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READINESS FOR INDUSTRIALIZED BUILDING SYSTEM IMPLEMENTATION AMONG MALAYSIAN ARCHITECTURAL FIRMS' MEMBERS

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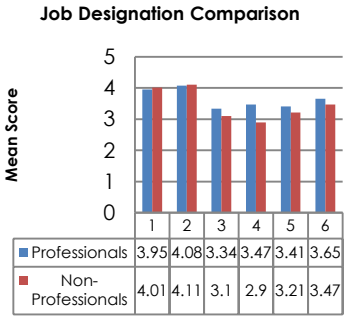
Graphical abstract



Abstract

The Malaysian construction industry has lags behind other industries in terms of performance that had drawn the attention to implement innovative construction method like Industrial Building System (IBS). However, the implementation of IBS in Malaysia remains low although the Government had commenced various efforts. The architects have been perceived as the prime mover for construction innovations by integrating their roles as designer, manager, and professional advisor with their strength in design. Therefore, this paper is designed to assess readiness for IBS implementation among organizational members of architectural firms by examining the influence of demographic backgrounds. The study distributes questionnaires to randomly selected respondents who represent firms that are located in highly developed states in Malaysia. Various analysis techniques have been used namely Cronbach's Alpha coefficients, frequency, mean, standard deviation, one-way ANOVA, and independent samples t-test towards achieving the research objective. The findings disclose that working experience in tender and construction stage (more than 18 years) indicate high likelihood of readiness to implement IBS. This research also reveals that demographic variables (job designation, working experience in design stage, and working experience in tender and construction stage) has significant impacts on the decision maker category, whereas decision maker is the most influential aspect for organizational readiness to implement IBS.

Keywords: Organizational readiness, architectural firms, implementation, industrialized building system, Malaysia

Abstrak

Industri pembinaan Malaysia jauh ketinggalan di belakang industri-industri lain dalam konteks prestasi telah menarik perhatian mereka melaksanakan kaedah pembinaan yang berinovatif seperti Sistem Bangunan Industri (IBS). Walau bagaimanapun, pelaksanaan IBS di Malaysia masih rendah walaupun kerajaan telah melaksanakan pelbagai usaha. Arkitek telah dilihat sebagai penggerak utama dalam inovasi pembinaan melalui pengintegrasian peranan mereka sebagai pereka, pengurus, dan penasihat profesional yang mempunyai kekuatan dalam reka bentuk. Oleh itu, kertas kerja ini diwujudkan untuk menilai kesediaan anggota organisasi firma arkitek dalam melaksanakan IBS melalui penilaian pengaruh latar belakang demografi. Kajian ini dijalankan dengan mengedarkan borang soal selidik kepada responden yang dipilih secara rawak yang mewakili syarikat di negeri-negeri maju di Malaysia.

Pelbagai teknik analisis telah digunakan untuk mencapai objektif kajian iaitu pekali Cronbach Alpha, kekerapan, min, sisihan piawai, ANOVA sehala, dan sampel bebas ujian-t. Hasil kajian mendedahkan pengalaman mereka bekerja pada peringkat tender dan pembinaan (lebih 18 tahun) berkemungkinan tinggi untuk bersedia melaksanakan IBS. Kajian ini turut mendedahkan pembolehubah demografi (jawatan pekerjaan, pengalaman dalam peringkat reka bentuk kerja, dan pengalaman dalam tender dan peringkat pembinaan kerja) mempunyai impak besar pada peringkat pembuat keputusan; di mana pembuat keputusan adalah aspek paling berpengaruh untuk kesediaan organisasi untuk melaksanakan IBS.

