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Advantages of industrialized building system in Malaysia

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Abstract

In the era of globalization, Malaysia is implementing the industrialization in construction sector under the term "industrialized building system" or "IBS". The Malaysian government has adopted the industrialized building system since sixties and underwent great efforts in this field. The most important benefits of this system which have been concluded in many studies are reducing construction time, reducing total cost, reducing the dependency on foreign workers, increasing quality of buildings, promoting safe and systematic factory working environment, and provide cleaner and neater site

However, there is still lack in awareness of the advantages of industrialized building system among the players in construction sector. Thus, a questionnaire survey study was carried out to validate the advantages of industrialized building system which was collected from the literature reviews and to determine the advantages to Malaysian society. The results demonstrate that the first five advantages of industrialized building system are reducing total construction time, minimizing the use of timber formworks at site, enhancing quality of building, minimizing solid waste, reducing number of workers at site and decreasing air pollution at construction site.

Keywords: industrialized building system, advantages of IBS.

Introduction

Malaysian government has adopted the industrialized building system since sixties and underwent great efforts in this field (Thanoon *et al.*, 2003). The early attempt to apply IBS in Malaysia was the two pilot projects, the first project was Pekeliling Flats in Kuala Lumpur in 1964 and the second was Taman Tun Sardon, Gelugor, Penang in 1965. (Din, 1984)

These two pilot projects have brought bad reputation to IBS due to the problems of leakage because the European systems used were not appropriate for Malaysian wet toilets and bathrooms. (Rahman & Omar 2006). Although the failure of these two projects, the government did not despair and improved its way towards enhancing the experience in prefabricated system field.

After the development of precast concrete and steel technology, Malaysian construction sector witnessed many successful projects such as Petronas Twin Towers, Bukit Jalil Sports Complex and Games Village, and the LRT lines and tunnels. (CIDB 2003 a)

The most important benefits of this system, as mentioned in several studies (Warszawski 1999), (CIDB 2005), (CIDB 2003b) and (Thanoon *et al.*, 2003) are quite high. Reducing construction time, reducing total cost, reducing the dependency on foreign workers, increasing quality of buildings, promoting safe and systematic factory working environment, and providing cleaner and neater site. However, there is still lack in awareness of these benefits among players in the construction sector. Therefore, this study was conducted to validate the advantages of industrialized building system.

Industrialized building system

Industrialized building system can be defined as a construction system which components are manufactured in a factory, on or off site, positioned and assembled into structures with minimal additional site work (CIDB, 2003a).

IBS was also defined 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. Rahman and Omar (2006)

According to (Warszawski, 1999) IBS can be defined as a set of interrelated element that act together to enable the designated performance of the building.

Industrialized building system also can be defined as a building system which involves industrialized production of building elements or components as well as erection and assembly of these elements into a desired building structure through mechanical means using as little in-situ construction as possible. The elements are thus precast or prefabricated either in an off-site factory or in an on-site casting yard (Triksa & Abang 2004).

CIDB has divided the industrialized building system into five types (CIDB 2003b):

- 1- Precast Concrete Framing, Panel and Box Systems which contain precast columns, beams, slabs, 3-D components (balconies, staircases, toilets, lift chambers), permanent concrete formwork, etc;
- 2- Steel Formwork Systems which contain tunnel forms, beams and columns moulding forms, permanent steel formworks, metal decks, etc;
- 3- Steel Framing Systems which include steel beams and columns, portal frames, roof trusses, etc;
- 4- Prefabricated Timber Framing Systems which contain timber frames, roof trusses, etc;
- 5- Block Work Systems which contain interlocking concrete masonry units (CMU), lightweight concrete blocks, etc.

The advantages of using industrialized building system

Many researches have mentioned the advantages of using IBS system in there works. This study can list the advantages of IBS as follows:

1- High quality and good acceptance

- High quality-controlled products due to controlled environment in factory, better material selection and using high mechanized technology. (Din 1984).
- Skilled workers with specific scope of works improve efficiencies and reduce errors. (Noraini 2009)
- Unaffected by weather element due to controlled environment of casting area. (Peng 1986).
- The industrialized building systems can reduce boredom and monotony by getting flexibility in architectural design. (Warszawski 1999).

