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Key Factors of BIM Implementation for Interior Design Firms in Malaysia

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Abstract: Building Information Modelling (BIM) is a process to improve and innovative tools for visualize the design phases, to coordinate the projects and to communicate the drawings and documentations as well as innovative technology in the construction industry. In Malaysia, BIM previously implemented by Architecture, Engineering and Construction (AEC) but in the Interior Design (ID) industry is a new approach and the lacking of knowledge is the issue for interior design industry to implement BIM. This research is to identify the key factors of BIM implementation in the interior design industry from the analysis of research and literature review. Mix-method was applied in this research and data were analysed to identify the key factors in this research. Research was found several of key factors in the interior design industry while using BIM in Malaysia. These factors will be isolated as variables and barriers for BIM implementation.

Keywords: Interior design, Building Information Modelling, key factors, barriers, variables

1. Introduction

Building information modelling is a tool for architecture, engineering and construction (AEC) industry by innovative and modern technology to create and to improve every aspect of the building before the construction started with the concrete structure. BIM were develop with all the information for each component of building which is integrate in a different criteria of the design to ensure the effectiveness and efficiency.

BIM was defined as a model in physically aspect and competence of the characteristics in a digital form (Azhar *et al*. 2008) to build a building in a virtual reality before development of the construction were start, to identify and analyzed the problem along the construction phases (Azhar, 2011). BIM also are known as components of a process and technology elements to enhance the quality and efficiency of delivering the projects for operation and management (Björk and Laakso, 2010).

In term of the interior design it is about of skill and knowledge which is to demonstrate the creativity in the design aspect which specialized in interior space's detailed design related with color, texture, lighting, heating, and material,

and furniture, specifications drawing and ergonomic of human being (Ding et al. 2017 & Kurtich and Eakin, 1993). However, interior design are quiet struggles to seem the reality, deprived of decorations and transcendent from the other parties. Today, interior design companies are more reliant while digital technologies and some of the existing software are not compatible for the interior design usage (Coles and House, 2007). The process of BIM is more like paddling team to monitoring all disciplines inline working in the same process at the same time. It is to ensure the team working together to create an efficient process and easy to work together. The key advantages for interior design using BIM is to develop interior design modeling, ability to capture and increase the clients needed and quality to embodied data in the model (Lok, 2004).

1.1 The Purpose of BIM for Interior Design

Interior designers are responsible to design aesthetic interior and functionally space for built environment for residents needed and owner's requirement must be coordinated with proper systems and process. Building information modeling (BIM) provided interior designers with new adoption by specifications features to simulate, analyze and solve problems accordingly coordination by design team members. Furthermore, BIM adoption also facilitates the organization, documentation and detailing information data.

Currently, industries practices circulate by integrated and collaborative process by BIM software as a platform to assistance the design process and efficient phases. Interior design industry is should be to balance between creativity and technical aspects to solve the process of interior environment. BIM also is important for interior design to enhance the scope of work and design process for better services and knowledge. Interior design industry are in moving to implement the technology by incorporate BIM software for producing construction documents (Rafael, 2007).

1.2 Barriers of BIM Adoption

Construction industry has facing the problems to implemented BIM technology has been constrained by many barriers in several types and categories. Most of the problems are related to the principles of BIM which is knowledge; technology and process and furthermore they are require for BIM adoption (Greenway Group Inc. 2009) and the barriers for BIM implementation depend the levels of usage and toughness (Yan et al. 2008). Some of the barriers need to validate with the expertise and professional to ensure the barriers can solve the problems when BIM implement in the construction industry. Table 1 shows the BIM implementation in generally in the construction industry and barriers from the literature review. The several of variables will be analyze to find out the problems BIM usage for interior design industry.

