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CHAPTER 1

INTRODUCTION

1.1 Introduction

Through globalisation, so many information, knowledge, and technology can be shared and transferred easily across countries. Industrialised Building System (IBS) is one of the technologies which can be categorised as an old technology in developed country but yet considered as a new technology when reached developing countries such as Asian region.

Although the implementation of IBS in Malaysia has started since 1960's, it is only become popular in 1998 when Cabinet of Ministers endorsed IBS Strategic Plan as the blueprint for the total industrialisation of construction sector. Since the time, Construction Industry Development Board (CIDB) has been actively promoting the use of IBS in Malaysian Construction Industry. First step taken by CIDB was formulating IBS Roadmap which stated several strategies and aggressive steps to promote the used of IBS in Malaysia. The main purposes of introducing IBS at that time were to gradually reduce the dependency on foreign labours and to increase productivity.

Over past decade, the level of IBS usage is still very low even though its implementation has started since early 1960's in Malaysia. Construction industry practitioners seem like reluctant to use IBS as their construction method. In spite of that, Warszawski (1999) highlighted that by adopting IBS, some saving in manual

labour on-site can be achieved, increasing construction speed and providing higher construction quality. Thanoon *et al.* (2003) also underlined cost saving, faster construction time and improvement of overall construction quality as the result of IBS implementation. From evidences provided, it can be concluded that, the used of IBS so far gained a good reputation among the researchers in general, which fulfil the basic goal of construction; time, resources and quality.

Due to this circumstance, several studies have been done. Badir (2002) for example has studied on building system technologies in Malaysia and examined problems and constraints associated with this technology. The study concludes that the problems related to IBS technology were the higher initial capital investment and the needs for expert labour to deal with heavily mechanised approach in IBS. Therefore, extra cost was needed to train existing semi skilled labour to be highly skilled labour.

On the other hand, Chung (2007) has investigated on current awareness of the usage of IBS in Malaysia. Moreover his study has analysed ways to improve the implementation of IBS in terms of the current policy and guideline available to implement the usage of IBS in the local construction industry. The study focused on the usage of 50% of the IBS elements in terms of cost. The Strength, Weakness, Opportunity and Threat (SWOT) Matrix has been used when analysing the current scenario in the local construction industry and therefore the strategic implementation plan has been suggested in his study which stated government need to provide a governing body that is only in charge of the legislations, training, financing, controlling, research and development so that an effective strategy can be formulated and applies to all the parties involved.

Apart from that, critical success factor in adopting IBS for Malaysian Construction Industry has been studied by Noriwani (2008). The study focused on success factors and barriers for IBS adoption in Malaysian building construction industry. The information and data gathered through questionnaire and then processed using average index method. Based on the study, she has determined the most critical success factors in adopting IBS as meeting flexibility in choosing components, meeting client expectancy, and ensures market security for a long term.

Meanwhile, in technical aspect, providing clear design process was the critical factor in successful IBS adoption.

1.2 Problem Statement

IBS appears as the most suitable system to overcome several problems in construction industry especially overused of foreign labour and low productivity rate. Unfortunately, the level of IBS usage in local construction industry is only 15% in 2003 (CIDB, 2003a). In 2006, only 10% which is less than one third of total completed construction project using at least one IBS product (CIDB, 2007).

Moreover, Tan Sri Dato' Ir. Jamilus Hussein has stressed in his speech in Malaysian IBS International Exhibition 2009 that construction industry are still far from achieving the ideal objective as articulated in IBS Roadmap even though almost all activities identified in the roadmap has been implemented. Based on the Roadmap mid-term review, it is clearly stated that one of the most barriers is negative perception by the consumer and the practitioner. Even contractors whom experiences in IBS construction project before, reluctant to use IBS in their next project. Why is this so?

Do Malaysian Construction practitioner acceptances on IBS implementation inline with the researcher studies and government hope? If not, probably there is some gap between the IBS and construction industry which resulted on various problems when IBS is being implemented.

