ESTABLISHMENT AND DEVELOPMENT OF IBS IN MALAYSIA

Mohammad Abedi[1] , Mohamad Syazli Fathi[2] and Abdul Karim Mirasa[3]
[1, 2, 3] UTM RAZAK School of Engineering & Advanced Technology, Universiti Teknologi Malaysia, International Campus, Kuala Lumpur, Malaysia

abedm1385@yahoo.com, syazli@ic.utm.my, abdkarim@ic.utm.my

ABSTRACT: Government of Malaysia has done a lot of effort to promote the usage of Industrialised Building System (IBS) as an alternative construction methods compare to conventional building system which is a more labour intensive. This paper describes the experiences of Malaysia in the adoption of industrialised building system (IBS) from the first level of establishment until its development along with various IBS definitions and categories. A comprehensive literature review from various sources was made to carry out the study. The idea of using IBS in Malaysia was first developed during the early sixties when the Minister of Housing and Local Government visited several European countries and evaluated their building systems performance. Then, in 1964, the government took a significant decision to implement one pilot projects using IBS concept which was launched on 1966. The findings of this research illustrated the timeline of IBS establishment and development in Malaysia along with the significant consequences of IBS implementation in construction industry. Therefore, it is hoped that the finding of this research could assist professional parties in construction industry in providing a better knowledge ground for improving decisions making to achieve the success of IBS construction projects implementation that could be along with attaining the project objectives in terms of predetermined objectives that are mostly within the time, specified budget and standard quality.

Keywords: Industrialised Building System, Malaysia, IBS Roadmap, Project Objectives, CIDB.

1. DEFINITION OF IBS

Government of Malaysia has done a lot of effort to promote the usage of Industrialised Building System (IBS) as an alternative construction method. Since the first project of IBS in year 1966, there has not been one absolute definition on Industrialised Building System (IBS) that could be describes the entire building construction system. However, there are several definitions by researchers who studied into building construction emphasizing on the concept on off-site construction (Pan, 2008) off-site production (Blismas, 2006), industrialized and automated construction (Warszawski, 1999), off-site manufacturing, prefabricated building, pre-assembled building (Gibb, 2003). Furthermore, IBS could be more elaborated by other definitions such as pre-cast building, pre-cast construction, non-traditional building, innovative building solutions and a Modern Method of Construction (MMC) (Goodier et al., 2007). Different definitions of IBS have been established by many researchers as illustrated in Table 1.

Table 1. Definitions of IBS

Author	IBS Definition
Chung (2007)	Mass production of building components either in a factory or at site according to specifications with standard shapes and dimensions and which are then transported to the construction site to be re-arranged with certain standards to form a building.
Rahman and Omar (2006)	A construction system that is built using pre-fabricated components. The manufacturing of the components is systematically done using machine, formworks and other forms of mechanical equipment.
Lessing et al., (2005)	An integrated manufacturing and construction process with well planned organization for efficient management, preparation and control over resources used, activities and results supported by the used of highly developed components.
Gibb (1999)	Preassembly for a given piece of work; the organization and completion of a substantial proportion of its final assembly work before installation in its final position including forming any temporary work or pre-assembly and it can also be carried out on or offsite which would involve the standard coordination.
Trikha (1999)	Two definitions have been created: 1) A system of construction that has been made to be mainly industrialized in its manner and process, such as the manufacturing of automotive components and furniture. 2) A system in which concrete components are prefabricated at site or in a factory and are assembled to form the structure with minimum on-site construction.
Warszawski (1999)	A set of interrelated elements that act together to enable the designated performance of the building.
Esa and Nurudin (1998)	A continuum beginning from utilizing craftsmen for every aspect of construction to a system that make use of manufacturing production in order to minimize resource wastage and enhance value for end users.
Parid Wardi (1997)	A system which uses industrialised production techniques either in the production of components or assembly of the building or both.
Junid (1986)	A process, by which components of a building are conceived, planned and fabricated, transported and erected at site. The system includes a balanced combination between software and hardware component. The software element includes system design, which is a complex process of studying the requirement of the end user, market analysis and the development of standardized components.
Dietz, A.G.H (1971)	Total integration of all subsystem and components into overall process fully utilizing industrialized production, transportation and assembly technique.