Table 1 - BIM implementation summary

Variables	Barriers	Literature Review
Increasing of cost for application	High initial cost of software. Costing for implementation process.	Azhar, (2011); Enshassi et al. (2016); Allen Consulting Group, (2010) & Thomson and Miner, (2007).
Lack of national standard	Incomplete national standard. Lack of information about BIM. Unavailability of standards and guidelines.	Azhar, (2011); Allen Consulting Group, (2010); Ganah and John, (2014); Bernstein and Pittman, (2004); Aibinu and Venkatesh, (2014); Alreshidi et al. (2014); Azhar et al. (2015); Chan, (2014); Bin et al. (2013) & Manderson et al. (2015).
Lack of skilled	Lack of professionals. High cost for training and education	Enshassi et al. (2016); Smith and Tardif, (2009); Sharag-Eldin and Nawari, (2010); Becerik-Gerber et al. (2011); NATSPEC, (2013) & Wu and Issa, (2014).
Organizational issues	Process problems. Learning curve. Shortage of senior support.	Aibinu and Venkatesh, (2014); Arayici et al. (2011); Won et al. (2013) & Demian and Walters, (2014).
Legal issues	Ownership Responsibility for inaccuracies Licensing problems Lack of support from policy makers	Azhar, (2011); Allen Consulting Group, (2010); Chynoweth et al. (2007); Udom, (2012); Abubakar et al. (2014) & Bin et al. (2013)

Table 1 - BIM implementation summary (Cont.)

Variables	Barriers	Literature Review
Lack of knowledge and awareness	Knowledge on BIM adoption Knowledge and practice on BIM Limited knowledge for staff	Lee *et al.* (2013); Brewer, (2006); Gerrard *et al.* (2010); Khosrowshahi and Arayici, (2012) & Bin *et al.* (2013)
Initial Costs	High of Initial Software and Hardware ROI of using BIM unclear	Abubakar *et al.* (2014); Azhar *et al.* (2015); Forsythe, (2014); Gerrard *et al.* (2010); Khosrowshahi and Arayici, (2012) & Rodgers *et al.* (2015).
Training and learning issues	Availability of training place Availability of instructor/facilitator	Abubakar *et al.* (2014); Azhar *et al.* (2015) & Chan, (2014)

1.3 Overview BIM Adoption in the Construction Industry

Building information modelling is a new era in innovation and technology combination with the planning and design scope. BIM is just not as a tool or software to create a complexity structure and documentation. It is more than as a tool and software. Nowadays, some of an architects and designers using 3-dimensional (3D) software to illustrate a drawing and documentation composition but BIM is more advance in this technology. It is multifunction usage and software can develop from the conceptual to the construction detail. Most developed countries using BIM in the construction industries such as USA, Australia, Hong Kong, Finland, Europe, Middle East, India and Singapore (Ahmad Latiffi *et al.* 2013) but in Malaysia is still freshly to adopt in the construction industry (Zakaria *et al.* 2013). Adoption BIM in construction industry is a potential idea to solve existing issue such as cost, time, documentation, quality and efficiency in progression of work. Malaysia is still slowly to implement BIM and the government initiative are still poor in BIM usage in the construction industry.
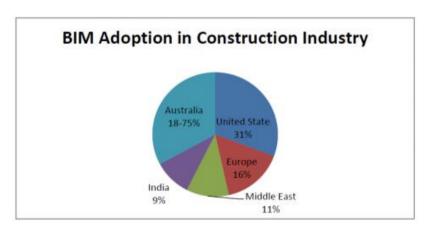

Fig. 1 - Countries using BIM in the construction industry (Sawhney, 2014).

1.4 Aims and Objectives

This study is to identify the key factors of BIM for interior design industry in Malaysia. This aim was supported by the objective is to evaluate the variables and barriers BIM in the interior design firms. The key factors were being determined the problem facing interior designers to adopt BIM in the profession. This research will be providing the recommendation to support BIM usage in the construction players especially for interior design industry.

