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Competencies Factors of Malaysian Architectural Firms Towards the Implementation of Industrialized Building System

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Abstract: The Malaysian construction industry is one of the leading areas for economic growth. In reality, the industry has been underdeveloped in comparison with other industries. Therefore, the introduction of innovative construction method that manifestly facilitates the shortcomings of the industry such as IBS has drawn the attention to industrialize the construction industry. Despite the fact that the precedent implementation of this system known as prefabrication has established negative perceptions and rejections among the construction players especially the architect, the assuring benefits of IBS that promotes the overall productivity and quality of buildings have motivated the Malaysian Government to outline strategies and instigate the implementation of IBS. However, the competencies of the architectural firms to implement this system are apt to be explored to assure successful transformation into industrialization. To address this matter, this paper aims to identify the main factors leveraging the architectural firms' competencies in implementing IBS at organizational level. This study engaged the use of structured questionnaire that were distributed to randomly selected respondents that represented firms that located in states with distinguished construction activities such as Selangor, Wilayah Persekutuan Kuala Lumpur, Pulau Pinang and Johor. The competencies factors were assessed using significant factors derived from the literature studies. These data were then manipulated to statistical tests such as Exploratory Factor Analysis, Frequency, Mean and Cronbach's Alpha Coefficients. The findings derived that the organization mobility and decision maker as the main factors that would intensify the competencies of the architects to implement IBS successfully at organizational level. This paper also found that the architects are restricted by the clients in the decision making process that caused the reluctance of using IBS among the architects. Therefore, the findings drawn from this study is fundamental for the architectural firms to consider while implementing IBS besides improving their competencies and enhancing the decision making process pertaining to IBS projects.

Key words: Competencies · Architects · Integrated building system · Malaysia

INTRODUCTION

The Malaysian construction industry is described as unproductive and incompetence to penetrate the international trades due to its unsatisfactory outputs. This has drawn the interests to industrialize the industry by introducing innovative construction method [1]. For instance, the introduction of prefabrication back in the early 1960s has commenced the transition of construction technology within the local industry [2, 3]. However, the system disclosed several drawbacks such as defective buildings, drainage system outflows, discontinued projects and unattractive architectural facades that resulted to contradictory responses from the construction players [3, 4, 5]. As a result, the conceptualization of prefabrication has been revised as IBS to improve responses towards the system [6].

The IBS is defined as a construction process that applies industrialized approach of prefabricated building components and onsite fabrication [7]. In detail, this system diminishes cost, expedites duration of works, elevates productivity, improves building quality,

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downsizes onsite manual labours and optimizes the use of material that further decreases construction waste [2, 7]. Therefore, the Malaysian government instigates definite investigations to provide wide observations and outlines strategies and advancements for IBS take up. In fact, the reinforcement of 70% IBS Score for government projects has demonstrated their persistence to overcome the existing setbacks of extensive foreign labours dependency and unsatisfactory outputs. Hence, successful implementation of IBS assures the improvement of competencies to enter the international trades.

Despite the outstanding advantages of IBS, the clients and professionals perceives it as uneconomical [8-10], defective workmanship [5, 11] and caused of delays [5] due to its lack of success. These disagreements have induced complications that lag the IBS take up. However, [10] scrutinized that lack of knowledge and experiences among that architects lead to misconception and misapplication of IBS. Therefore, this paper is based on the research that aims to identify the competencies factors of IBS implementation from the view of the architects.

Competencies Factors for Ibs Implementation in Malaysia: A few studies have enlisted widely varied of critical success factors together with the barriers and shortcomings to achieve successful implementation of IBS in Malaysia [12, 13]. In fact, these factors are classified into two distinct aspects of internal and external. For instance, the internal aspects are defined as the intrinsic capabilities of an organization, whereas the external aspects are determined as the extrinsic proficiencies that leveraged the organization's competitiveness such as the local Government policy and economic prospects [14]. Therefore, the implementation of IBS at the organizational level has been leveraged by two distinct aspects that represented the internal capabilities of the organization and the external impacts of the built environment.