Kata kunci: Kesediaan organisasi, firma-firma arkitek, perlaksanaan, sistem bangunan berindustri, Malaysia

1.0 INTRODUCTION

The construction industry is one of the leading areas for local economic growth that provides infrastructures for social and economic development [17]. Construction Industry Development Board (CIDB), however, challenges the capabilities and productive capacity of the Malaysian construction industry to penetrate the international trades [4]. This is supported by [17], who stated that the construction industry is lagging behind other industries in practical utilization of advance technology. This draws attention of the Malaysian government to improve the capacity and appearance of local construction industry by advocating the use of innovative methods of construction such as Industrial Building System (IBS) through the implementation of the Construction Industry Master Plan (CIMP).

CIDB described IBS as a construction process that combined the use of prefabricated components with onsite construction works [6]. In fact, the use of IBS assures the reduction of construction costs, duration of onsite works, and foreign labours dependency, while simultaneously improves onsite works safety and improves the building facades [6]. According to [7], the government promoted the implementation of IBS by demonstrating the efficiencies and practicalities of IBS through the construction of national landmarks like Bukit Jalil Sports Complex, Petronas Twin Tower, facilities for Light Rail Transit, and buildings in Wilayah Persekutuan Putrajaya from the year 1995 until 1998 that utilized IBS products like precast, steel, and hybrid system. An investigation by CIDB in 2003, however, disclosed that despite various attempts and strategies undertaken by the government in promoting and encouraging the use of IBS, the implementation of IBS in Malaysia remained low [7].

According to [27], the government's efforts to promote the implementation of IBS were ineffective due to various determinants that had influenced the successful implementation of IBS in Malaysia. For instance, the use of IBS received contrary responses from the public and construction players [20,27], consultants and contractors demonstrated lack of knowledge and experience in IBS [7,19], IBS were implemented by using conventional approach [7], and required high capital investment [8]. Researchers strived to improve the implementation of IBS by suggesting collaboration between construction players like the construction clients, consultants, contractors, and manufacturers [27, 21].

According to [29], however, suggested that the architects had the capabilities to pioneer innovations within the construction industry. Then, [18] concurred with this view and expressed that the conventional roles of an architect as designer, manager, decision maker, and professional advisor gave the architects opportunities to encourage the development of construction innovations. This shows that the architects have the potential to influence the construction client and consultants to implement IBS and thus, discloses their impacts in IBS implementation in Malaysia. The use of IBS in the construction sector will be further enhanced through government procurement to increase efficiency while reducing dependency on unskilled labour, in line with the Construction Industry Transformation Programme (CITP), 2016-2020. This paper refers to an investigation that aims to assess the readiness for IBS implementation among organizational members of architectural firms in Malaysia. In fact, this paper determines the influences of the organizational members' background towards organizational readiness by examining their demographic information.

According to [34], most researchers concurred that the capabilities of an organization had significant impacts on organizational readiness for change (ORC). This is in line with the view of [35], who believed that the structure and function of an organization and its members influenced the capabilities of an organization. This draws attention to define ORC from the internal aspect of an organization and its members. This paper refers to [34], who defined ORC at organizational members' level as the state of being ready to engage in implementing changes from psychological aspects

like cognition, behaviour, and attitude. In fact, [35], who clarified that understanding, beliefs, and intentions towards the need for changes determined the state of organizational members' readiness to implement the changes. Therefore, this study proposes ORC as the capabilities of an organization that includes its structure and function as well as its members' abilities to perform changes that is determined by their understanding of the intended changes.

According to [35], the structure of an organization consists of organizational resources like finances, facilities, and human capitals. In fact, [34], who described that organizational function as organizational behaviour and efficiencies to implement changes. This suggests that the determinants for organizational competencies to implement changes are organizational resources, decision maker, and efforts to implement changes. This paper, however, refers to [9], who held the view that knowledge, experience, and perception interrelated with understanding that determined the organizational members' readiness to implement changes. This reflects the view of [12], who measured the extent of public understanding on science by assessing their knowledge on scientific products and scientific processes. This discloses that understanding of the intended changes from the aspect of concept and implementation are the determinants for organizational members' readiness to implement changes. Thus, this paper measured the extent of readiness to implement changes at organizational level by assessing the organization's competencies and its members' understanding of the concept and implementation.