1.3 Research Aim and Objective

The aim of the study is to evaluate the effectiveness of current IBS implementation for Malaysian construction industry. To achieve this aim, the following objectives have been identified:

- i. To determine the level of IBS acceptance in construction industry.
- ii. To evaluate the problems of IBS implementation in construction industry.
- iii. To develop a strategy to promote the use of IBS in Malaysian Construction Industry.

1.4 Research Sampling

The construction industry in Malaysia consists of three main groups namely Client (owners and developers), Consultants (architects, engineers, surveyors), and Contractors (building and civil contractor). Basically, Client as the owner/developer is the organisation that will decide whether to use IBS or not. Thus, Client will appoint Consultants comprising planners, architects, engineers, surveyors who will convert Client intention to a project design by referring the existing IBS tools. The tools comprises IBS catalogues, Modular Coordination guideline, MS 1064 standard, and etc. Finally Contractor will construct the building according to the consultants' drawing and specification by applying their knowledge and experiences. As far as IBS work is concern, manufacturer becomes one of the important groups in construction industry as the fabricator and supplier of the component. For the purpose of this study, the sample will be chosen randomly according to the four groups explained above within limitation and scope assigned below.

1.5 Scope of Study

Random sampling will be done in assigned area, whom practicing Conventional Construction Method and Industrialised Building System Method. There are some limitations for this study;

- i. The information and data taken only covers projects within 2005 until now
- ii. Only covers IBS superstructure using precast concrete systems

- iii. Area for data collection confine within states of Johor, Melaka, Negeri Sembilan and Selangor

1.6 Brief Research Methodology

The study was conducted using literature method, interviews with expert panels and questionnaire survey. A literature search was carried out as preliminary study in gaining information about recent strategies, problems and challenges in implementing IBS. It is done by referring to many sources such as published books, articles in books, journals and papers, other published research works, academic and research magazines, newsletter, brochures and information from the internet. Then only followed by interviews with expert panels and distributing questionnaire survey.

Figure 1.1 explains the brief methodologies used in this study.



PTTA UTHM
PERPUSTAKAAN TUNKU TUN AMINAH

RESEARCH METHODOLOGY	ACTIONS	OBJECTIVES
<div style="border: 1px solid black; padding: 5px; width: fit-content; margin-bottom: 10px;">Secondary data</div> <div style="border: 1px solid black; padding: 5px; width: fit-content; margin-bottom: 10px; margin-left: 100px;">Survey Questionnaire</div> <div style="border: 1px solid black; padding: 5px; width: fit-content; margin-left: 100px; margin-bottom: 10px;">Interview Experts</div> <div style="border: 1px solid black; padding: 5px; width: fit-content; margin-left: 100px;">To develop new strategy to improve IBS in Malaysia</div>	<p>Stage 1: Research tools</p> <p>1. Search secondary data</p> <ul style="list-style-type: none"> - search for IBS and Malaysian construction industry concept in general - review of IBS implementation being practice nowadays - review IBS implementations in other country <p>2. Survey Questionnaires</p> <ul style="list-style-type: none"> - Develop survey questionnaires - Select sample frame - Determine the sample size for the survey - Determine the response rate <p>3. Interview Experts</p> <ul style="list-style-type: none"> - Develop a structure interview content - Determine which company to interview - Process structure interview - Time schedule and others <p>Stage 2 : Develop new IBS implementation strategy</p> <ul style="list-style-type: none"> - Together with secondary data, survey, and interview findings to develop a new IBS implementation strategy for Malaysian Construction Industry 	<p>To understand what IBS and MCI is all about</p> <p>To understand the existing IBS implementation strategy being used</p> <p>To find out any better way to implement IBS</p> <p>To identify IBS level of acceptance</p> <p>To evaluate any problems occur due to existing IBS implementation</p> <p>To evaluate the effectiveness of existing IBS implementation plan</p> <p>To find out any good ideas for better IBS implementation</p> <p>To develop new IBS implementation strategy for Malaysian Construction Industry</p>

Figure 1.1: Brief methodologies

CHAPTER 2

INDUSTRIALISED BUILDING SYSTEM

2.1 Introduction

This chapter will cover basic theories on industrialised building system such as definitions, characteristics, types of IBS, and advantages. This information is important to improve understanding on Industrialised Building System in general.

