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The Constraints of Industrialized Building System from Stakeholders' Point of View

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Abstract- In spite of all great efforts of Malaysian government to promote the implementations of Industrialized Building System (IBS) in local construction industry, the usage level of IBS is still low. A survey carried out in 2003 by Construction Industry Development Board (CIDB) Malaysia revealed that the usage level of IBS in local construction industry was only 15%. Many contractors prefer to use conventional system because of some restraints in applying IBS. Therefore, interviews have been carried out to collect the information and to determine the main constraints of IBS in Malaysia from stakeholders' (manufacturers', consultants', contractors', academicians' and authorities') point of view. It has been found that the implementation of IBS have encountered many constraints which varies among the stakeholders. Suggestions have been put forward by the authors to circumvent the constraints.

Keywords: industrialized building system (IBS), constraints of IBS, suggestion to improve IBS.

I. INTRODUCTION

Industrialized building system (IBS) 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 [1]. Malaysian government has introduced the industrialized building system for more than forty years ago. However, the usage level of IBS in local construction industry is still low. 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% [1]. The main reason of maintaining using conventional construction is the intensive capital cost of IBS compared to capital cost of conventional labor. Furthermore, the failure of early precast systems introduced in Malaysia because some of the Western systems used were not suitable for Malaysian climate. Also shoddy installations caused problems of leakage due to lack of workers experience to install IBS components in early time [2]. These problems brought bad reputation to industrialized building system. Furthermore, many contractors prefer to use conventional construction system because of the cheapness and abundance of foreign workers in Malaysia [3]. Moreover, the local workers are not keen on joining this industry because of the low wages and low emphasis on working conditions [4]. Although many members of the industry are keen on manufacturing

in the field of industrialized building system, the majority of the industry stakeholders are hindering this system, may be because they do not want to change to new system which they do not have sufficient information to support feasibility of change [5].

II. CONSTRAINTS OF IBS

The main constraints of industrialized building system collected from several studies can be mentioned as follows:

- 1- The fluctuation in construction markets and demands for large housing projects make the using of prefabricated building system perilous. Therefore, many developers alienate to conventional system [6].
- 2- Academic curricula in universities and institutes provide inadequate educational courses about IBS and MC (modular coordination) principles. Thus, the players who are interested in this field have more tendencies to use the familiar conventional method. The shortage of adequate awareness with industrialization among building professionals is the greatest hindrance to its successful application in practice [6].
- 3- Bad reputation of prefabricated building system due to the unsuccessful initial stage which occurred because of poor quality control and lack of technical experience and caused several defects such as blemishes, cracks, moisture percolation, and poor thermal insulation in completed buildings [6].
- 4- The inability of prefabricated components to change which might be required in the building over its economic life especially in small span room size [6].
- 5- The weakness of connection and jointing systems in IBS. These systems are very critical and sensitive to the error and sloppy work.
- 6- Shortage in raw materials, supply delay, and bad weather which affect on transportation are the main reasons for delay in IBS projects completion [7].
- 7- Enormous capital cost which include set up the plant, supplying machinery and moulds, and the expenditures of transportation process (amounts to 3%-5% of their total cost for distances not exceeding 50km-100km [5]. The cost can be effective only in large projects when using repetitiveness in design [8] for example apartments, schools, hospitals and so on.
- 8- Cheapness of unskilled workers make the contractors prefer conventional method against prefabricated system.

- 9- The fragmentation and diversity in construction industry sector make it is difficult to organize IBS planning stage which need consensus among parties [9].
- 10- Shortage in experience among workers. Many of foreign skilled workers had left the country after the widespread crackdown on illegal foreign workers in 2002. The new batches of foreign workers do not possess the required skill and have to be retrained [9].
- 11- Shortage in IBS information and researches. The practitioners could not accept this system unless the benefits of IBS are well documented [10].
- 12- Transportation process also has its limitation like difficulties to access to site and difficulties to transport big components from factory to construction site [8].
- 13- Storage process needs large area in a factory to store IBS components and area for trailers and cranes movement [7]. This will add more cost to establish factories.
- 14- Most of local authorities in Malaysia are unlikely to change local building regulation to suit IBS because these modifications will consume time and cost [11].