Moreover, [20] expressed that the literary reviews disclosed that several researchers combined the list of shortcomings and barriers to IBS implementation as critical success factors (CSFs) for IBS implementation. This paper, however, classified the CSFs for IBS implementation at organizational level into four; (a) organizational resources [21, 4]; (b) decision maker; (c) efforts to implement IBS [19, 4]; (d) understanding of IBS concept [13, 6, 7, 2] and; (e) understanding of IBS implementation [20, 21, 4]. In fact, this paper suggested these external and internal aspects of CSFs for IBS implementation as determinants that had influenced the capabilities of an organization and the abilities of organizational members to implement IBS at organizational level. This paper acknowledged the impacts of bureaucracy efforts towards industrialized construction that assured the improvement of IBS implementation within the local construction industry. However, this paper stressed the importance of the internal factors that had significant impacts towards IBS implementation as the underlying determinants for architectural firms' readiness.

2.0 MATERIALS AND METHODS

This study utilized self-administered questionnaire to assess readiness at organizational level as suggested by [16], and [33]. The researcher conducted a pilot survey with a panel of architectural firms' experts with more than 20 years of working experience to validate the preliminary questionnaire and the suitability of these instruments in achieving the research objectives as suggested by [14]. As stated by [32], this study selected these experts in accordance to their knowledge, experience, and enlightenment on IBS. The questionnaire consists of several parts that collects demographic information of the respondents and their architectural firms, measures the extent of agreement on 5-point Likert scale (1 = strongly disagree; 5 = strongly agree) on the organizational competencies to implement IBS and organizational members' understanding of IBS concept and implementation. This study constraints the population frame to the states in Peninsular Malaysia with intense construction activities and development like Selangor, Wilayah Persekutuan Kuala Lumpur, Johor, and Pulau Pinang that are represented by the Gross Output percentage of 61.6%, 34.7%, 68.1%, and 44.7% respectively [11]. Therefore, this study collected data from organizational members of architectural firms in these states by using simple random sampling method as suggested by [28]. The sample size was determined by using an equation provided by [36]:

$$n=p/(1+p(e^2)) \quad (1)$$

The researcher referred to [36] and assumed 95% for confidence level and ±5% for confidence interval to calculate the sample size. Therefore, this study determined 283 architectural firms that were registered as sole proprietorship, partnership, and architectural body corporate as the sample for the study from the population size of 1064 [31, 28].

This paper utilized several statistical tests like the descriptive statistics (frequency, mean, and standard deviation) to observe the characteristics of the respondents and distributions of data and conducted the independent samples t-test and one-way ANOVA to achieve the objectives of the study. According to [26], *t*-test compared the mean score between two different groups with continuous variables that displayed statistically difference in the mean score of two groups, while one-way ANOVA disclosed significance difference in the mean score between more than two groups. The value for Sig. that shows less than 0.05, ($p \leq 0.05$), demonstrates that there is statistically difference among the mean score of the groups [26]. Therefore, this paper conducted an independent-sample t-test and one-way between groups analysis of variance to investigate demographic background influences on organizational readiness to implement IBS.

3.0 RESULTS AND DISCUSSION

The researcher self-administered 300 questionnaires to counterbalance the number of unreturned questionnaires and managed to obtain 92 responses within over approximately two to three months of being sent out, corresponding to response rate of 31%. This is similar to a construction related study by [3] that has utilized similar survey instrument and data collection method that is the self-administered questionnaire. The survey questionnaire consists of 49 items that measure the organizational competencies to implement IBS (15 items), understanding of IBS concept (17 items), and understanding of IBS implementation (17 items) among the organizational members of architectural firms that intends to determine the readiness to implement IBS at organizational level.

3.1 Cronbach's Alpha Coefficients

Table 1 shows the Cronbach's Alpha Coefficients for the measures. According to [15], the value of 0.70 is satisfactory, while [30] believed that the value of 0.80 was very good. As stated in Table 1, the internal reliability for three components that measures organizational readiness is 0.942, suggesting that the items that measured each variable were statistically reliable and acceptable for conducting further analysis.

