COMPARING CONVENTIONAL TO INDUSTRIALISED BUILDING SYSTEM CONSTRUCTION COSTING: A CASE STUDY OF SCHOOL BUILDING PROJECTS

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"Dedicated to my beloved mother, father and siblings"

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ABSTRACT

The Malaysia construction industry is undergoing a transitional change from a project based industry to a more systematic and mechanized product based technology which is Industrialised Building system (IBS). IBS construction method can increase productivity and quality of work through the use of systematic machinery, equipment, materials and extensive pre-project planning. However, cost impact appears to be major hindrance in preventing the contractor to use IBS. The perceived high cost of IBS solutions, unless balanced by an understanding of value, will result in a continued reluctance by the industry to be more fully embrace the approach. As such, good cost comparison data and a holistic and thorough valued-based comparative system is required by the industry to ascertain the true benefits of IBS for the particular project settings to support decision making in opting IBS over the conventional system. The construction cost of a building using IBS should be assessed in its overall context of product. There is saving in time. Also, if properly designed and executed, precast method can lead to much better quality of work. The overall cost impact of IBS construction, therefore, has to take all these factors into consideration. Therefore, the objectives of this study is to propose a comparative cost study of IBS versus conventional system of school building construction projects by using Elemental Cost Analysis technique. Then, study on the effectiveness of IBS school building projects in term of cost, time and improvement in construction productivity will be carried out. The data required for these case studies was generated through interviews. From the results of the case studies undertaken, it can be concluded that even though building cost of IBS school project is higher than conventional system but IBS offer better quality in term of improving productivity and quality, faster construction time for completion and occupation and manage to complete within cost of the projects. Hopefully, this research study help to support decision making in opting IBS over conventional method and to overcome the main barrier in increasing the use of IBS.

ABSTRAK

Industri binaan Malaysia kini sedang mengalami perubahan peralihan dari industri yang berasaskan projek kepada industri binaan berteknologi berasaskan produk yang lebih sistematik dan mekanisasi iaitu IBS. Kaedah pembinaan secara IBS boleh meningkatkan produktiviti dan kualiti kerja melalui penggunaan mesin, peralatan, bahan binaan dan perancangan pra-projek secara menyeluruh dan sistematik. Walau bagaimanapun, impak dari segi kos ternyata menjadi halangan utama yang menghalang kontraktor untuk menggunakan IBS. Penyelesaian terhadap tanggapan kos IBS yang tinggi, kecuali jika diseimbangkan dengan pemahaman nilai, akan membawa kepada keengganan yang berterusann oleh pihak industri untuk menerima sepenuhnya pendekatan ini. Oleh itu, data perbandingan kos yang bagus dan sistem perbandingan berdasarkan nilai secara holistik dan menyeluruh diperlukan oleh indutri untuk menentukan manfaat sebenar sistem IBS bagi sesuatu projek tertentu dalam menyokong keputusan untuk memilih IBS berbanding sistem konvensional. Kos binaan bangunan menggunakan IBS harus dinilai dalam kontek produk secara keseluruhannya. Terdapat penjimatan dari segi masa binaan. Juga, jika direkabentuk dan dilaksanakan dengan betul, kaedah pra-tuang ini mampu manghasilkan kualiti kerja yang lebih baik. Keseluruhan impak kos bagi pembinaan secara IBS, untuk itu, perlu mengambil kira dan mempertimbangkan kesemua faktor ini. Oleh itu, objektif kajian ini adalah untuk mengusulkan satu kajian komparatif kos bagi IBS versus konvensional sistem untuk projek binaan bangunan sekolah dengan menggunakan teknik Analisis Kos Elemen. Kemudian, kajian mengenai keberkesanan dari segi kos, masa dan peningkatan dalam produktiviti binaan bagi projek pembinaan bangunan sekolah yang menggunakan kaedah IBS akan dijalankan. Data yang diperlukan untuk kajian ini telah diperolehi melalui sesi temu bual. Dari hasil kajian kes yang dijalankan, dapat disimpulkan bahawa walaupun kos bangunan bagi projek sekolah yang menggunakan kaedah IBS lebih tinggi daripada

sistem konvensional namun IBS menawarkan kualiti yang lebih baik dari segi peningkatan produktiviti dan kualiti binaan dan tempoh pembinaan yang lebih cepat untuk disiapkan dan diduduki dan berupaya dibina dalam kos projek yang ditelah ditetapkan. Semoga, kajian ini dapat membantu dalam menyokong keputusan untuk memilih IBS berbanding sistem konvensional dan dapat mengatasi halangan utama dalam meningkatkan penggunaan IBS.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

The Malaysian construction industry plays an important role in generating wealth to the country and development of social and economic infrastructures and buildings. The construction industry is one of the productive sectors that constantly contribute to the economy (Kamar et al., 2009). Since the 1990's, the contribution of the construction sector to the GDP also fluctuated albeit at a more stable rate varying from a high of 4.8 percent in 1997 to an estimated low of 2.7 percent in 2005 (CIDB, 2008). This shows that the demand for construction is highly sensitive to the developments in other sectors of the economy. Recent data showed that the construction sector growth at 5.3% in 2007 and contributed 2.1% total Gross Domestic Product (GDP) of Malaysia (CIDB, 2008).