III. RESEARCH SIGNIFICANCE

In these few years, the enormous increasing of population has generated intensive demands on houses [12]. The construction sector had to adopt fast method and accelerate its implementation to cope with these demands. Therefore, the solution was to adopt the industrialized building systems (IBS) in construction sector and designing plans to improve this system. The emphasizing on (IBS) from Malaysian government has become quite high. The first attempt to adopt IBS was in early sixties [9]. Although IBS has been introduced for more than 40 years, the construction industry still applies the conventional method which has been proven dirty, dangerous and wasteful [11]. There are some constraints in applying IBS that lead the contractors in construction sector to prefer using conventional method. Therefore, there is a need to determine these constraints and probe the most effective constraint to propose suggestions to solve them. Interviews with IBS experts have been carried out to collect the information and determine the main constraints of industrialized building system in Malaysia from stakeholders' point of view. Then, suggestions have been improved to resolve these constraints.

IV. METHODOLOGY

1- Literature review

Intensive studies of literatures have been done to understand IBS situation in Malaysia and eliciting constraints that hinder using this system. Then, the constraints have been gathered and determined and the questions of the interviews with experienced persons have been formed to investigate these constraints.

2- Collecting Data

The data required for this study has been collected by personal standardized interviews with specific points to elicit the information about the constraints of industrialized building system in Malaysia. The interviewees were 10 IBS manufacturers, 6 IBS consultants, 4 IBS contractors, 9 interested academicians and 3 local authorities. The manufacturers, contractors and consultants interviewees were selected from IBS supply chain directory 2009 (from IBS Center website) who is working in Kuala Lumpur and Selangor states and who accepted to interview the researcher. On the other hand, academicians and authorities were chosen by supervision advice. The data that gathered from the interviewees was arranged, processed and analyzed using Statistical Package for Social Science (SPSS) software program for Windows.

V. RESULTS ANALYSIS

The questions that have been asked during the interviews were divided in to two parts. The first part was companies profile and the second part was about IBS constraints in Malaysia that were collected from literatures.

Part one: A- Company Specialization:

The interviewees were 10 IBS manufacturers, 6 IBS consultants, 4 IBS contractors, 9 academicians and 3 authorities. Table I shows the interviewees' specializations.

TABLE I
INTERVIEWEES' SPECIALIZATIONS

	Frequency	Percent	Valid Percent	Cumulative Percent
Manufacturer	10	31.3	31.3	31.3
Consultant	6	18.8	18.8	50.0
contractor	4	12.5	12.5	62.5
academician	9	28.1	28.1	90.6
Authority	3	9.4	9.4	100.0
Total	32	100.0	100.0	

Part two: IBS constraints:

A- Lack of Experience

1- IBS in academic curriculums in universities

The interviewees were asked whether there is adequate education in academic curriculum in universities about IBS. Large numbers of them were not satisfied about the academic curriculums. Therefore, the academic curriculums in universities need to develop. Table II shows the responses of all the interviewees.

TABLE II
ARE THE ACADEMIC CURRICULUMS IN UNIVERSITIES PROVIDING ADEQUATE EDUCATION ABOUT IBS?

Specialization		Frequency	Percent
Manufacturers	Somewhat	3	30.0
	No	7	70.0
	Total	10	100.0
Consultants	No	6	100.0
Contractors	Somewhat	1	25.0
	No	3	75.0

Academicians	Total	4	100.0
	Somewhat	1	11.1
	No	8	88.9
	Total	9	100.0
Authorities	Somewhat	1	33.3
	No	2	66.7
	Total	3	100.0

2- MC in academic curriculums at universities

The interviewees were asked whether there is adequate education in academic curriculum in universities about modular coordination MC. Large numbers of them were not satisfied about the academic curriculums. The students usually get IBS and MC courses for only few months and when they graduate, they prefer to work in conventional method. Therefore, there is an urgent need to develop the academic curriculums in universities. Table III shows the responses of all the interviewees.

TABLE III
ARE THE ACADEMIC CURRICULUMS IN UNIVERSITIES PROVIDING ADEQUATE EDUCATION ABOUT MC?