The most significant, feasible and practical definition of IBS in Malaysia was introduced by the Construction Industry Development Board in Malaysia's Roadmap of IBS (CIDB, 2003). CIDB defines IBS as a construction technique in which components are manufactured in a controlled environment (on or off site), transported, positioned and assembled into a structure with minimal additional site works. This research will use the definition by CIDB in categorising the building construction system. However, Industrialised Building System (IBS) is not new to the construction industry because it has just again become feasible and visible in Malaysia as a valuable solution to improve the construction

industry mainly in terms of efficiency and productivity. In a larger view and open minded perception, IBS is further than implementing the construction project through prefabricated methods. According to Kamar et al., (2009), IBS is about the changing of conventional mindset, enhancing the capability, competency and value of human capital, developing better cooperation, team working and trust among the parties in construction industry, promoting intelligibility, innovation, transparency and most significantly the high integrity that will eventually enhance the productivity and efficiency within the construction industry. IBS has been identified as a potential method to improve overall construction performance in Malaysia in term of quality, cost effectiveness, safety and health, waste reduction, efficiency and productivity.

There are many benefits of Industrialised Building System (IBS) as a modern method of construction such as reduction in construction time, less site materials, better site management, minimal wastage, cleaner and neater environment, controlled quality, reduction of labour intensity, construction standardization, quality improvement and lower total construction costs that will eventually produce better products for the parties such as clients and contractors in construction industry (Kamar et al., 2009). The Malaysian government have implemented a lot of various significant efforts in to bringing the IBS for all professionals involved in the construction industry. One of these significant efforts is the establishment of IBS Roadmap 2003 -2010 that has been endorsed by the Government to be the blueprint document for the industrialisation of the Malaysian construction sector. The effort to promote the usage of IBS as a valuable (efficient and effective) alternative compare to conventional and labour intensive construction method should be more emphasized by the CIDB of Malaysia. Also, Kamar et al., (2009) asserted that although members of the industry are open to the idea, a major portion of the industry stakeholders are indifferent, perhaps due to resistance towards change, insufficient information and lack of technology transfer methods to support the feasibility of change to IBS. Successful IBS projects are Sekisui Home (Japan), Living Solution (United Kingdom), Open House (Sweden) and Wenswonen (Netherlands) (Oostra & Joonson, 2007).

According to Astrand (2002), the existing process of selecting innovative building systems or IBS can be divided into two main stages which are pre-occupancy and occupancy. Abdullah and Egbu (2010) stated that the decisions in pre-occupancy stage, (pre-design stage and design stage) are significantly

valuable in terms of efficiency, effectiveness and productivity that will be made by stakeholders. These valuable decisions can be considered as combined, shared, united and consensus decision-making, because there is an efficient and well organized cooperation between the design teams and clients that will eventually discuss the best alternative for the building system to be implemented in the construction project. Furthermore, providing efficient, proper and adequate information beside the project knowledge will lead us to create and develop the best decision-making process. Knowledge based decision-making can reduce uncertainty for successful implementation of risk management that will facilitate the construction project parties to achieve the project objectives in terms of time, cost and quality to eventually enhance the success of construction projects.

2. ESTABLISHMENT AND DEVELOPMENT OF IBS IN MALAYSIA

IBS in Malaysia has been established, introduced and applied in construction industry in order to deal with a growing demand of affordable housing, solving issues associated with foreign workers and improving quality, efficiency and productivity of construction industry. Nowadays, IBS has evolved and implemented in hybrid construction projects to build national landmark as significant valuable national assets. From the comprehensive literature review, establishment and development of IBS have been illustrated through the timeline as shown in figure 1.