Table 1 presented the synthesized critical success factors that are acknowledged as the competencies factors for the firms to implement IBS successfully. For example, an extensive literature of previous research that focused on the critical success factors for successful implementation of IBS in Malaysia by [12] has characterized both the internal and external aspects. In detail, the internal aspects are identified as IBS knowledgeable and experienced human resources and the efforts to implement IBS. In fact, the efforts to promote the use of IBS by the Government are disclosed as the external aspect. However, [13] has augmented these initial factors by incorporating several factors which are the organizational environment, design stage processes and

Table 1: The competencies factors for IBS implementation in Malaysia

Aspects	Factors	Items	References
Internal	Human Resources	Human resource educated with IBS knowledge	[12]
		Attempts to educate human resource with IBS knowledge	[13]
		Human resource trained with IBS knowledge	[12]
		Attempts to train human resource with IBS knowledge	[13]
	Organizational Environment	Top management liability	[13]
		Corporate encouragement	[13]
	Efforts to Implement IBS	Take a risk to implement IBS	[12]
		Encourage decision makers to apply IBS	[12]
	Design Stage Processes	Early decision on management strategy	[13]
		Early decision on IBS application	[13]
		Early decision on building design	[13]
		Early decision on logistics	[13]
		Requires team members' coordination	[13]
		Requires coordination of design, manufacture, transportation and installation process	[13]
		Requires comprehensive design works schedule	[13]
		Requires comprehensive strategy and execution schedule	[13]
External	Marketing Strategies	The Government required IBS Score of 70% for government building project	[12]
		The Government recommended IBS Score of 30% for private building project	[15]
		Prolong requirement for IBS building projects increase the market for IBS	[13]

prolong market requirement for IBS projects. However, these studies have disregarded the competencies factors from the perspective of the architects. Therefore, these existing factors are perceived as the fundamentals for identifying the definite factors of IBS implementation that focused on the perspective of the architects.

MATERIALS AND METHODS

The research was conducted using questionnaire surveys. It is developed at the stage of literature studies of IBS conceptualization and implementation that focused on the view of the architects. The preliminary questionnaire was then evaluated and modified by means of a pilot survey to validate the suitability of the instrument in achieving the research objective [16]. In fact, a panel of architectural practice experts that are consisted of three architects are interviewed [17]. As a result, several modifications to the appearance were made including coordinating the instructions, consistent use of similar response scale and rewording or rephrasing the statements to enhance the convenience of the survey.

The questionnaire is structured into two parts. The first part inquired demographic information of the respondent and the architectural firm. The second part examined the firm's competencies factors to implement IBS. The respondents are required to express the extent of their agreement on a 1-5 point Likert scale (1 = strongly disagree; 5 = strongly agree). Despite the fact that the extent of agreement diversifies from one respondent to another, the questionnaire aimed to derive a collective evaluation of the firm's competencies to implement IBS. Thus, the agreement was connected with the overall competencies to implement IBS at the initiation stage of a construction project.

The population are constrained to firms which were located in Peninsular Malaysia with distinguish construction activities and high developments such as Selangor, Wilayah Persekutuan Kuala Lumpur, Pulau Pinang and Johor. However, only firms that provide architectural services solely and registered with Lembaga Arkitek Malaysia under the categories of architectural body corporate, partnership and sole proprietorship are included in the population frame. Therefore, a total of 1064 firms are identified to represent the population of architectural firms in Malaysia for the research.

The simple random sampling method is preferred due to its manageable and economical convenience that accommodates the research constraints [18, 19]. The sample size is calculated using the equation [11]:

n=p/(□1+p*(e□^2))

Where;
n = sample size;
p = population size;
e = error of ±0.05 percentage point (in decimal value)

An assumption of 95% for confidence level and ±5% for confidence interval is made as recommended by Yamane (1967). The population size of the firms is set as 1064. Thus, these figures are used to calculate the sample size for the main survey. In brief, 291 respondents are identified as representatives for each firm from the entire population.

A total of 300 questionnaires are distributed to counterbalance the number of unreturned questionnaires. Although the questionnaires are personally administered by the researcher, there are a certain number of questionnaires that are required to be left for a week or two because they are occupied to provide for immediate answers. However, a total of 92 questionnaires are returned out of 300 are sent has demonstrated 30.67% response rates. These responses are utilized to conduct several statistical tests and descriptive tests such as Cronbach's Alpha Coefficients, Exploratory Factor Analysis, Mean and Frequency that are required to achieve the objectives of the research.

RESULTS AND DISCUSSION

Cronbach's Alpha Coefficients: A total of 16 items that assessed the architectural firms' competencies displayed the internal reliability of 0.902. This value is recognized as very good based on the internal reliability value proposed by [20]. Therefore, the reliability of the data was very good and statistically reliable for conducting further analysis.

Demographic Profiles: Table 2 displayed the characteristics of the respondents. For instance, 84.8% of the respondents or 78 individuals acquired bachelor degree as their highest level of education, whereas the second highest are diploma with the percentage of 8.7 or eight individuals from the total of 92. In short, most respondents are graduates with bachelor degree.

In addition, the investigation has demonstrated that most respondents hold the position as architects. In detail, 19.6% or 26 individuals are principals, 20.7% or 19 individuals are professional architects (20.7%) and 28.3% or 26 individuals are graduate architects. In brief, most respondents are certified architects.