Specialization		Frequency	Percent
Manufacturers	Somewhat	2	20.0
	No	8	80.0
	Total	10	100.0
Consultants	No	6	100.0
Contractors	Somewhat	1	25.0
	No	3	75.0
	Total	4	100.0
Academicians	Somewhat	1	11.1
	No	8	88.9
	Total	9	100.0
Authorities	Somewhat	1	33.3
	No	2	66.7
	Total	3	100.0

3- The availability of architectural experience about IBS and MC in Malaysia

The interviewees were asked whether there is enough IBS and MC experience among architects. Great numbers of them were not satisfied about the availability of IBS and MC experience among architects. This may be because of the limited academic curriculums at universities. Table IV shows all the responses.

TABLE IV
ARE THERE ENOUGH ARCHITECTURAL EXPERIENCE ABOUT IBS AND MC IN MALAYSIA?

Specialization		Frequency	Percent
Manufacturers	Somewhat	4	40.0
	No	6	60.0
	Total	10	100.0
Consultants	Yes	5	83.3
	No	1	16.7
	Total	6	100.0
Contractors	Somewhat	2	50.0
	No	2	50.0
	Total	4	100.0
Academicians	Somewhat	5	55.6
	No	4	44.4
	Total	9	100.0
Authorities	Somewhat	1	33.3
	No	2	66.7

Total	3	100.0
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4- The availability of contractors and installers experience IBS in Malaysia

The interviewees were asked whether there is enough IBS experience among contractors and installers. Great numbers of them were not satisfied about this matter. This also may be because of the limited academic curriculums at universities and institutes. Table V shows all the responses.

TABLE V
ARE THERE ENOUGH IBS CONTRACTORS AND INSTALLERS WHO EXPERIENCED WORKING IN IBS PROJECTS IN MALAYSIA?

Specialization		Frequency	Percent
Manufacturers	Yes	2	20.0
	Somewhat	5	50.0
	No	3	30.0
	Total	10	100.0
Consultants	Yes	5	83.3
	Somewhat	1	16.7
	Total	6	100.0
Contractors	Yes	3	75.0
	Somewhat	1	25.0
	Total	4	100.0
Academicians	Yes	2	22.2
	Somewhat	7	77.8
	Total	9	100.0
Authorities	Somewhat	3	100.0

5- The availability of skilled and semiskilled IBS workers in Malaysia

The interviewees were asked whether there is enough skilled and semiskilled IBS experience among workers. Large numbers of them were satisfied about this matter. The interviewees claimed that workers are not the root of the problem. The most important thing is the experience of the leaders of the work who are architects and engineers. Table VI shows all the responses.

TABLE VI
ARE THERE ENOUGH IBS WORKERS WHO EXPERIENCED WORKING IN IBS PROJECTS IN MALAYSIA?

Specialization		Frequency	Percent
Manufacturers	Yes	6	60.0
	Somewhat	1	10.0
	No	3	30.0
	Total	10	100.0
Consultants	Yes	5	83.3
	Somewhat	1	16.7
	Total	6	100.0
Contractors	Yes	4	100.0
Academicians	Yes	8	88.9
	Somewhat	1	11.1
	Total	9	100.0
Authorities	Yes	1	33.3
	Somewhat	2	66.7
	Total	3	100.0

B- Cost Constraint

1- The effect on construction cost when IBS is used

The interviewees were asked about the effect on cost when using IBS. 100% of manufacturers agreed that the cost is decreased as they are like any sellers who want to

merchandise (promote) their products. On the other hand, 75% of contractors were on the contrast. They believed that using IBS can increase project cost. 83.3% of consultants believed that using IBS can increase project cost, while 16.7% of them believed that project cost can not be affected by using IBS. Large number of academicians (77.8%) believed that project cost can be increased when using IBS. 66.7% of authorities supported that using IBS can reduce project cost because they wanted to encourage using IBS as they are the leaders of industrialized building program. Table VII shows all the responses.

TABLE VII
WHAT IS THE EFFECT ON CONSTRUCTION COST WHEN IBS IS USED?