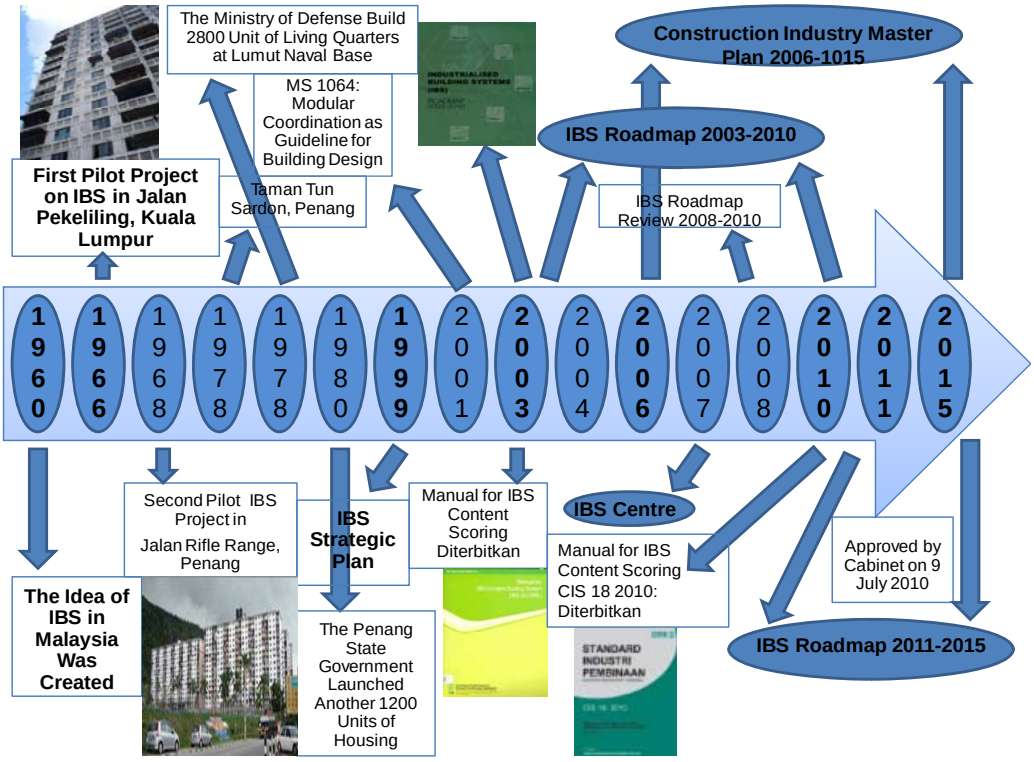

Figure 1. Establishment and Development of IBS Timeline in Malaysia

According to figure 1, various efforts have been adopted since the establishment of IBS in Malaysia on the early 1960's. Furthermore, these efforts has been reviewed and improved for enhancing the efficiency, effectiveness and successful implementation of IBS until 2015.

The usage of IBS in Malaysia has begun since early 1960's in a low cost housing scheme when Ministry of Housing and Local Government of Malaysia visited several European countries and evaluated their housing development program (Thanoon et al., 2003). After their visit in 1964, the Government had launched first pilot project on IBS to speed up the delivery time and built affordable and quality houses. Almost, 22.7 acres of land along Jalan Pekeliling, Kuala Lumpur was dedicated to the project comprising seven blocks of 17-storey flats (3,000 units of low-cost flat and 40 shops lot). This project was awarded to JV Gammon & Larsen and Nielsen using Danish System of large panel pre-cast concrete wall and plank slabs. The project was completed within 27 months from 1966 to 1968 including the time taken in the construction of the RM 2.5 million casting yard at Jalan Damansara (CIDB, 2006; CIDB, 2003 and Thanoon et al., 2003). In 1968, the Government of Malaysia launched a second housing project which was a six block of 17-storey flats and three blocks of 18-storey flats at Jalan Rifle Range, Penang. The project was awarded to Hochtief/ Chee Seng using French Estoit System (CIDB, 2006; CIDB, 2003 and Din, 1984).