2.2 Definitions

To date, there are various definitions of IBS interpreted by researchers. Among the earliest one is Junid (1986) who described IBS as process by which components of building are conceived, planned and fabricated at factory, transported, and erected at site. The system combined software and hardware, including system design, which is complex process of studying the requirement of end user, market analysis, and the development of standardize component. Parid (1997) defined IBS as a system which use industrialised production technique either in the production of component or assembly of the building or both.

Rahman and Omar (2006) defined IBS as 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. The components are manufactured offsite and once completed will be delivered to construction sites for assembly and erection. Chung and Kadir (2007) defined IBS as a mass production of building components either in factory or at site according to the specification with standard shape and dimensions and transport to the construction site to be re-arranged with certain standard to form a building.

Nonetheless, IBS Roadmap (2003) defined IBS as a construction process that utilises techniques, products, components, or building systems which involved prefabrication works (off-site or on-site) under controlled environment, transported, positioned, and on-site installation with minimum site works.

2.3 Characteristic of IBS

To date, there are various characteristic of IBS identified by researchers. Among the accepted one is stated by Thanoon *et al* (2003) which consist of closed and open system, modular coordination, standardization and tolerance, mass production, specialization, good organization, integration, production facilities, transportation, and equipment.

According to Warszawski (1999), IBS can be characterised as prefabrication of as much as possible building elements and components offsite, within central facilities through specialised equipment and organization. Then the components will be assemble to site, and involved extensive mechanized handling with minimum task. A part from that, IBS involved integrated design, production and erection work on site which needs to be planned and coordinate accordingly.

Considering the above characteristics, CIDB (2003b) have summarised IBS characteristics as;

- i. Industrial production of components through prefabrication or highly mechanised on site processes
- ii. Reduced labour usage both at prefabrication stage and onsite work.

- iii. Modern design and manufacturing method through Computer Aided Design (CAD) and Computer Added Manufacturing (CAM)
- iv. Applying Systematic Quality Control throughout the process of IBS project implementation
- v. Open Building system which allows hybrid application, and adaptable to standardization, tolerance and modular coordination.

2.4 Types of IBS

IBS can be classified into five common types based on structural aspects of the system which are;

- i. Type 1: Precast Concrete Framing, Panel and Box Systems - includes precast concrete columns, beams, slabs, walls, "3-D" components, permanent concrete formworks, etc.

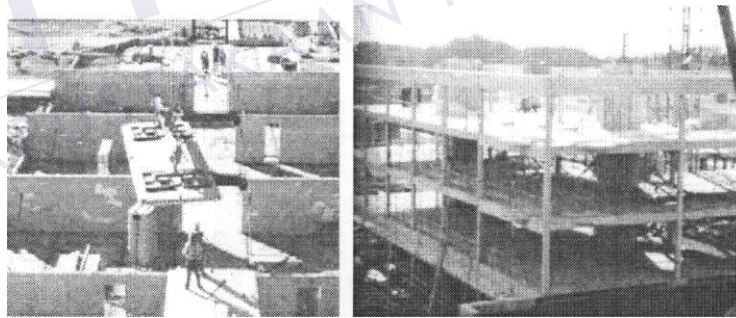


Figure 2.1: Precast Concrete Framing and Wall Systems

- ii. Type 2: Steel Formwork System - includes tunnel forms, tilt-up systems, beams and columns moulding forms, and permanent steel formworks



Figure 2.2: Steel Formwork System

Type 3: Steel Framing System - Steel beams and columns, portal frame systems, roof trusses, etc.

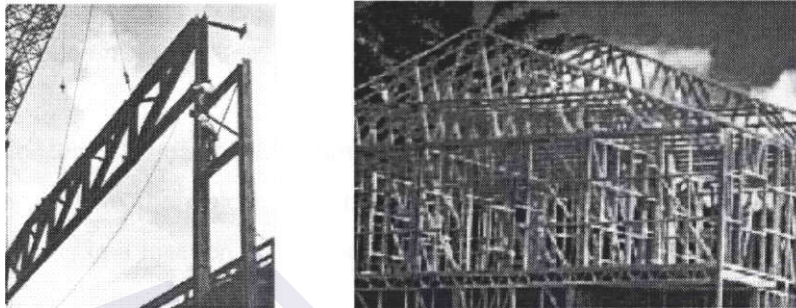


Figure 2.3: Steel Framing System and Roof Trusses

Type 4: Prefabricated Timber Framing System - Prefabricated timber trusses, beam and columns, roof trusses, etc.