Table 1 Cronbach's Alpha Coefficients for the measures of organizational readiness

	Cronbach's Alpha	Number of Items
Organizational resource	0.85	6
Decision maker	0.87	3
Efforts to implement IBS	0.78	6
Understanding of concept	0.91	17
Understanding of implementation	0.92	17
OVERALL	0.94	49

3.2 Demographic Profiles

Table 2 presents the demographic background of 92 respondents who represent the architectural firms in Malaysia. Most of respondents are non-professionals (58%) with 43% of them are professionals, suggesting that the distributions of responses are proportionate among the organizational hierarchy of architectural firms. Table 2 discloses that the majority of the respondents hold the education level of bachelor degree (85%). As stated in Table 2, 60% of them had at least 5 to 11 years of working experience in design stage, whereas 59% of them had at least 5 to 11 years of working experience in the stage of tender and construction. This demonstrates that the organizational members has been involved in various construction stages that consist of distinct architectural works throughout their working experience. Therefore, this paper believes that this shows that the organizational members of architectural firms in Malaysia had sufficient knowledge and experience on IBS and represent their architectural firms well.

3.3 Descriptive Statistics

The descriptive statistics for the variables showed the distribution of responses as presented in Table 3. The respondents demonstrated inclination towards strong agreement for variables that measured the availability of organizational resources, decision maker, and efforts to implement IBS at organizational level, suggesting that they were certain with the capabilities of their architectural firms to implement IBS. As shown in Table 3, the distribution of responses for variables that assessed the understanding of concept and implementation of IBS, however, disclosed that most responses inclined towards slight agreement, suggesting lack of certainty with the abilities of the organizational members to implement IBS at organizational level. This showed that 58% of the respondents, who were non-professionals, comprehend the concept and implementation of IBS to some extent. The distributions of responses for organizational readiness, however, displayed inclination towards strong agreement (mean = 3.54), suggesting that the organizational members of the architectural firms in Malaysia including professionals and non-professionals were well equipped to implement IBS at organizational level.

Table 2 The Characteristics of the respondents

Demographics	Frequency	Valid Percentage
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:		
Professionals	39	42.5
Non-professionals	53	57.7
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

Table 3 Descriptive Statistics for the variables of organizational readiness

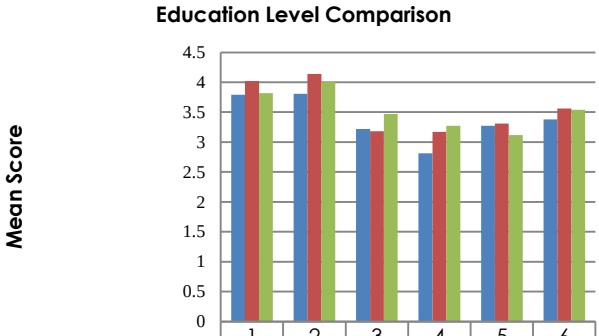
Organizational Readiness	Mean	Standard Deviation
Organizational resource	3.99	0.47
Decision maker	4.10	0.48
Efforts to implement IBS	3.20	0.76
Understanding of concept	3.14	0.88
Understanding of implementation	3.29	0.66
OVERALL	3.54	0.47

3.4 Education Level Comparison

This paper conducts one-way ANOVA to investigate the influence of education level on organizational readiness to implement IBS. The researcher collapses five level of education (certificate, diploma, bachelor degree, master degree, and doctorate) into three groups namely technical (certificate and diploma), under-graduate (degree), and post-graduate (master degree and doctorate) to assist the interpretation of results. Figure 1 shows that there is no statistically difference at the $p \leq 0.05$ level in scores within all groups that measures organizational readiness and within the actual mean scores. This suggests that the level of education has no influence on organizational readiness to implement IBS, which is in line with a study within the architecture, engineering, and construction industry [10]. Post hoc comparison using the Tukey HSD, however, demonstrates that the mean score for technical (mean = 2.81) is significantly different from degree (mean = 3.17) and post-graduate (mean = 3.27) within the decision maker category, suggesting that the organizational members with technical level of education are not involve in the decision making of IBS implementation. This reflects the view of [37] who stated that the architect was one of the decision maker for IBS implementation in Malaysia. In fact, the Boards of Architects Malaysia (LAM) entitles a graduate with at least under-graduate level of education from recognized institutions as Graduate Architect, LAM [22].