Table 2: The characteristics of the respondents

Demographic Profiles		Frequency	Valid Percent
Level of Education	Certificate	1	1.1
	Diploma	8	8.7
	Bachelor degree	78	84.8
	Master degree	4	4.3
	Doctorate	1	1.1
Job Designation	Principal	18	19.6
	Professional architect	19	20.7
	Graduate architect	26	28.3
	Architect assistant	19	20.7
	Technical assistant	4	4.3
	Others	5	5.5
Design Stage Work Experience	≤ 5 years	32	34.8
	6-11 years	23	25.0
	12-17 years	8	8.7
	18-23 years	14	15.2
	24-29 years	9	9.8
	≥ 30 years	6	6.5
Tender and Construction Stage Work Experience	≤ 5 years	38	41.3
	6-11 years	16	17.4
	12-17 years	12	13.0
	18-23 years	12	13.0
	24-29 years	10	10.9
	≥ 30 years	4	4.3
Firm Registration Type	Sole proprietorship	45	48.9
	Partnership	27	29.3
	Body corporate	20	21.7
Duration of Practice	≤ 5 years	21	27.2
	6-11 years	42	23.9
	12-17 years	25	25.0
	18-23 years	10	10.9
	24-29 years	10	10.9
	≥ 30 years	2	2.2
Firm Size	≤ 5 employees	21	22.8
	6-20 employees	42	45.7
	≥21 employees	29	31.6
Level of Market Position	Local	59	64.1
	International	2	2.2
	Both	31	33.7
Construction Client	Government	4	4.3
	Private	18	19.6
	Both	70	76.1
Duration of Practice Using IBS	None	27	29.3
	≤ 5 years	59	64.1
	6-11 years	6	6.5
Number of IBS Projects	None	31	33.7
	≤ 5 projects	57	62.0
	6-20 projects	4	4.3

Moreover, 34.8% from 92 respondents or 32 individuals have been involved in the design stage for five years or less, while respondents with at least six to 11 years and 18-23 years working experience are represented by 25.0% and 15.2% respectively. Furthermore, 41.3% or 38 individuals have experience in the tender and construction stage for five years or less, whereas respondents with six to 11 years and 18-23 years of working experience are represented by 17.4% and 13.0% each. In essence, it can be concluded that most respondents acquired five years or less working experience in the construction industry.

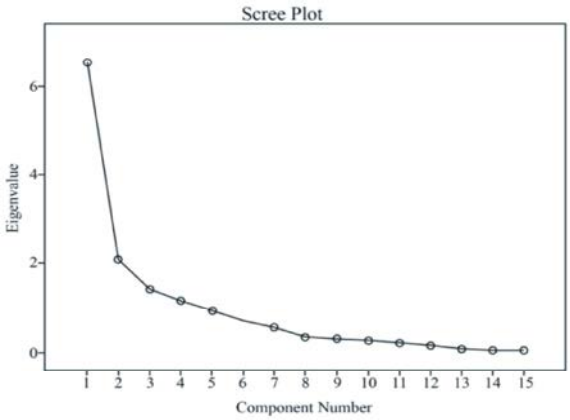

Fig 1: Scree Plot for the Firms' Competencies

The Architectural Firms' Competencies Factors: 15 statements that assessed the firm's competencies to implement IBS in Malaysia were used to run the Exploratory Factor Analysis (EFA) using Principal Component Analysis (PCA). The value of 0.722 for Kaiser-Meyer-Olkin and 0.000 for Bartlett's test has demonstrated a significant value for conducting EFA as prescribed by [21]. Moreover, the communalities values dispersed from 0.50 to 0.80 has verified the use of small sample for conducting EFA [22, 23]. Therefore, these values allows the use of EFA for this investigation.

Figure 1 depicted the scree plot for the firms' competencies. In detail, a total of 15 items were categorized into two components. PCA extracted these items into four components using the Kaiser's Criterion that sustained items with eigenvalues of more than 1.00. However, unsatisfactory component with less than three items are awaiting to be eliminated or sustained by the researcher [22]. The extraction are repeated by manually sets the number of components to be extracted within the range from one to five in reference to the values from the scree plot and PCA. Thus, the components were extracted into four and rotated using Varimax with Kaizer Normalization to facilitate the interpretations.