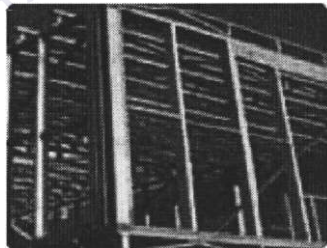


Figure 2.4: Prefabricated Timber Framing System

Type 5: Block work Systems - includes interlocking concrete masonry units and lightweight concrete blocks.

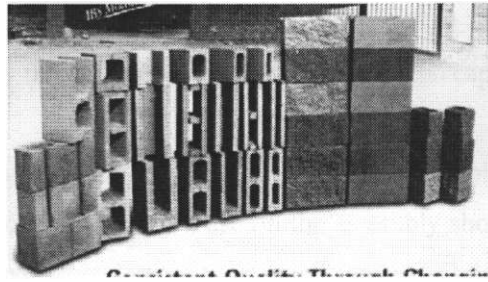


Figure 2.5: Types of Concrete Masonry Units

2.4.1 Precast Concrete

The concept of precast (also known as prefabricated) construction includes those buildings where the majority of structural components are standardised and produced in plants in a location away from the building, and then transported to the site for assembly. These components are manufactured by industrial methods based on mass production in order to build a large number of buildings in a short time at low cost. The main features of this construction process are as follows:

- i. The division and specialisation of the human workforce
- ii. The use of tools, machinery, and other equipment, usually automated, in the production of standard, interchangeable parts and products

This type of construction requires a restructuring of the entire conventional construction process to enable interaction between the design phase and production planning in order to improve and speed up the construction.

2.4.1.1 Production Processes

Based on Ali (2006), there are six stages of pre-cast concrete production process namely; 1) Preparation, 2) Casting, 3) Curing and treatment, 4) Stripping and

demoulding, 5) In-process check, and 6) Lifting and handling. All of those stages will involve with so many machineries which needs really high capital cost.

Preparation stage for example, involved mould assembly and reinforcing cage. At first, a person with similar expertise on the assembly should be present. He needs to produce trial cage which suit the provided mould. Only the final suitable tied or welded reinforced cage with no displaced and distorted while handling and casting operation will be assembled into the mould. Then these will followed by next process.

Stage 2 is casting which can be considered as major process in production of IBS components. It can be divided into 3 elements which are; 1) Concrete mixing, 2) Concrete supplying, and 3) Concrete pacing and compacting. The concrete mixing system in a prefabrication plant includes several components such as aggregate bins that store separately the various aggregates used for concrete production, feeding mechanism consisting of scrapers, conveyors, hoists, and so on, which transfer aggregates scales and then to mixers, cement silo and a conveyor screw that transfer cement from the silo to the cement scales and a mixer - horizontal or vertical - where the aggregates, cement, and water are mixed and then discharged to concrete carrying vehicles. Then only transferring concrete to the mould using vehicles such as wheel-mounted bucket or crane will take place.

The process explained that production processes taken by manufacturer were really involved with very high capital cost and messy task. It becomes one of the major problems in implementing IBS nowadays and explained why there are lacks of manufacturers distributed all over the country.

2.5 Advantages

There are several advantages on implementing IBS. In general, IBS is a highly mechanised system thus the produced system would be more accurate. In

addition, higher quality controlled in production processes at factory ensures higher quality of final components produced. Furthermore, reduction of construction materials at site provide cleaner and safer construction site.

In term of cost, IBS promised for low site workers requirement due to simplified construction methods and elimination of conventional timber formwork which can reduce wastage and redundant cost in construction. Moreover, there will be no delay due to bad weather and manpower; work can be done concurrently at factory and at site hence speed up construction works. Thus, faster completion of construction project can be achieved.