Nonetheless, the industry is under a constant pressure to improve its performance. As in the conventional construction which is a common practice in Malaysia, reinforced concrete frame and brick, beam, column, wall and roof are cast in situ using timber framework while steel reinforcement is fabricated offsite. This method

is labour intensive involving formwork fabrication, steel bending and concreting. It requires many wet trades on site such as skill carpenters, plasterers and brick workers. The process can hamper by quality issue, unfavorable site condition, skilled labour shortage and bad weather conditions (Kamar et al., 2009).

Whereas, Malaysia's housing policy is geared toward meeting the objective of ensuring access to adequate and decent shelter to all citizens, particularly the low-income groups (Badir et al., 2002). It is predicted that between years 1995 to 2020, Malaysia will need a total of 8,850,554 houses, including 4,964,560 units of new housing, to cater for the increase in population during this period (Yoke et al., 2003). Unfortunately, only 1,382,917 units were constructed under the Sixth and Seventh Malaysia Plans. This means that another 3,581,643 units need to be built within the next twenty years to meet targets (Nawi et al., 2010). The achievement are somewhat disappointed with only 20% completed houses reported despite numerous incentives and promotions to encourage housing developers to invest in such housing category (Ismail, 2001).

Majority of the developers and contractors are still using the conventional building system method which could not cope with the huge demand. Therefore, the former system must be replaced by an industrialised building system (IBS) which has immense inherent advantages in term of productivity, indoor quality, durability and cost (IEM, 2001). Haron et al. (2005) highlighted that, the Malaysia construction industry is undergoing a transitional change from an industry employing conventional technologies to a more systematic and mechanized system employing the latest computer and communication technologies. This is vital for the future health of the industry, given the trends towards global competition and the advent of the k-economy.

The Industrialised Building Systems (IBS) is a construction process that utilises techniques, products, components, or building systems which involve prefabricated components and on-site installation (CIDB, 2003a). The IBS systems as defined earlier are not new in Malaysia. Local IBS industry has began since early 1960's (Thanoon et

al., 2003). Accroding to Nawi et al. (2010), despite the introduction of IBS in Malaysia was over 40 years ago, the pace of implementation is still slow. A survey carried out in 2003 by Construction Industry Development Board (CIDB) Malaysia showed that the usage level of IBS in the local construction industry was only 15% (CIDB, 2003b).

Since the demand of building construction has increased rapidly, it is necessary to innovate a construction method, which speeds up the building construction process. To sum-up, in general, the IBS is a methodology whereby a local construction industry is driven towards the adoption of an integrated and encouraging key players in the construction industry to produce and utilize pre-fabricated and mass production of the building at their work sites. This will help to enhance the efficiency of construction process, allowing a higher productivity, quality, time and cost saving (Haron et al., 2005).

In an attempt to understand the poor diffusion of IBS, some researchers have investigated the barriers for effective IBS implementation in construction. Reconciling the relevant literature, these IBS barriers can be categorized into five main themes: cost and financial, skills and knowledge, procurement and supply chain, perception from customers and professionals and lack of government incentives and promotion (Nawi et al., 2010).

Cost impact is appears to be the major hindrance in preventing the contractor to use IBS. The belief that using IBS is more expensive than traditional construction is clearly the main barrier. (Goodier & Gibb, 2004), Even though the large proportion of construction practitioners preservely thought that one of the advantages of using IBS was both a reduced in initial cost and reduced whole life cost, the decision required to choose one method of construction over another is too often based on cost rather than value (Blismas et al., 2006).

The construction cost of a building using IBS should be assessed in its overall context. The traditional method of costing by material quantities with a fixed factor for labour cost can lead to incorrect estimation. For example, if labour usage is halved, this will more than compensate for a 10 percent material increase. More importantly, there is saving in time. Also, if properly designed and executed, precast method can lead to much better quality of work. The overall cost impact of IBS construction, therefore, has to take all these factors into consideration. With the rising costs of labour and less assurance of dependable skilled manpower, the trend is that IBS construction will become increasingly competitive as compared to cast-in-situ construction (CIDB, 1997).

1.2 Problem statement

With the ongoing construction trend in Malaysia, that is still very comfortably use of conventional methods of construction and with the Government's call for more affordable housing and other type of building project, the need to switch for IBS methods seem to be the vital measure. IBS offers benefits in term of cost and time certainty, attaining better construction quality and productivity, reducing risks related to occupational safety and health, alleviating issue on skilled workers and dependency on manual foreign labour and achieving ultimate goal of reducing overall cost of construction (Kamar et al., 2009). Despite the well-rehearsed benefits of such technologies and the introduction of IBS in Malaysia was over 40 years ago, the pace of implementation is still slow.