2- Cost

- Reducing on-site workers significantly reducing labor cost for contractors. (Wisam 2005).
- Minimizing cost of transferring waste material duo to quality control and reducing waste material. (Noraini 2009)

The ability to use the components' moulds repeatedly which made of steel, aluminum, etc for • (different projects. (Bing et al. 2001

- Exemption of the Construction Levy for housing developers who utilize IBS components exceeding than 70 %. (CIDB 2005).
- No need to do rectification works because of closely checking and controlling in factory and this will save a lot of money. (CIDB 2005).

3- Time

- Faster completion of projects due to advance off-site preparations and simplified installation process. (Wisam 2005).
- Manageable construction schedule by the use of planning control, estimated lead time and forecasted down time. (Noraini 2009)
- Off-site production can start while the construction site is under earthworks. This offers earlier occupation of building and minimizes interest payment. (Peng1986).

4- Safety

- Promote safe and systematic factory working environment as minimal workers, materials and construction waste is required on-site. (CIDB2003b).

5- Cleanness and neatness:

IBS provide cleaner sites due to:

- Systematic components storage and timely material delivery (Just-in-Time principles). (CIDB 2005).
- Reduction of construction material at site. (Wisam 2005).
- Reduction of waste materials at site due to casting in factory. (Wisam 2005).
- minimizing the use of formworks and props at site because of casting in factory. (CIDB 2005).

6- Social benefits:

- Reduce the dependency on foreign workers and reduce money outflow and their social problems, low quality works, delays, and diseases. (CIDB 2009).

- Saving in labour at construction site (about 40-50% compared to conventional method). (Warszawski 1999).

Problem statement

The enormous increasing of population during the latest years has generated intensive demands on houses. According to (Chen, 2000), Malaysia need a total of 8,850,554 houses between years 1995 to 2020 on average 1,790,820 units to be built for every ten years. This means that the construction sector must adopt fast method and accelerate its implementation to cope with these demands.

The Annual Labor Force Survey conducted by the Department of Statistics indicated that the number of foreign workers has increased to 1.1 million in year 2000 compared to about 136,000 persons in the early eighties. Latest immigration statistics revealed that the number of legal foreign workers in Malaysia rose to 1,359,632 workers as at July 2004 (MOF, 2005). According to Construction Industry Development Board (CIDB) Malaysia, 69% (552,000) out of total 800,000 of registered construction workers as at June 2007 is foreign workers (CIDB, 2007b). The danger of the foreign workers has become very noticeable. Money outflow to other countries, social problems such as getting drugs, fighting and quarrels which may occur between foreigners and citizens, low quality and productivity works, delay in works, and dangerous diseases such as hepatitis and AIDS. (Wan Hamidon 2008)

Furthermore, the abundance of cheap foreign workers in Malaysia has become the reluctant force against the use of industrialized building system and makes the contractors and developers prefer the conventional systems. (Thanoon 2003)

Moreover, the local workers are not keen on joining with construction industry because of the low wages and low emphasis on occupational safety and health. This case has created an image of dirty, difficult and dangerous (3D) in construction industry. Therefore, Malaysian construction industry is not in the line of the future development. (CIDB, 2007a).

To solve these problems, industrialized building system has been proposed in several studies as the solution to reduce construction time, reduce the dependency on foreign workers in construction industry, enhance the quality of buildings and provide safer working environment to attract the local workers

By adopting the industrialized building system and minimizing the use of conventional method, the dependency on foreign workers will also reduced, thus gaining billions of Ringgit currently being transferred to their home countries, and reducing social problems of foreign workers. (CIDB, 2003b).

In Israel, it has been found that the use of industrialized building system can provide labor saving about 40-50% as compared to the conventional methods, (Warszawski, 1999) thus reducing the dependency on foreign

The issue of foreign workers was the main topic in discussion held by Building Industry Presidential Council (BIPC) “The Presidents & CEO Roundtable Discussion”. It has discussed the financial problems that were caused to some contactors and developers by the foreign labor supply disruption in mid-2002. The possibility of repeating that scenario must be the driving force to make the industrialized building system the dominant method in the construction industry. ((Ibrahim 2003

The use of IBS for many years (in a long term) will bring considerable benefits to Malaysian society both economically and socially. (Wan Hamidon 2008)

However, there is still lack of awareness of these benefits among the players in construction sector. Thus, a questionnaire survey study was carried out to validate the advantages of industrialized building system which was collected from the literature reviews and to determine the advantages of industrialized building system to Malaysian society.