Specialization		Frequency	Percent
Manufacturers	Decreased	10	100.0
Consultants	Not affected	1	16.7
	Increased	5	83.3
	Total	6	100.0
Contractors	Decreased	1	25.0
	Increased	3	75.0
Academicians	Decreased	2	22.2
	Increased	7	77.8
	Total	9	100.0
Authorities	decreased	2	66.7
	Increased	1	33.3
	Total	3	100.0

2- The effect swing of markets demands on IBS cost

The interviewees were asked whether swing of markets may affect on IBS cost. Many of them agreed to that and on one denied this effect. Table VIII shows the responses of the interviews.

TABLE VIII
DOES THE SWING OF MARKETS DEMANDS AFFECTS ON IBS COST?

Specialization		Frequency	Percent
Manufacturers	Yes	9	90.0
	Sometimes	1	10.0
	Total	10	100.0
Consultants	Yes	6	100.0
Contractors	Yes	2	50.0
	Sometimes	2	50.0
	Total	4	100.0
Academicians	Yes	8	88.9
	Sometimes	1	11.1
	Total	9	100.0
Authorities	Yes	3	100.0

3- Delays that may happen in completion IBS projects over the exact time

The manufacturers, consultants and contractors were asked whether they experienced delay in IBS projects. Only 16.7% of consultants and 50% of contractors claimed that IBS projects delay sometimes over the completion exact time. They attributed the main reason of that delay to late in payment from the client. The same question in a suitable wording has been asked to academicians and authorities. 44.4% of academicians and 33.3% of authorities claimed that delay happen sometimes in IBS projects and also they mentioned the same reason.

Table IX shows the responses of the interviewees to that question.

TABLE IX
ARE THERE ANY DELAYS THAT MAY HAPPEN IN COMPLETION IBS PROJECTS OVER THE EXACT TIME?

Specialization		Frequency	Percent
Manufacturers	No	10	100.0
Consultants	Sometimes	1	16.7
	No	5	83.3
	Total	6	100.0
Contractors	Sometimes	2	50.0
	No	2	50.0
	Total	4	100.0
Academicians	Sometimes	4	44.4
	No	5	55.6
	Total	9	100.0
Authorities	Sometimes	1	33.3
	No	2	66.7
	Total	3	100.0

4- Delay of payment

The manufacturers, consultants and contractors were asked whether they experienced delay of payment in IBS projects. Only 10% of manufacturers claimed that delay of payment happen sometimes while 90% of them have refused. On the other hand, 100% of consultants and 75% of contractors claimed that they experienced delay of payment sometimes while only 25% of contractors have refused. Delay in payment may happen in IBS project because the clients used to pay in batches for conventional method- which is not suitable for IBS projects. Table X shows the responds.

TABLE X
IS THE PAYMENT MAY DELAY ON ITS EXACT TIME?

Specialization		Frequency	Percent
Manufacturers	Sometimes	1	10.0
	No	9	90.0
	Total	10	100.0
Consultants	Sometimes	6	100.0
Contractors	Sometimes	3	75.0
	No	1	25.0
	Total	4	100.0

5- High transportation cost

The interviewees were asked whether the transportation process need high cost. All of them were either agree or somewhat agreed except manufacturers who indicated that it does not need high cost. Table

TABLE XI
DOES THE TRANSPORTATION PROCESS NEED HIGH COST?

Specialization		Frequency	Percent
Manufacturers	No	10	100.0
Consultants	Yes	1	16.7
	Somewhat	5	83.3
	Total	6	100.0
Contractors	Yes	2	50.0
	Somewhat	2	50.0
Academicians	Yes	3	33.3
	Somewhat	6	66.7
	Total	9	100.0
Authorities	Somewhat	3	100.0

6- Storage process cost

The interviewees were asked whether they thought that providing storage area in factories need high cost. 100% of manufacturers agreed while 100% of authorities claimed that the cost is somewhat high and it can be retrieved in a short time. In spite of that, this matter may hinder IBS contractors and consultants to produce there components and extend their works and convert to manufacturers. 75% of contractors and 50% of consultants claimed that providing storing area in factories need high cost. Table XII shows all the responses.