Table 3 presented the results of EFA. In detail, the rotation solution dispersed the items to four components and displayed that component one and two are largely unaffected by the rotation. However, one component with

Table 3: The Results of EFA

Items	Factor Loadings 1	2	3
Organization Mobility			
IBS Score 70% achievement	0.785		
IBS Score 30% achievement	0.748		
Human Resource educated	0.737		
Human Resource trained	0.723		
Manufacturers familiarization	0.719		
Components familiarization	0.711		
Attended IBS training	0.569		
Decision Maker			
Top management as decision maker		0.831	
Decision maker for IBS application		0.800	
Decision maker for IBS projects		0.749	
Architect's fee		0.705	
Architect's Role			
Advised application			0.861
Convinced application			0.847
Introduced application			0.727
Initial Eigenvalues			
Total	6.563	2.094	1.426
% of Variance	43.755	13.961	9.507
Cumulative %	43.755	57.716	67.222
`Rotated Solutions			
Total	3.956	3.068	3.018
% of Variance	26.371	20.451	20.123
Cumulative %	26.371	46.822	66.945

Table 4: The Summary of the First Factor

Factor	Items	Mean
Organization Mobility	IBS Score 70% achievement	3.60
	IBS Score 30% achievement	3.53
	Human Resource educated	2.93
	Human Resource trained	2.89
	Manufacturers familiarization	3.30
	Components familiarization	3.46
	Attended IBS training	3.11
	Mean average score	3.26

Note: Scale 1= strongly disagree; 5 = strongly agree

less than three items are reduced [22]. In fact, the item risks to advise are eliminated based on the value of factor loadings. In short, three components are extracted from a total of 15 variables. extracted from a total of 15 variables.

Research Findings

Organization Mobility: Table 4 presented the organization mobility as the first factor that leveraged the firms' competencies to implement IBS at organizational level. In particular, this factor has suggested as many as seven item that included the IBS Score 70% achievement (mean = 3.60), IBS Score 30% achievement (mean = 3.53), human resource educated (mean = 2.93), human resource trained (mean = 2.89), IBS manufacturers familiarization, (mean = 3.30) IBS components familiarization (mean = 3.46) and attended IBS training (mean = 3.11) as the variables that were comprehended as the organization's mobility. In brief, the average mean score for the organization mobility factor are 3.26.

Table 5: The Summary of the Second Factor

Factor	Items	Mean
Decision Maker	Top management as decision maker	3.25
	Decision maker for IBS application	3.04
	Decision maker for IBS projects	3.09
	Architect's fee	3.50
	Mean average score	3.22

Note: Scale 1= strongly disagree; 5 = strongly agree

Table 6: The Summary of the Third Factor

Factor	Items	Mean
Architect's Role	Advised application	3.13
	Convinced application	2.90
	Introduced application	3.09
	Mean average score	3.04

Note: Scale 1= strongly disagree; 5 = strongly agree

Decision Maker: Table 5 displayed the decision maker as the second factor that influenced the firms' competencies to implement IBS at organizational level. In detail, this factor has recommended a total of four items including the top management as decision maker (mean = 3.25), decision maker for IBS application (mean = 3.04), decision maker for IBS projects (mean = 3.09) and architect's fee (mean = 3.50) as the variables that were conceived as the decision maker. In short, the average mean score for the decision maker factor are 3.22.

Architect's Role: Table 6 demonstrated the architect's role as the final factor that determined the firms' competencies to implement IBS at organizational level. In particular, this factor has proposed a sum of three items known as the advised application (mean = 3.13), convinced application (mean = 2.90) and introduced application (mean = 3.09) as the variables that were apprehended as the architect's role. In brief, the average mean score for the architect's role factor are 3.04.

CONCLUSION

This research outlined the critical success factors for IBS implementation in Malaysia at organizational level that were relevant for the architectural firms.

These factors were then classified into two categories of internal and external that included the human resource, organizational environment, efforts to implement IBS, design stage processes and marketing strategies.

The organization mobility and decision maker emerged as the most distinguished factors that leveraged the architectural firms' competencies to implement IBS within the Malaysian scene. In detail, the organizational competencies that were conceived as the organization mobility incorporated the firm's internal capacities such as collective knowledge and experiences on the conceptualization and implementation of IBS as well as their capabilities to achieve the required IBS Score for an IBS project. However, the organization mobility is affected by the factor of decision maker. In fact, the decision making process depends extensively on the clients' approval. Therefore, it can be comprehended why most of the architects in Malaysia demonstrated reluctance towards the implementation of IBS.

These findings have supported the lack of competencies among the consultants that are specified by [4, 6, 24]. This has verifies the general concern and the urge to improve the willingness among the consultants particularly the architects to implement IBS as an innovative construction method that will enhance the productivity and quality of the local construction industry. Through this survey, the identified competencies factors could be used as an outline for the architects to intensify their organizational competencies and improves their participation in the decision making process.

Nevertheless, it is recommended to administer a formal investigation in future that explores the distribution of this issue on the competencies among other construction players that were involved in the IBS projects in Malaysia.

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