Collecting data (Methodology)

The data required for this study was collected by the questionnaire which was designed carefully and accurately according to be completed from the respondents in shortest time possible. The questionnaire has been done in two phases. The first phase is pilot survey to pretest and find out if there is any possible confusion and to recognize the presence of any offensive or difficult questions that exist in the questionnaire. There are two methods to pretest the questionnaire. The first method is to expose the questionnaire to some expert, while the second method is to distribute the questionnaire to some of IBS companies that is chosen as a sample for pilot survey phase. The method of pretesting the questionnaire of this study is exposing it to some experts. Suggestions to improve the questionnaire were reviewed and treated respectively. After the first phase was over, the final revision of questionnaire was delivered and distributed through e-mail and by hand. The data that have been gathered on IBS in Malaysia was processed and analyzed using Statistical Package for Social Science (SPSS) software program for Windows.

Sampling Design

The population of this study is the IBS manufacturers and consultants companies which have been gained from CIDB Directories 2008

To obtain more accurate results, the sample of this study was the whole population. Among 90 companies (56 manufacturer companies and 34 consultant companies), only 35 (28 manufacturer companies and 7 consultant companies) responded the questionnaire.

Data analysis

The data collected from the respondents through the questionnaires was analyzed precisely.

1- Respondents' background

A total of 35 respondents consisted of 22.9% company owners, 28.6 % sales managers, 25.7 % general managers, 17.1 % project engineers, 2.9 % project designers and 2.9 project contractors were the respondents of the questionnaires.

Table 1 indicate the respondents' position in the company

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid general manager	9	25.7	25.7	25.7
sales manager	10	28.6	28.6	54.3
project engineer	6	17.1	17.1	71.4
project contractor	1	2.9	2.9	74.3
owner	8	22.9	22.9	97.1
project designer	1	2.9	2.9	100.0
Total	35	100.0	100.0	

In this study, 5.7 % of the respondents have achieved diploma in the related field, 71.4% of them obtained a degree of bachelor, 5.7 % of them achieved master, 14.3% of them achieved PHD and 2.9% of them achieved Prof. The highest academic qualification of respondents can be presented in table 2

Table 2 shows the highest academic qualification of respondents

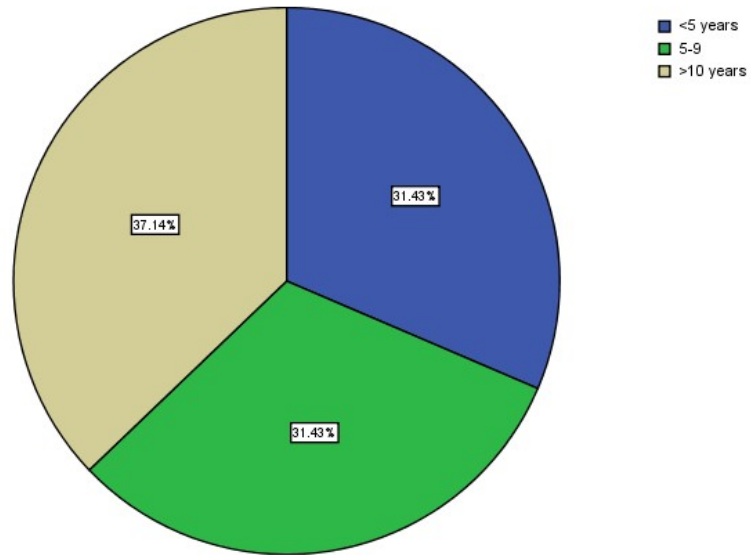
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	bachelor	25	71.4	71.4	71.4
	deploma	2	5.7	5.7	77.1
	master	2	5.7	5.7	82.9
	PHD	5	14.3	14.3	97.1
	prof.	1	2.9	2.9	100.0
	Total	35	100.0	100.0	