In a view of researchers, Warszawski (1999) highlighted that by adopting IBS, some saving in manual labour on-site can be achieved, increasing construction speed and providing higher construction quality. Thanoon *et al.* (2003) also underlined cost saving, faster construction time and improvement of overall construction quality as the result of IBS implementation. From evidences provided, it can be concluded that, the used of IBS so far gained a good reputation among the researchers in general, which fulfil the basic goal of construction; time, resources and quality.

2.6 Summary

This chapter has explained roughly the theories on industrialised building system. It helps the students and researcher to understand what is IBS and why it being implemented in this industry.

CHAPTER 3

CURRENT INDUSTRIALISED BUILDING SYSTEM (IBS) IMPLEMENTATION

3.1 Introduction

Malaysian construction industry is very popular with a dirty, difficult, dangerous, and highly intensive industry. This has led towards low productivity and inefficiency of work at construction site. The highly dependency on unskilled and cheap foreign workers has definitely contributed to low productivity of work because even though they are cheap, they are not efficient and results in high degree of wastage. Moreover, statistic from Bank Negara shows that almost RM 9.1 billion had been transferred from our country by foreign workers to their country until end of June 2008. In addition, the quality of work has also been badly affected due to unskilled working method. After completion defects, structural failures and design inadequacies are some of the common scenario in our country.

According to CIDB (2000), complaints made by consumers through national media and authorities are stated that some of the numerous indications on low quality of construction products. At the end, it leads to low quality of life with uncomfortable and unfriendly environments of building. Furthermore, with the Government's announcement for more affordable housing through budget 2005, the construction industry is now compulsory to fulfil national housing and commercial programs which has eventually affecting the quality of work.

Although the long-introduced Industrialised Building System (IBS) has promised to solve and improved the current construction method and scenario in our country, however the IBS method is still low in gaining popularity. These may be due to lack of awareness and coordination among the relevant parties. Currently, the level of usage of IBS method is very low as compared to the conventional methods in building construction. Despite of its many benefits, the different perceptions among the construction players and practitioners towards its application in construction industry has led to the low usage of IBS components in the construction industry. The question on how far IBS method can contribute towards reducing the total construction period, the efficiency of the assembling and erection processes at site and the production stage still lingers on and remains unanswered. At the end of the day, the IBS method remains unknown and unfamiliar to the local construction industry.

Currently, public buildings in Malaysia are still widely constructed using the conventional Cast-In-Situ method. Many problems are associated with the conventional method, since the traditional brick and mortar give low and inconsistency quality since workmanship plays the main role, in which again relying on the skills of the foreign unskilled workers. With poor quality control at site, common problems such as project delay and possible monetary losses are a constant headache for the Client. Late delivery of work will often result in late occupancy of the building, and this often caused insufficient for public facilities. Thus, recently in 2009, Malaysian Government is making the construction industry compulsory to use IBS in government projects. For the start, the government insists that the building shall have at least 70% IBS components in each of their project.

3.2 Critical Success Factor in Implementing IBS

Although promotions on IBS as the construction method in Malaysia has been extensively done for several years starting from 2003 when IBS Roadmap being introduced, however the level of IBS usage is still consider as low compared to other country. So many factors which affect the usage of IBS have been identified by

researchers especially by CIDB, who's responsible to make sure Malaysian Construction Industry become more competitive. Among the factors that are critical in IBS implementation are demand and market factors, government initiatives, and availability of expertise in IBS (Thanoon et al, 2003; David, 2000). All of these factors will be thoroughly discussed in this sub topic.

3.2.1 Demand and Market Factor

This is one of the main factors which affecting the used of IBS in construction industry. This is because, if there is no demand from the customers (e.g. clients, developers, government, or personal financial funded), there will be no project, neither conventional, nor IBS. In United State for example, a study on prefabrication for construction industry has started since early 1900. And until 1940, the respective parties were still struggling to developed prefabrication technologies. Only after the war period (1940 - 1945), the prefabrication being used extensively when government spent massive investment into very large settlement residential projects to overcome the problem of housing shortage. Then only the signs of prefabrication's growth showed up in United State (Kelly, 1951).