3.5 Job Designation Comparison

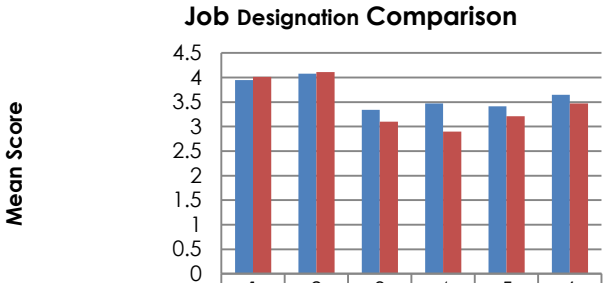
The independent samples *t*-test examine the impact of job designation on organizational readiness to implement IBS. The researcher classifies the job designation (principal, professional architect, graduate architect, architect assistant, technical assistant, and others) into two groups (professionals, non-professionals) to facilitate the interpretation of results. The professionals group consists of principal, professional architect, and associate architect, whereas the non-professionals group consist of graduate architect, architect assistant, technical assistant, and interns. Figure 2 discloses that there is no statistically difference at the $p \leq 0.05$ level in scores within all groups that assesses organizational readiness, suggesting that job designation has no impact on organizational readiness to implement IBS. This is contrary to the findings of [10]. However, the decision maker category is significant with the value of $p = 0.003$, suggesting that job designation has impacts on decision maker category. This is similar with a study by [33], which has been conducted on manufacturing firms that disclosed the relationship of organizational readiness to change with decentralization of decision-making. The actual mean score between groups demonstrate that the mean score for non-professionals (mean = 2.90) is significantly different from professionals (mean = 3.47) within the decision maker category, suggesting that organizational members who were non-professionals has no authorization to decide for IBS projects or to determine the use of IBS products or components in a construction project. This is in line with the view of [37], that the architect is one of the decision maker for IBS implementation in Malaysia.



	1	2	3	4	5	6
Technical	3.79	3.81	3.22	2.81	3.27	3.38
Under-Graduate	4.02	4.14	3.18	3.17	3.31	3.56
Post-Graduate	3.82	4.01	3.47	3.27	3.12	3.54

Note. 1 = understanding of IBS concept, 2 = understanding of IBS implementation, 3 = organizational resource, 4 = decision maker, 5 = efforts to implement IBS, 6 = organizational readiness

Figure 1 One-way ANOVA for education level



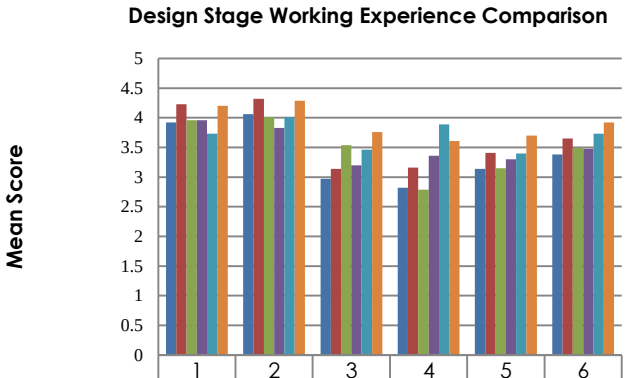
	1	2	3	4	5	6
Professionals	3.95	4.08	3.34	3.47	3.41	3.65
Non-Professionals	4.01	4.11	3.1	2.9	3.21	3.47