According to the two pilot projects, a performance comparison between the IBS system and conventional system has been carried by Thanoon et al., (2003) in terms of cost, productivity, and quality. It was discovered that the first pilot project incurred 8.1% higher cost than a similar building using conventional construction method, while the second project was 2.6% lower than conventional construction method. In term of construction speed, both projects required 27 months to complete, inclusive of time required to set up the recasting factories. Also, it was found that the quality of building finishes was better than the conventional construction method.

Precast concrete is one of the main IBS category built in Malaysia since 1960s. However, according to Rahman and Omar (2006) these buildings were normally associated with pre-fabricated mass construction method, low quality buildings, leakages, abandoned projects, unpleasant architectural appearances and other drawbacks. Among the earliest housing development project using IBS was at Taman Tun Sardon, Penang in 1978, (1,000 units of five-storey walk up flat). IBS pre-cast component and system in the project was designed by

British Research Establishment for low cost housing in tropical countries (BRECAST system). A similar system was constructed almost at the same time at Edmonton, North London and about 20,000 BRECAST dwellings were constructed through out UK from 1964 to 1974 (CIDB, 2006).

Rahman and Omar (2006) also indicated that due to the poor architectural design, the old pre-fabricated buildings have given the public, bad impression about precast concrete. There have been quite a number of cases where the use of IBS had lead to such drawbacks such as, in the case of Pekeliling Flats in Kuala Lumpur and Taman Tun Sardon, Gelugor, Penang. These two early pre-fabricated flats were constructed in mass to produce low cost accommodation for lower income groups. In the case of Taman Tun Sardon the design was very basic and not considering the aspect of serviceability such as the need for wet toilets and bathrooms. Lacking in this design consideration leads to problems of leakage that becomes the common issue with precast buildings. In addition, in many cases the low cost housing was not maintained properly, thus contributing further to the poor image of IBS buildings. Other important aspect is the quality inspection which in housing construction is one of the major factors that general contractors have to consider for improving customer satisfaction and raising their intake in the industry (Kim, Oha, et al., 2008).

In 1978, the Penang State Government launched another 1200 units of housing using prefabrication technology. Two years later, the Ministry of Defense adopted large prefabricated panel construction system to build 2800 unit of living quarters at Lumut Naval Base (Trikha and Ali, 2004).

Nevertheless, the industrialisation of construction at its beginning stage on the early 1960's was never sustained. This issue could be due to failure of early closed fabricated system which made the professional parties in construction industry afraid of changing their construction method. Furthermore, other overseas systems that were introduced during 60s and 70s were found unsuitable for the Malaysia climate and social practices. Hence, newer technologies were constantly being introduced to the market such as wet joint systems that were identified to be more suitable choice for Malaysia tropical climate. For instance, it was better to utilise the bathroom types which were comparatively wetter than those types in the European countries (CIDB, 2005). In the period of 1980 till 1994 there is a huge gap of discontinuous and decreasing the IBS utilization towards developing and implementing the IBS. This could be because of problems in the leakage of IBS design that eventually

contributing to poor image of IBS buildings for construction industry. Also, this gap could be due to lack of clients and contractors trust and interest to these IBS systems. IBS was not popular in 1980 to 1994. However, IBs become more popular in 1990's when many Malaysian infrastructure and mega projects were build especially for the Commonwealth games in 1998. As a result in Malaysian construction industry during 1994-1997, pre-cast, steel frame and other IBS were used as hybrid construction method to build national landmarks such as Bukit Jalil Sport Complex, Kuala Lumpur Convention Centre, Lightweight Railway Train (LRT) and Petronas Twin Towers (Kamar et al., 2009 and CIDB, 2006).

