties involved designers, engineers and contractors are required to avoid problems such as 'constructability' and 'manufacturability.' Manufacturers should be involved at an early stage of the design process so that the components will be produced to meet the specifications laid down without having to go through the process of renovation of components. Implementation of Value Management workshop in early phase of IBS development projects is one of interesting method proposed by the industry in overcoming the problem.

**IBS Business Concept Proposal**

Recent opportunity to get IBS project is quite difficult. Thus, the industry itself must play a role in

creating the market for IBS project. One proposed method is through enhanced supply chain management system (supply chain management) in the construction IBS sector (Kamar *et al*., 2014). Business strategy adopted by the IBS industry now needs to be fixed or transformed into the concept of personal (individual) or separate (isolated) to the concept of collaboration (team) or collaboration (collaboration).

In addition, manufacturers must adopt business strategies of cooperation or 'joint venture' with consulting firms to ensure that all activities involving IBS projects run smoothly. The purpose of this approach is to expand the scope of work and diversify of services that may be offered by the result of the partnership. This method can also be very effective in overcoming the problems associated with communication issues, particularly in the design phase (design) and (fabrication) component of a project of IBS. This approach will not only help overcome the financial capital round, but at the same time, it also can enhance a culture of sharing knowledge and skills (knowledge and skill sharing) between organizations.

Among advantages achieved as a result of this cooperation is technology transfer success and skill sharing/transfer between two organisations. This approach can also be looked as opening of opportunity to IBS small producer to increase skill and competitiveness confidence in exploring IBS areas of business that is becoming increasingly developed. At the same time partners also had benefited through decrease of operational cost especially those involving construction projects around peninsular Malaysia North zone.

Proposed implementation of concept-based business known as 'one-stop centre.' This concept operation's key theme is to work under one roof (co-location). This approach is mostly practiced by private companies that have long been involved in IBS construction sector in the Klang Valley. This method is seen very suitable in practiced especially to overcome issues that often shackle IBS implementation currently including; communication process weakness and integration among project team member, IBS product delivery slowness of process and skills shortage and knowledge by contractor and developer.

Emphasis on entrepreneurship should be applied by everyone in the IBS industry. Each individual or organization must have a basic entrepreneurship in themselves, to expand the size and scope of work in the future. However, this business strategy can be initiated from below by their respective professional fields previously developed by the capabilities and opportunities that may exist in the future (bottom-up strategy).

Development of business models that will be implemented by the local IBS industry should not ignore the basic elements of teamwork towards being 'trend' during construction in IBS industry.

## CONCLUSIONS

Objective of this study is to measure IBS consumption level in building construction work, identify perception, obstacles that exist and propose actions for IBS implementation and development; improvement proposal and develop business model that helps IBS concept project to be implemented in private sector. Retrieval research showed, as much as 46% of private construction projects used IBS as construction method; out of 186 projects, 118 projects or 65% achieved IBS score exceeding 55% (use IBS in structural work). IBS system that was used more often in private projects was concrete pre panel cast system followed with other systems like block system and mold system. Steel framework system and pre completed wood systems were used for roof components. Study also found, IBS key factor having been used in private projects is because of shortening the construction period and rendering a deluxe quality of construction.

Through this study, it was found that the use of IBS by the private sector depends on two critical factors such as the policy of the local authority (LA) and a private developer's own initiative. For policy factors, for example the Kuala Lumpur City Hall (DBKL) has mandated the use of IBS to force private projects since 2012 and since the start of this policy IBS construction has increased dramatically among private developers. While due to the private developer initiatives, in particular, companies like Sime Darby Properties, Sri Pajam and SP Setia have already implemented the use of IBS in their construction projects. However, the issues and constraints faced by the private projects using IBS were identified through this study, particularly as it involved a higher overall cost than conventional methods mainly due to the; lack of suppliers, purchasing expensive molds and high transport costs. In addition IBS adoption is hampered by; component manufacturing requires high-tech expensive equipment, lack of project integration, skills shortages and limited training schemes. There is no uniformity in the design and perception of buyers stating IBS difficult project modified also is an obstacle in the implementation of IBS in private construction projects.

Based on the findings, a number of concrete proposals have been identified for the recommended promotional programs (awareness program) with the Local Authority (LA) and a private developer on an ongoing basis and at the same time strengthening the implementation of IBS with the introduction of open systems back in order to encourage an increase in the number of entries from manufacturers and suppliers in the market. There is also a need to develop a business model or a mode specifically for IBS implementation in private sector projects by introducing concepts such as joint ventures, partnering, consortium and one-stop centers and propose a policy for private construction projects worth RM100 million and above using IBS to systematically reduce dependence on foreign workers.

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