31.4 % of companies have experience less than five years and also 31.4 % of companies have experience between 5 to 9 years while 37.1 % have experience more than 10 years. The years of companies' experience is presented in table 3

Table 3 shows the number of years' experience of companies in IBS

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	<5 years	11	31.4	31.4	31.4
	5-9	11	31.4	31.4	62.9
	>10 years	13	37.1	37.1	100.0
	Total	35	100.0	100.0	

Figure 1: the percentage of years' experience of companies in IBS

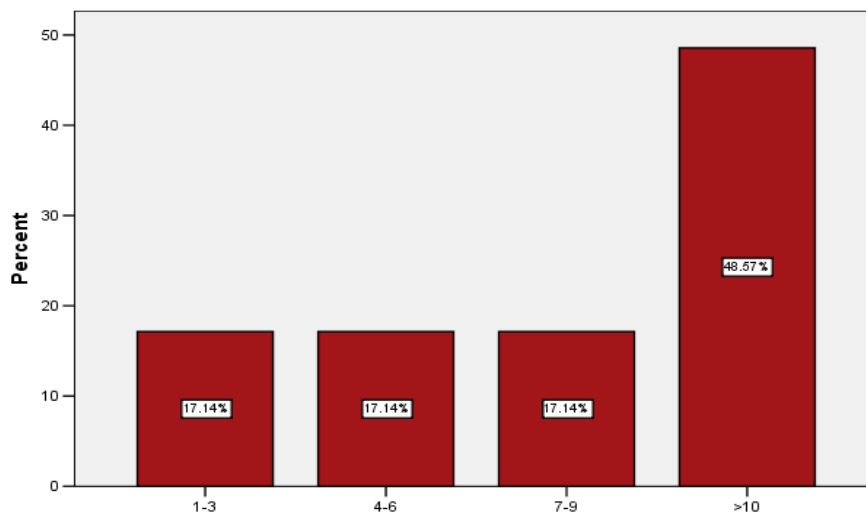


The number of IBS projects which the company contributed is presented in table 4

Table 4: Number of IBS projects of companies

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid 1-3	6	17.1	17.1	17.1
4-6	6	17.1	17.1	34.3
7-9	6	17.1	17.1	51.4
>10	17	48.6	48.6	100.0
Total	35	100.0	100.0	

Figure 4: Percentage of IBS projects of companies

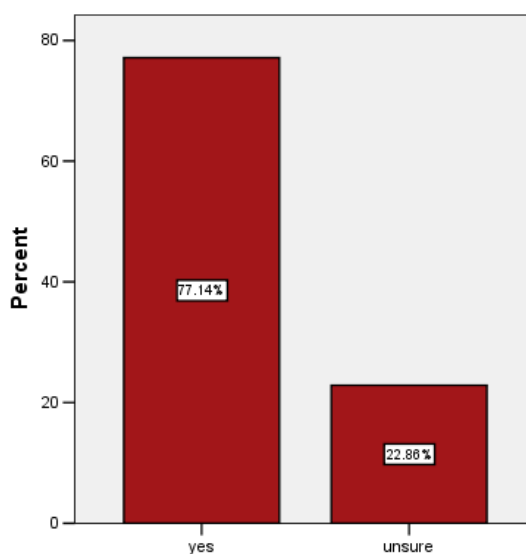


The respondents were asked if their companies intend to continue using IBS in future. 82.1 % showed their agreement while 17.9 % of companies were unsure. Neither manufacturer nor consultant companies showed their disagreement to continue using IBS in future. Table 5 shows the intention to continue using IBS in future.

Table 5 shows the intention to continue using IBS in future.

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid yes	27	77.1	77.1	77.1
unsure	8	22.9	22.9	100.0
Total	35	100.0	100.0	

Figure 5: Intention of companies to continue using IBS in future.



2- Survey findings

The advantages of industrialized building system which collected from literature reviews and suggestions from IBS experts during the pilot survey phase have been categorized under six main advantages: cost benefits, time benefits, quality benefits, environmental benefits, social benefits and safety benefits. The respondents identify variables that they perceived by responding to a scale from 1 (strongly disagree) to 5 (strongly agree). The five rating Likert Scale is, 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = disagree and 5 strongly disagree. Mean of each factor was calculated and ranking of these factors has been done to determine the most effective advantages of IBS in Malaysia.