In Malaysia, projects which used IBS as a construction method mostly categorised as a mass project which involved thousands unit of houses for residential projects or more than 10 stories high-rise building. If not, the project must be government funded project such as schools project, government quarters, or commercial buildings, with special purposes. A survey done by CIDB in 2005 (CIDB, 2005) on the architect shows that 67% of IBS project is government funded projects.

Due to this fact, government have made a final decision on October 2008 through a new circulation stated that the use of IBS for government project is compulsory effective on the circulation date. Even the project being awarded before the date, it would still compulsory to use IBS. This measure is purposely done to increase the demand of IBS in construction industry.

3.2.2 Government Initiatives

A government initiative is really important as a step to promote, guide, facilitate, and reduce the burden on the contractors while implementing a new technology, IBS in this case. In Malaysia, government through its construction arms (CIDB and JKR) has done so many things to ensure successful IBS implementation as targeted in IBS Roadmap. Among all, guideline or manual for the construction industry's practitioners such as Modular design guide, IBS Score Manual, Manual: IBS implementation for government project, and Construction Industry Standard (CIS). To promote IBS, IBS digest has been published and being distributed freely through CIDB's website. Moreover, Malaysian International IBS Exhibition has been organized two times (2006 and 2009) to provide a platform for all construction industry players and IBS practitioners to built network, share ideas, and discover the latest state of IBS technology. Not enough with organising international exhibition, by accompanied with *Pusat Khidmat Kontraktor* (PKK) and Ministry of Entrepreneur and Co-operative Development (MeCD), CIDB has also organised road show on IBS as a vendor development programme to tighten supply chain in IBS industry.

Although a lot of facilities have been provided such as 'IBS one step centre', 'IBS Orange Books', 'improve the policies through UBBL and Malaysian Standard (MS1064 Part 1-10)', and 'development of IBS village at Cheras', however, there is still various loops need to be covered to achieve a successful IBS implementation.

3.2.3 Availability of IBS expertise

Lack of expertise is another reason why IBS is not being used extensively until now. The current civil engineering and architecture curriculum rarely state IBS as one of compulsory subjects to be taken by student while taking their degree at university. As a result, there are only a few professionals that can be claimed as experts in precast concrete systems. Consequently, this may lead to poor design, 'plant management and production', and erection practices.

On the perspective of manufacturers, lack of competence can cause failures in the production stage that in turn may cause delays in the erection schedule. These affect not only the manufacturer but also the contractor, because they avoid contractor from gaining profit through short construction period. On the other hand, lack of expertise on behalf of the contractor can cause delays in the erection schedule, even if the components are delivered to site on time.

Finally, the designers with expertise in precast concrete systems have no choice and inevitable to used conventional method to avoid the use of these systems. Actually in terms of structural analysis and design of precast concrete components, there is not much different with conventional reinforced concrete structure, but an important issue when applying IBS is joint analysis and design. The manufacturers normally in charge on this matter, but conflicts of responsibility often arise between manufacturers and designers.

Even though IBS roadmap has suggested on IBS curriculum in universities since 2003, until now the syllabus is yet to be implemented. This is because there is no directive from the Department of High Education and difficulties to include new subject in the existing curriculum syllabus (Fauzi, 2009). It appears that teaching the know-how of industrialised building systems is not at the top of educational institution's priority lists since it is still complicated to include IBS in existing architecture or engineering curriculum.

However, academic community has started to discuss on IBS and Modular Coordination. Even more students has started to study on IBS and arranged visits to IBS centre, IBS manufacture, and IBS project. These indicate some improvement in community to achieve higher knowledge on IBS.

3.3 IBS in Practitioners Perspective

There are four key players of construction industry consist of contractor, consultant, client, and manufacturer. Each of them involved with IBS

implementation in different ways but sometimes within the same scope of works. For example between manufacturer and designer, both of them involved with design works but in different stage of works. This may lead on conflict among them. Detail key players perspective on IBS implementation will be covered in next sub topics.