1.5 Research Methodology

The research method is based on the literature review and collecting data. Mix-method was applied to find out the factors of barrier in BIM for interior design industry. Some of the previous research, expert interviews and qualitative data were recognizing in a collecting data. All information on BIM was taken from books, conference paper, journal articles, and internet materials. Literature review is one of the method to find out about BIM definition, BIM adoption, beneficial of BIM, awareness and readiness of BIM and barriers of BIM. The key factors were identified as the barriers of BIM adoption in the construction industry then a preliminary study was structured to develop questionnaire survey and distributed to the interior design experts for validation. This preliminary study was randomly select from the interior design firms to get a pre-review from the interior designers (Fig. 2).
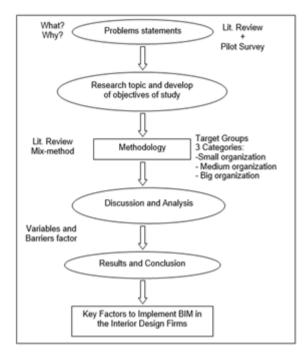
Fig. 2 - The research methodology structure.

The pilot study were identify the key factors will be re-evaluate and refine via interview. The survey develop and divided in three (3) sizes of firms; small; medium and big firms. Interior design firms were select from the registered list in Lembaga Arkitek Malaysia (LAM) and this study were focused in the Central Zone (Klang Valley) in Table 2.

Table 2 - Interior design firms in Malaysia divided by zoning.

Zone	No.	State		No. of Interior Design Firms
North	1	Perlis		0
	2	Kedah		5
	3	Penang		7
	4	Perak		4
			Total	**16**
East	5	Kelantan		1
	6	Terengganu		2
	7	Pahang		2
			Total	**5**
Central	8	Selangor		60
	9	Kuala Lumpur		47
	10	Negeri Sembilan		0
			Total	**107**
South	11	Melaka		3
	12	Johor		5
			Total	**8**
East Malaysia	13	Sabah		2
	14	Sarawak		7
			Total	**9**
			Overall Total	145

The assortment of this zone based of the quantity of interior design firms' established. All the information and data will be analyzed through empirical analysis were recorded and analyzed using data analysis software. The finding was represented by text, tables and figures in percentage. Discussion and results were determent the finding in this research.

2. Results and Discussion

This research is done with a mix method and engaged with a total number of sixty-three (63) respondents in this survey to identify the key factors of BIM implementation for interior design firms in Malaysia. All the respondents were chosen according to registered company with Lembaga Arkitek Malaysia (LAM) and divided in three groups based on the size of firm which is small, medium and big organizations.

2.1 Background of Respondents

According to Table 3, from the respondents profile of interior design firms, the data was abstract which is the frequency of small firm is present 43% more respondents compare 33% and 24% for each medium and big firms.

In category of firms, interior design consultant was highly with 68% comparing others category. Based on the data, BIM usage was determined the application of BIM for interior design firms. According to the data it is shows 69% of interior design firms using BIM in 2 to 5 years and 23% of interior design firms using BIM in 6 to 9 years. Based on the result, interior design industry are ready to used BIM but it is still slightly quantity usage among the interior design industry (Table 3).

Table 3 - Respondent's profile for interior design firms.

	Characteristic	Frequency			Statistics (%)
		Small	*Medium*	*Big*	
Size of Organization	(1-5 staffs)	27			43%
	(6-10 staffs)		21		33%
	(11 and more staffs)			15	24%
Year of Established	1990 and below	3	5	3	17%
	1991 - 2000	5	3	2	16%
	2001 - 2010	8	5	6	30%
	2011 and above	11	8	4	37%
Categories of Firm	ID Consultant	24	10	9	68%
	Design and Build	3	7	6	25%
	Contractor	0	4	0	7%
	Others	0	0	0	0%
BIM Usage	Less than 1 Year	0	0	0	0%
	2 to 5 Years	2	4	3	69%
	6 to 9 Years	1	2	0	23%
	More than 10 Years	0	0	1	8%