Note. 1 = understanding of IBS concept, 2 = understanding of IBS implementation, 3 = organizational resource, 4 = decision maker, 5 = efforts to implement IBS, 6 = organizational readiness

Figure 2 Independent Samples *t*-test for job designation level

3.6 Design Stage Working Experience Comparison

One-way ANOVA investigates the influence of the respondents' working experience in the design stage on organizational readiness to implement IBS. Figure 3 demonstrates that there is no statistically difference at the $p \leq 0.05$ level in scores within all groups that measures organizational readiness. The result is either in line with an investigation by [25] or is inconclusive due to the classification of working experience in this study that was separated in accordance to the stages of construction works. However, the results show statistically significance for two categories, namely the understanding of IBS concept ($p = 0.026$) and decision maker ($p = 0.010$), suggesting that working experience in the design stage has influence on the understanding of IBS concept and involvement as decision maker for IBS implementation. This indeed similar with a view held by [1], who concluded that decision makers should acquire knowledge on IBS and positive perceptions towards IBS to make decisions on IBS implementation. The results suggest that at the design stage of a construction project, the organizational members' understanding of IBS concept and their role as decision maker play an important role to determine the implementation of IBS.



	1	2	3	4	5	6
≤ 5 years	3.92	4.06	2.97	2.82	3.14	3.38
6-11 years	4.23	4.32	3.14	3.16	3.41	3.65
12-17 years	3.96	4.01	3.54	2.79	3.15	3.49
18-23 years	3.96	3.83	3.2	3.36	3.3	3.48
24-29 years	3.73	4.01	3.46	3.89	3.4	3.73
≥ 30 years	4.2	4.29	3.76	3.61	3.7	3.92

Note. 1 = understanding of IBS concept, 2 = understanding of IBS implementation, 3 = organizational resource, 4 = decision maker, 5 = efforts to implement IBS, 6 = organizational readiness

Figure 3 One-way ANOVA for design stage working experience

3.7 Job Tender and Construction Stage Working Experience Comparison

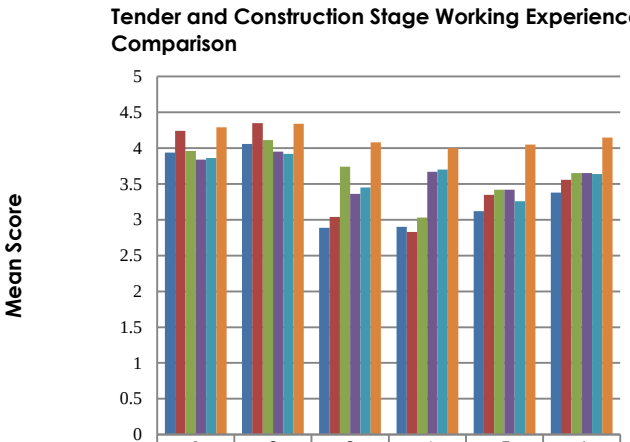
This paper examines the impact of the respondents' working experience in the tender and construction stage on organizational readiness to implement IBS by using one-way ANOVA. As in Figure 4, organizational readiness ($p = 0.022$) is significant at the $p \leq 0.05$ level in scores within all groups, suggesting that the working experience in the tender and construction stage has strong impact on readiness to implement IBS. This is either contrary to a study by [25] or inconclusive due to the classification of working experience in this study. This paper believes that this is due to the common practice of IBS implementation in Malaysia. As stated by [24], the fragmentation of Malaysian construction industry had caused the decision making process for implementing IBS and the integration of IBS in a construction project were made in the construction stage. The result shows

similar findings for decision maker category that is significant at the $p \leq 0.05$ level, with the value of p = 0.003. In fact, the result discloses another category that is significant, namely the organizational resources (p = 0.001). This suggests that working experience in the tender and construction stage has significant impact on organizational resources and authorization as decision maker for IBS implementation.