According to Construction Industry Development Board (CIDB, 2005) based on the resolution which was made during the Colloquium of Industrialised Construction System in 1998, the CIDB eventually formed the IBS Steering Committee on 1999 for the effort to bring to the forefront all the IBS related issues in a framework to promote the greater usage of IBS in the construction industry and to drive the industry forward. The IBS Strategic Plan in 1999 was published as a result for establishment of this committee. After this significant effort in 2001, one early initiative was the introduction of the Modular Coordination Guideline for Building Designs ("MS1064") which is essential for the adoption of IBS in the industry. This guideline was a public-private joint effort towards standardisation through modular coordination. However, this guideline was not made compulsory. The Construction Industry Master Plan 2006-2015 (CIMP 2006-2015) has been published in December 2006 as means to chart the future direction of the Malaysian Construction Industry. The importance and effort to promote IBS is highlighted under Strategic Thrust 5: Innovate through R&D to adopt new construction methods such as IBS in the Construction Industry Master Plan 2006-2015 (CIDB, 2007).

These various significant efforts by the government to promote the usage of IBS as an alternative compare to the conventional method did not made significant progress. Therefore, the IBS Roadmap 2003-2010 was developed and published to steer the direction of IBS implementation and promotion activities, guide the practitioners and policy makers on IBS related issues in ensuring the global competitiveness of Malaysian construction players through the efficient and effective usage of IBS. It is a systematic and coordinated blueprint which is mainly focused towards achieving totally an industrialized construction industry for Malaysia and achieving open building systems concept

by the year 2010. The formulated roadmap is a comprehensive document that divided the IBS programme into a 5-M strategy (five main focus areas) that reflects the inputs needed to drive the programme which are Manpower, Materials, Management, Monetary and Marketing (CIDB, 2003).

The various efforts by the government to promote the usage of IBS such as IBS Roadmap 2003-2010 as a significant valuable alternative for construction industry on the end of 2010 did not achieve the goals of this roadmap. According to CIDB in Malaysia (CIDB, 2011), only one KPI (Monetary) out of the 5 measurable KPI's was achieved. The KPI's was categorized to Manpower (Reducing the percentage of foreign workers), Monetary (Enhancing the percentage of governmental construction projects using IBS), Materials (Increasing the numbers of IBS Manufacturers), Bumiputera Development (Increasing the numbers of Bumiputera IBS Manufacturers), Bumiputera Development (Increasing the numbers of Bumiputera IBS contractors or Installers). Hence, the new IBS Roadmap 2011-2015 is developed by CIDB under consultation with the industry players to chart the way forward for IBS industry. On the other hand, Construction Industry Development Board (CIDB, 2011) have emphasized on four policy objectives including quality, efficiency, competency and sustainability leading to a sustainable IBS industry that will eventually contribute to the competitiveness of construction industry in Malaysia. The main goals for this IBS Roadmap 2011-2015 were encapsulated below:

1. To sustain the existing momentum of 70% IBS content for public sector building projects through to 2015.
2. To increase the existing IBS content to 50% for private sector building projects by 2015.

3. CLASSIFICATION OF IBS SYSTEM IN MALAYSIA

In Malaysia, Construction Industry Development Board (CIDB, 2003) has classified the IBS system into 5 categories as follows:

i). Precast concrete framed buildings, ii). Precast concrete wall system,
iii). Reinforced concrete buildings with precast concrete slab, iv). Steel formwork system and v). Steel framed buildings and roof trusses.