TABLE XII

DO YOU THINK THAT PROVIDING STORING AREA IN FACTORIES NEED HIGH COST?

Specialization		Frequency	Percent
Manufacturers	Yes	10	100.0
Consultants	Yes	3	50.0
	Somewhat	3	50.0
	Total	6	100.0
Contractors	Yes	3	75.0
	Somewhat	1	25.0
	Total	4	100.0
Academicians	Yes	5	55.6
	Somewhat	4	44.4
	Total	9	100.0
Authorities	Somewhat	3	100.0

7- Need to store IBS components at construction site

The interviewees were asked whether there is a need to store IBS components at construction site. 100% of manufacturers have denied while 66.7 % of consultants, 75% of contractors, 66.7% of academician and 66.7% of authorities clarified that the contractors sometimes need to store IBS components at construction site because of early delivery from factories. They also are obliged to store IBS components at construction site to avoid delay in construction. Storing the components at site may give messy site, confuse workers and delay the work. To overcome this constraint, just in time principle have to be applied correctly in Malaysia. Table XIII shows all the responses.

TABLE XIII

DO THE CONTRACTORS NEED TO STORE IBS COMPONENTS AT CONSTRUCTION SITE?

Specialization		Frequency	Percent
Manufacturers	No	10	100.0
Consultants	Sometimes	4	66.7
	No	2	33.3
	Total	6	100.0
Contractors	Sometimes	3	75.0
	No	1	25.0
	Total	4	100.0
Academicians	Sometimes	6	66.7
	No	3	33.3
	Total	9	100.0
Authorities	Sometimes	2	66.7
	No	1	33.3
	Total	3	100.0

8- Assembly process cost

The interviewees were asked whether they thought that assembly process need high cost. 100% of manufacturers, 83.3% of consultants, 50% of contractors, 77.8% of academicians and 100% of authorities have denied assembly high cost of IBS components. Table XIV shows all the responses.

TABLE XIV

DO YOU THINK THAT THE ASSEMBLY PROCESS COST IS EXPENSIVE?

Specialization		Frequency	Percent
Manufacturers	No	10	100.0
Consultants	Somewhat	1	16.7
	No	5	83.3
	Total	6	100.0
Contractors	Somewhat	3	75.0
	No	1	25.0
	Total	4	100.0
Academicians	Somewhat	2	22.2
	No	7	77.8
	Total	9	100.0
Authorities	No	3	100.0

9- The revenue from IBS projects

The interviewees were asked whether they are getting revenue from IBS projects. 100% of manufacturers, 83.3% of consultants, 75% of contractors, have agreed that they are getting revenue from IBS projects, while the rest where somewhat agreed. Table XV shows all the responses.

TABLE XV

DO YOU GET REVENUE IN IBS PROJECTS?

Specialization		Frequency	Percent
Manufacturers	Yes	10	100.0
Consultants	Yes	5	83.3
	Somewhat	1	16.7
	Total	6	100.0
Contractors	Yes	3	75.0
	Somewhat	1	25.0
	Total	4	100.0

VI. CONCLUSIONS AND RECOMMENDATIONS

Based on the results, it can be conclude that large number of respondents indicated that academic curriculum in universities do not provide adequate education about IBS and MC. They also responded that there is lack of experience among current architectures, contractors and workers about IBS and MC.

For cost constraints, all the manufacturers indicated that project cost can be decreased when using IBS as they are like to merchandise (promote) their products while 83.3% of consultants and 75% of contractors were on the contrary. IBS cost can be affected by many factors which are common in IBS projects such as swing of markets demands, delay in completion projects, delay in payment, transportation cost, storage cost and assembly cost.

100% of manufacturers, 83.3% of consultants and 75% of contractors responded that they got revenue in IBS projects in spite of their pretension of increasing project cost when using IBS. This pretension may be due to small revenue that they got because of large amount of expenditure.



Industrialized building system (IBS) in Malaysia is still young and need more support from the government to improve the construction sector to move from conventional system and use IBS and improve the educational system to improve IBS and modular coordination (MC) courses. Also the government has to legislate some regulations to limit the number of foreign workers who enter the country every year.

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