The highly dependency on unskilled and cheap foreign worker and has directly contributed to low productivity of work, because although they may be cheap, but they are not efficient and cause high wastage. The quality of work has also been terribly affected due to unskilled working method. Table 1.1 shows that, in 2008 our dependent

on foreign construction workers in Malaysia is still high which more than 300,000. Although the number is less than local construction workers but relatively the number is considerably on the high side. While the Figure 1.1 below show the percentage of construction foreign worker of every state in Malaysia.

Table 1.1: Sector of Construction Worker Statistic in Malaysia (2003-2008) (CIDB, 2011a).

	2003	**2004**	**2005**	**2006**	**2007**	**Mac 2008**
Local Workers	224,877	272,053	309,528	350,831	377,243	352,694
Foreign Workers	231,184	265,925	281,780	267,809	266,742	316,559
Total	456,061	537,978	591,308	618,640	643,965	669,253
% Foreign Workers	51%	49%	48%	43%	41%	47%

Negeri	Purata %
Selangor	97
Wilayah Persekutuan K. Lumpur	95
Melaka	86
Pahang	76
Johor	73
Negeri Sembilan	62
Pulau Pinang	52
Sabah	48
Perak	48
Kedah	36
Terengganu	24
Kelantan	17
Perlis	13
Sarawak	6
Purata Negeri	52
Purata Tapak Binaan	54

Figure 1.1: Percentage of Foreign Construction Labour by state in Malaysia (2005-2006) (CIDB, 2011a).

CIDB strongly supports the use of labour-reducing systems in order to reduce the dependency on foreign labour in the local construction industry. Besides increasing the outflow of Ringgit to foreign economies, dependency on foreign labour brings about several negative impacts to the nation within the social and cultural context (CIDB, 2003b).

The belief that using IBS is more expensive than traditional construction is clearly the main barrier to the increased use of IBS (Goodier & Gibb, 2004). There continues to be a climate, within construction, of benefit evaluation based almost solely on cost. Nonmonetary benefits and disbenefits of the construction process are merely alluded to, or disregarded (Blismas et al., 2006).

Blismas et al. (2006) further explained that, the discrepancy between current evaluation systems and the identified benefits of IBS provide a convincing argument as to why IBS is not widely adopted. A more holistic and thorough value-based comparative system is required by the industry to ascertain the true benefits of IBS for particular project settings. In addition, the cost aspects need to be more thoroughly addressed to cover all product, project and whole-life costs.

Surveys done among construction practitioner stated that honest comparative cost data of IBS versus traditional construction and comparative costs of different IBS systems would be the most useful information. They like to be fully informed of all the facts before they make strategic decisions and until information on IBS is freely and clearly available then the key decision makers will either think the IBS industry has hidden costs to hide or they will use a construction solution for which information is already plentiful and available (Goodier & Gibb, 2007).

The perceived high cost of IBS solutions, unless balanced by an understanding of value, will result in a continued reluctance by the industry to more fully embrace the approach (Blismas et al., 2006). The negative past images of IBS need to be addressed

and overcome and more transparent information is required for the decision makers in the construction process, particularly that relating to clear cost comparisons with traditional methods. Some practitioners believe that one of the advantages of using IBS is a reduced initial and whole life cost. Further investigation is obviously required in this area in order for decision makers to make an informed decision (Goodier & Gibb, 2007).

Most decision makers will use construction solution for which information is already plentiful and available whereas they will think that IBS has had a hidden cost to hide (Goodier & Gibb, 2007). As such, good cost comparison data and format must be developed to support decision making in opting IBS over the conventional method (Blismas et al., 2003).

1.3 Objective of Study

The objectives of this study are as follows:

i. To identified in general the method of construction cost comparison in construction industry.

ii. To propose a comparative cost study of IBS versus conventional system of Public Work Department (PWD) school building construction projects.

iii. To study the effectiveness of IBS in term of cost, time and improvement in construction productivity of PWD school building projects.

1.4 Scope of Study

The main scope of this study is focusing on cost of IBS and conventional school building construction projects. Then, study the effectiveness of IBS school building projects in term of cost, time and improvement in construction productivity. The research parameters are presented as below:

i. The school building projects is under the execution of PWD (Building Division-Education Section) Malaysia.

ii. The school building projects is under Design Standardization in accordance and prepared by PWD (Architect Division) Malaysia.

iii. The selected case study only focusing on additional/replacement school block projects.

iv. The information and data taken only covers projects within 2006 until 2010.

v. The selected school projects for the case study and data collection only confine within the area of Selangor.

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