4. ADVANTAGES AND DISADVANTAGES OF IBS

Despite its plausible advantages and systematic implementation plan established trough the IBS Roadmap, numbers of barriers were identified as

being potential hurdles to the implementation. One of the most important barriers to IBS Implementation in Malaysia is Awareness and Knowledge (Kamar et al., 2009). According to IBS Roadmap Review (CIDB, 2007) report, the adoption of IBS in Malaysia is a client driven. Client with a good knowledge and awareness of IBS benefit will surely encourage appointed designers to design building according to IBS. However, lack of awareness program to understand client needs and giving correct information on IBS has contributing to a lack of interest from the client and decision makers (Rahman & Omar, 2006). Relatively, the low labor cost in Malaysia is the main root cause of the construction industry failing to reform and being complacent with the current systems of IBS, which if implemented will eventually enhance the level of productivity, efficiency, quality and safety (CIDB; IBS Roadmap Review, 2007). However, to be competitive at the international level and become globalized, it is important for the Malaysia construction industry to evolve, be well organized and prepared. This aim will be facilitated and achieved through enhancing the productivity, efficiency, quality and safety of construction industry. The advantages and disadvantages of IBS can be also compared and justified with the conventional system, whereas, conventional construction methods that have proven to be more time consuming , wasteful, dangerous and messy are illustrated in table 2.

Table 2. Advantages and Disadvantages of IBS

Advantages of Industrialized Building Systems	**1. Achieving Higher Quality** through careful selection of material, use of advanced technology and strict quality assurance control (Thanoon et al., 2003).
	2. Faster Construction Time: Wisam (2005) asserted that faster completion of projects will be achieved due to advance off-site preparations and simplified installation process.
	3. High Cost Saving: Control in using materials, such as: steel, sand, and timber will contribute in savings in material cost and savings in labor cost that will ultimately result in substantial savings on the overall cost of the project (Bing et al., 2001).
	4. Reduction of Unskilled Workers and Fewer Site Workers: Warszawski, (1999) indicated that IBS and particularly prefabrication takes place at a centralised factory, thus reducing labour requirement at site.
	5. **Enhancing the Social Benefits:** Reducing the dependency on foreign workers and reducing the money outflow and their social problems, low quality works, delays, and diseases (CIDB, 2009).
	6. Increased Environmental and Construction Site Cleanliness: According to Wisam (2005), this could be achieved through reduction of construction material at site and reduction of waste materials at site duo to casting in factory.
	7. **Increasing the Safety:** Implementing IBS will promote safe and systematic factory working environment as minimal workers, materials and construction waste is required on-site (CIDB, 2003).

Disadvantages of Industrialized Building Systems	**1. Higher Initial Investment Cost:** IBS requires high initial investment capital for pre-casters to purchase new machinery, mould, importing foreign technology and wages of skilled workers (IBS Steering Committee, 2006; Thanoon et al., 2003; Rahman & Omar, 2006).
	2. The Industry is Uncompetitive Due to Lack of Open Collaboration: Contractors in Malaysia are obligate to close system and getting supply from the same manufacture throughout the construction (Chung & Kadir, 2007).
	3. Specialized Skills which Require more Time and Investment: This is due to intensive training and apprenticeship such as system integrator or assemblers (Thanoon et al., 2003; IBS Steering Committee, 2006; Rahman & Omar, 2006).

5. CONCLUSION

Industrialised Building Systems (IBS) is a construction process that utilizes techniques, products, components, or building systems which involves mainly the prefabricated components and onsite installation. Successful and effective implementation of IBS in Malaysia construction industry can offer various benefits compare to conventional in-situ systems. Those are: the speed of construction, less wastage of materials which means cost savings, reduction of unskilled workers, better quality control of construction, increased site cleanliness and safety in construction projects. These are very important aspects in achieving the efficient and effective construction industry which will enhance the market share of construction industry as well as contributing to the Malaysian economy. The government has done a lot of efforts to enhance the current conventional, labor-intensive activities to a more technologically advanced method of construction such as by developing the Industrialised Building Systems (IBS) through the Construction Industry Development Board (CIDB). The government had efforts in creating the 1st and 2nd IBS Roadmap to put Malaysia construction industry in producing fast, cost effective and high quality construction products and able to compete with the global construction market.

6. ACKNOWLEDGEMENT

The authors would like to thank Universiti Teknologi Malaysia for sponsoring this research through grant number Q.K130000.7140.01J58.

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