Despite reaching statistically significance, the actual mean score between groups is quite small. Post hoc comparison using the Tukey HSD shows that the mean score for organizational members with more than 18 years of working experience in tender and construction stage is significantly different from the respondents who have been working for 17 years or less. This demonstrates that organizational members with more than 18 years of working experience in the tender and construction stage displays high likelihood of readiness to implement IBS at organizational level. In fact, the result suggests that at the tender and construction stage of a construction project, the organizational resources, and the role of decision maker is essential for the readiness to implement IBS.

4.0 DISCUSSION

This paper aims to examine the readiness for IBS implementation among organizational members of architectural firms in Malaysia. In order to determine the influence of demographic variables on organizational readiness, this paper investigates the relationship between the demographic variables (education level, job designation, and working experience in design stage, and working experience in tender and construction stage) with organizational readiness. The results disclose that demographic variables that indicate high likelihood of readiness to implement IBS are working experience in tender and construction stage (more than 18 years). This paper, however, finds that demographic variables like education level, job designation, and working experience in design stage has no relationship with organizational readiness to implement IBS, suggesting that it is either does not support the findings of prior studies or inconclusive due to the size of the study.



	1	2	3	4	5	6
≤ 5 years	3.94	4.06	2.89	2.9	3.12	3.38
6-11 years	4.24	4.35	3.04	2.83	3.35	3.56
12-17 years	3.96	4.11	3.74	3.03	3.42	3.65
18-23 years	3.84	3.95	3.36	3.67	3.42	3.65
24-29 years	3.86	3.92	3.45	3.7	3.26	3.64
≥ 30 years	4.29	4.34	4.08	4	4.05	4.15

Note. 1 = understanding of IBS concept, 2 = understanding of IBS implementation, 3 = organizational resource, 4 = decision maker, 5 = efforts to implement IBS, 6 = organizational readiness

Figure 4 One-way ANOVA for tender and construction stage working experience

The result, in contrast, discloses that these demographic variables (job designation, working experience in design stage, and working experience in tender and construction stage) has significant impacts on the decision maker category. This demonstrates that the decision maker category appears as the most significant category with the highest mean score of 4.10. This paper believes that this is because it is common practice in Malaysia to integrate the use of IBS as a construction method at the construction stage [24]. This clarifies why the demographic variables indicate decision maker as the most influential aspect for organizational readiness to implement IBS. In fact, [37], who stressed the importance of decision making for IBS implementation at the earliest stage of a construction project, supported this finding.

The result also discloses that the role as decision maker within the architectural firms is limited to the professionals. This draws the attention to conclude that the professionals with more than 18 years of working experience in the tender and construction stage displays high likelihood of readiness to implement IBS compared to the non-professionals, which is in line with the view held by [37], who classified the architects' involvement as decision makers for IBS implementation.

These findings demonstrate that the organizational members of architectural firms in

Malaysia, particularly well experience professionals are ready to implement IBS. In fact, this suggests that the architects in Malaysia have display high likelihood of readiness towards innovative construction method. Thus, this finding challenges the studies that disclose the lack of competencies to implement IBS among Malaysian architects [20, 23]. This paper, however, suggests that the Government should increase the efforts to promote knowledge and exposure on IBS among the organizational members of architectural firms in Malaysia, particularly the non-professionals, to improve organizational readiness for IBS implementation.

5.0 CONCLUSION

The construction industry is one of the leading areas for local economic growth which provides infrastructures for social and economic development. In order to gain a lot of benefits from construction industry, the government actively promotes the implementation of IBS. One of the importance stakeholders, called architects have an important roles to implement this IBS and thus, disclose their impacts in IBS implementation. This study has shown that the decision maker appears as the most significant category. The finding demonstrates that the organizational members of architectural firms in Malaysia, particularly professionals who have well experience are ready to implement IBS. However, this study also has some limitations that need to be considered in the future research. This research finding should be perceived together with the readiness status of the other stakeholders' organisation. Moreover, a qualitative research would be an important approach towards strategizing non-professionals to improve organizational readiness for IBS implementation.

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