The size of firms was elaborated with the year of establishment of firms which is shows 37% firms was established from year 2011 and above, firms established from year 2001 to 2010 representative 30% firms and firms established from year 1991 to 2000 and below representative 16% and 17% only. Most of the firms are mostly new in the interior design industry was clarify by survey (Fig. 3). Comparing other construction industry, it is highly BIM implementation are consistent for development of scope of work and documentation. From the survey, small firms are large number in this survey representative 43% (27) from others group.
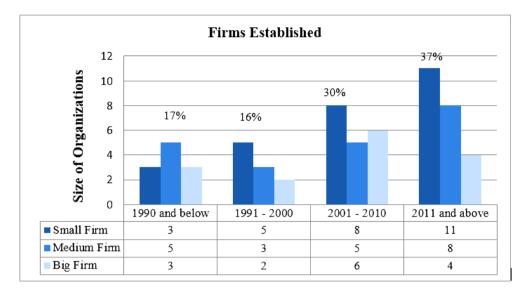
Fig. 3 - Year of interior design firms established.

2.2 Satisfaction Using BIM in the Interior Design Firms

BIM is very important to improve the knowledge and skill to ensure the project will be done as a schedule and efficient. By Implementation BIM, the designers and stakeholders are satisfied the quality of work process and documentation as well. According to Fig. 4, the results shows the respondents choose the service performance as a satisfied BIM usage in the interior design industry. By using BIM technology it is can enhanced the quality of work and efficiency in the service performance. The most satisfied of BIM usage for interior design firm is medium firms where the respondents willing to use BIM technology and the affordable in financial by supporting the project return of investment (ROI). However, for small firms are still new to using BIM and need to improve the ability while using BIM unless the respondents has a strength supporting financial to implement BIM technology in the firms. From the observation for the big firms, the respondents has a strength supporting financial but they are still back dated to using BIM although they have experienced and strength on the human resource and staff.
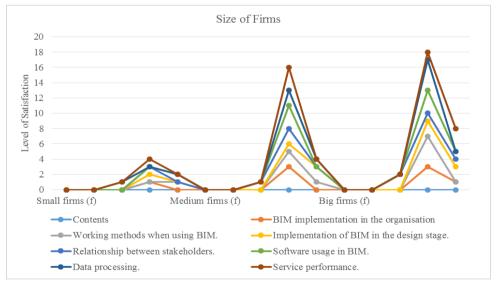

Fig. 4 - Level of satisfaction while using BIM in the interior design firms.

2.3 Barriers Usage of BIM in the Interior Design Firms

The important of BIM implementation in the AEC industry has stated in introduction of this paper. Numerous of countries in the world has implemented of BIM in the construction industry. Some of their government has provided some initiative to ensure the construction industry adopt BIM in the project and also committed to develop BIM as one of the rule and condition to submit project.

According to the results, the data indicate small firms are facing the several of barriers in the interior design firms. It is shown the main barriers are conflict of design and the cost constrain during implemented BIM in interior design. The financial problem is a critical for small interior design firms to implement BIM in the industry. Less ROI and a small amount project delivery is one of the causes why small firms they are not appropriate to using BIM technology. Compare to the big firms is seen have not facing the problem to implemented BIM in the project deliver. Lack of knowledge also take a place as a barrier to implement BIM in the interior design industry.

The major awareness and readiness that has been found for the analysis is the issue of interoperability to implement BIM in the interior design industry. Most of the interior design firms are not willing to implement BIM technology as their alternative in the project. They are still using traditional or conventional method to submit and implement in the project requirement (Fig. 5).
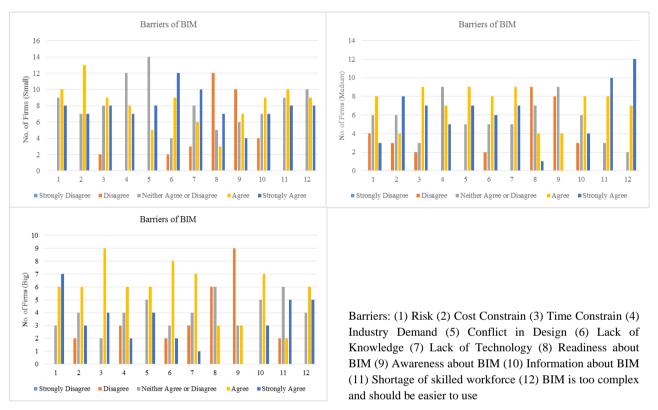