Table 6: Advantages of industrialized building system

Factors	Mean	Standard deviation	Category ranking	Overall ranking
1- Cost benefits				
-Reduce total cost of the project	3.54	0.980	4	15
-Reduce number of workers at site	4.20	0.797	1	4
- Reduce money transfer to other countries (through foreign workers)	3.69	1.132	2	13
-Non-needs for periodic maintenance	3.66	0.968	3	14
2- Time benefits				
-Reduce the construction time of the project	4.43	0.698	1	1
-Ease of erection	3.97	1.014	2	9
-Enhance scheduling at construction site	3.94	0.968	3	10
3- Quality benefits				
-Enhance quality of building	4.23	0.690	1	3
- Production process is not exposed to weather affections	4.09	0.853	2	6
-Increase satisfaction of occupants	4.03	0.891	3	8
-Increase resistance of building to insects and moisture	3.97	0.891	4	9
4- Environmental benefits				
-Minimize using timber formworks at site	4.40	0.736	1	2
-Minimize solid waste	4.20	0.719	2	4
-Reduce noise at construction site	3.83	0.857	4	12
-Decrease air pollution	4.11	0.758	3	5
5- Social benefits				
-Reduce number of foreign workers at site	4.09	0.818	1	6
- Reduce dangerous diseases which is brought by foreign workers	4.06	0.725	2	7
- Reduce fighting problems which may occur between foreigners and citizens	3.91	0.853	4	11
-Reduce stealing problems at construction site	3.94	0.765	3	10
6- safety benefits				
-Reduce accidents at construction site	4.03	0.822	1	8
-Reduce accidents in factory	4.03	0.857	1	8

3- The first five advantages of industrialized building system in Malaysia

From the variables that have been categorized under six categories which were ranked according to their means, the first five variables were determined and shown in table 7. There are 6 variables fell into the 5 top-ranking factors because of the same mean of some variables. Many organized body perceived that industrialized building system can reduce building cost. However, this study has illustrated the contrast. Reducing the building cost is not really in Malaysia and its ranking was 15.

Table 7: First five advantages of industrialized building system

Factors	Mean	Standard deviation	Category ranking	Overall ranking
-Reduce the construction time of the project. (time benefits)	4.43	0.698	1	1
-Minimize using timber formworks at site. (environmental benefits)	4.40	0.736	1	2
-Enhance quality of building. (quality benefits)	4.23	0.690	1	3
-Minimize solid waste. (environmental benefits)	4.20	0.719	2	4
-Reduce number of workers at site. (social benefits)	4.20	0.797	1	4
-Decrease air pollution. (environmental benefits)	4.11	0.758	3	5

Discussion

From table 7, it is obvious that industrialized building system can reduce the construction time of the project which is the first advantages of IBS in Malaysia in this study. Malaysian construction sector needs this property to accelerate its implementation and cope with the intensive demands for housing. Minimizing the use of timber formwork at construction site will bring cleaner and neater construction site and will affect on the productivity of work because the workers will not be confused. Building quality is very important issue for Malaysian construction sector to be competitive in global markets. Reduction the solid waste at site will decrease the cost to transport it out of site and will give neater and cleaner site. Minimizing the number of workers at construction site is also an important issue which will affect on the cost because of reducing paid salaries to each worker. To gain pure air and clean environment, industrialized building system can reduce the air pollution at construction site.

The findings demonstrated that IBS can reduce the number of workers at construction site which ranked at fourth rank, while reducing the number of foreign workers located at sixth rank. This is may be because there is not enough experience among the local workers so the industrialized building systems need foreign experts.

Conclusion

The objective of this study was to determine the real advantages of industrialized building system in Malaysia. The questionnaire forms were distributed for IBS manufacturing and consultant companies to collect their responses.

From the findings, it can be concluded that the main advantages of industrialized building system are reducing the construction time of the project, reducing the use of timber formwork at site, enhancing the quality of building, reducing solid waste, reducing number of workers at site and reducing air pollution at construction site.

Many organized body perceived that industrialized building system can reduce building cost. However, the findings of this study illustrated that reducing building cost was ranked at number 15.

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