3.3.1 Manufacturer Perspective

The contribution of manufacturer in IBS project not only limited to manufacture the product but also involved with the whole processes including planning, design, project management and implementation. Taking the experience of Setia Precast Sdn Bhd as an established precast concrete manufacturer, first thing to do is converting the conventional design into more comprehensive design needed for precast construction. Then only production work will take place and followed by transporting, erecting, and joining the elements. That is means, even though they are manufacturer, the scope of work being covered is really wide compared to manufacturer for conventional construction method who's only responsible to supply materials for contractor.

3.3.2 Client Perspective

It has been widely recognised that client tend to be the most important party in improving the used of IBS in construction industry. Unfortunately, there are lists of barriers which overcome client enthusiasm to used IBS. First issue is availability of manufacturer capacity to provide IBS product. As been published in Orange Book, ten out of fifteen precast manufacturers located around Selangor and Kuala Lumpur and only five distributed in other states. More worsen, only several of them produce complete set of IBS components. That is why client need to reconsider their decision to use IBS for their projects.

In addition, Malaysian construction industry scenario itself did not helped at all to implement IBS. This is due to Malaysian 'island mentality', and lack of integration and collaborative approach which restrict the development of IBS. Moreover, project leadership and site management issues in developing IBS industry are lack of standard and certification as guideline for products, process, and short of specialist crew have increased the barriers.

Furthermore, the client is already known as performance and cost driven in developing a project. However, there is an inherence fear of IBS through past experience even though those problems are already solved by now.

3.3.3 Consultant Perspective

Currently, the used of Modular Coordination in designing precast structure is very rare. Most of civil and structure consultant (C&S) will be appointed by contractor who have win Design and Built tender on IBS project. Based on architectural drawing, structural drawing will be produced traditionally but stress more on joining element. Usually, joining element and component will be suggested by manufacturer and C&S consultant will just follow the suggestion. This circumstance sometimes may lead to redesign works which means increased in design cost.

Moreover, current technical solutions including Modular Coordination, Malaysian Standard and Precast Catalogue are not sufficient to suit traditional procurement process and that finally affect the preference of designer on traditional method.

3.3.4 Contractor Perspective

On behalf of contractor, there is no doubt that they are already comfort with their working environment which indeed explained why they are reluctant in changing the method of construction from conventional to IBS. Historically, most contractors already have permanent relationship in supply chain, sub contractors, and clients who are the main contributors for their projects. Moreover, even though they are willing to change, greater incentives for training purposes are needed which means higher cost to start implementing IBS. In spite of these, unclear method statement and control process for IBS project worsen the situation and limit the willingness of contractor to change. At this circumstance, client roles are really important in order to make the IBS method compulsory. Then only contractor are agreeable to change.

3.4 Conventional Project Implementation

According to Bannet and Grice(1985), conventional construction approach is based on a rigid separation of design and construction. The design team prepares detailed drawings, specification and Bill of Quantity. The tender documents are prepared and the contract will be awarded to the winning bidder among the contractors. The contractor will then construct the projects by using subcontractors. Conventional construction method involves construction work which mostly being carried out at site. It involves site preparation by fellow contactors before the laying of the footings. The foundation is then built on the footings, to the working level which is above the ground level. The building is then made on the foundation. Usually a floor is laid on the foundation. Then, beams will be constructed, followed by the construction of columns and slabs. When necessary, staircases will be constructed, and eventually roof beams are constructed, followed by the construction of rooftrusses. When the roof is to be framed on the site, the top sill plate is nailed on top of the wall sections. Cutting and nailing each piece of wood one at a time takes a lot of time. Not only each piece must be cut but even worse, each piece needs to be carried up the ladder to the right place.

Water proofing materials will be placed to ensure the roof is water proof before roof tiles are placed in position. Brick walls will be constructed where necessary, with allocations for the placement of doors and window panels. Painting and aesthetic decoration on walls and floor slabs will follow up and a complete end product will be on-site then.