Barriers: (1) Risk (2) Cost Constrain (3) Time Constrain (4) Industry Demand (5) Conflict in Design (6) Lack of Knowledge (7) Lack of Technology (8) Readiness about BIM (9) Awareness about BIM (10) Information about BIM (11) Shortage of skilled workforce (12) BIM is too complex and should be easier to use

Fig. 5 - Level of agreement of barriers implement BIM in the interior design firms.

2.4 Awareness and Readiness BIM in The Interior Design Industry

BIM is very important for construction industry to enhance the quality of work and efficiency of project time frame. In Malaysia, construction players especially architecture, engineering and construction (AEC) already implemented BIM but it is need more developed about the knowledge and technology. Level of awareness and readiness for interior design are very crucial and poor.

According to Fig. 6, shows the level of awareness and readiness based on the different categories of size organizations. From the data, small organizations have a poor results comparing big organizations awareness and readiness. This is because the small firms are not prepared using BIM technology and very expensive on the software and hardware. They need to trained and develop the manpower from the beginning. This is will involve high cost and not really confident the return of investment (ROI) will help on BIM adoption. Otherwise, medium firms are very rational and they are aware the BIM technology to adopted in the interior design industry. This level they are willing to using outsource in certain project while BIM is implemented during the project progress.

In the construction industry, a good of financial is very important to deliver the project either small or big size of project. Some of the barriers need to improve or solve to ensure all parties in the interior design players available using BIM. The gaps of awareness and readiness in the construction industry within interior design industry are very crucial and poor.

Fig. 6 - Level of awareness and readiness BIM for interior design firms.

3. Summary

This study is to define and introduce BIM as a modeling technology to increase the quality of work and documentation. It is also to enhance the efficiency in the management and drawing in project using BIM technology in the construction industry especially interior design professional. Additionally, BIM in the interior design are still new and need to develop for design process and project phase's implementation. However, the main objective of this paper is to find out the key factors implementation BIM technology in the interior design firms. The several key factors very critical such as financial constrain and lacking of knowledge. Readiness and awareness level also as a part of the poor result in the data analysis.

In a new era and modern, technology and innovation are very important to ensure the efficiency and quality of work are sustained. BIM is the one of new technology which is construction industry especially interior design industry need to develop the knowledge and skill. Most of the country in the world already adopted BIM as a new technology for their sustainable in the construction industry.

This study proves it the several evidences of Building Information Modelling (BIM) will be improve the BIM adoption in the Malaysia construction industry but from the results is shows the decreasing of implementation BIM in the interior design industry. Several key factors influence the contributions of the BIM technology was identified; (1) Lacking of knowledge about BIM, (2) Financial constraints, (3) Awareness and readiness level poor and (4) Human resource constraints. However, this issues should have addressed by government about the requirement and needed for interior design industry. Government should support as a role to ensure the implementation of BIM in the construction industry in Malaysia especially interior design industry aware and ready to adopt BIM in the construction industry.

Finally, this study is limited to an initial BIM implementation key factors for interior design industry in Malaysia. The probability from this finding is to help the interior design industry to understand the significant of BIM as technology and to employ BIM with less coast and better efficiency of key factors. In the future research, hopefully the key factors will be determining on the BIM framework in different view and opinion in the interior design profession. The conclusion can be addressed that Malaysia construction industry need to enhance the quality of the construction approach in terms of technology, knowledge, skill, manpower, management and innovation accordingly global ordinary.

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