Undoubtedly, with so much on-going works exist on site, many skilled and unskilled workers are needed to carry out on site tasks. Formwork has to be constructed to specified dimensions and next, concrete casting will take place when all the formworks and reinforcements have been properly laid. Weather is a common factor that affects the working schedule on site, and as usual, material wastage will be common problem faced by contractors. Conventional construction method requires proper planning and scheduling to ensure that the work is within the progress schedule. Due to many uncertainty and risk of wastage at site, close watch on the cost of the construction project is essential to minimise any risk due to increment in construction cost for the entire project.

3.5 CIDB Roles Through IBS Centre

In order to ensure the successful of IBS Roadmap 2003-2010, it is vital that the IBS Centre becomes one-stop reference centre regarding IBS for both government and private sectors. This will promote knowledge sharing and facilitate better cooperation among the stakeholders. Several key programs have been planned and implemented; based on a development framework that is divided into two components.

The first component is the Capability Building that is based on Soft Aspects (Knowledge Development). While Soft Aspects are being emphasises, the importance of the Hard Aspects are also being acknowledge. The second important is the Capacity Building which is based on Hard Aspects (Technology & Physical Projects Development). Activities in IBS Centre are being executed based on the five main thrusts of the IBS Centre comprise of: (1) IBS Industry Planning; (2) IBS

Promotion and Marketing; (3) IBS Technology; (4) IBS Certification and Verification; and (5) IBS Training.

One of the main functions of IBS Centre is to act as the main secretariat of IBS Roadmap and industry coordination. The implementation of IBS in Malaysia is being monitored by the Construction Industry Master Plan (CIMP) Committee as well as the IBS Steering Committee. Both committees are represented by relevant government agencies as well as industry leaders. IBS Centre also supports partnering (joint venture) developments and functions as a gateway to market IBS products domestically and internationally. In supporting the National Mission, Bumiputera development programs are also being emphasised.

For promotion and marketing purposes, the programs being organised are related to seminars, road shows, promotional activities and knowledge sharing sessions. Other than activities involving with the industry players, it also involves development of IBS Centre as a proactive role in supporting the human capital development needs and also IBS Showcase. The IBS Showcase is equally important as it offers Malaysia's largest external display of IBS components' application.

While industry planning and knowledge development is being given main priority, the hard aspects of IBS are also being addressed by IBS Centre. CIDB Malaysia, through CREAM, supports research and development as well as technology transfer programs by local experts. Since 2007, a total of RM19.13 million has been provided for the IBS researchers. The development of IBS-related Malaysian Standard (MS) and Construction Industry Standards (CIS) as well as design systemisation exercises are also being supported by the IBS Centre. It also offers a special incubator program for local IBS technical entrepreneurs as well as general technical IBS advisory services to the industry.

Not to be ignored, the IBS Centre also handles the evaluation, certification and registration of IBS players in Malaysia. Currently, the IBS Status program is offered to IBS manufacturers, consultants and contractors. This initiative is essential in avoiding inferior service providers and manufacturers from affecting the initiative. The IBS Status program is not restricted to verification exercises only as it can also

be used to support incentives programs. Until today, a total of 119 IBS manufacturers are registered with IBS Centre. Out of that, 26 companies are verified and included in the IBS Manufacturers Status List. As for consultants currently there are 16 Quantity Surveyors, 26 architects and 52 engineers company have been listed in the IBS Consultant List 2008.

Human capital development programs through trainings are also a strong focus area for the IBS Centre. IBS Centre is playing a proactive role in supporting the human capital development needs through continuous and well-structured programs. There are always monthly training programs provided by CIDB for construction practitioners who are interested in starting IBS business. More than that, there are also training program provided for fresh graduate who are interested to learn more on IBS including planning and management, technical matters, and design skills.

3.6 IBS Implementation

Implementation stage carries largest scale of project life cycle including variety of physical work such as design, fabrication work at factory, logistics task (e.g. transportation, supply chain management, vendor), installation and erection work at site, and commissioning.

In the other words, there are several activities of implementation which can be categorised as upstream activities and downstream activities. Upstream activities can be list as design, planning, and production works. On the other hand, procurement system, supply chain, transportation system, legislation and regulation can be classified as downstream activities in implementing IBS. Different activities of a project can proceed subsequently with different speeds in design and consequent stages, but all must come together in testing and commission stage for the finish building.

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