EVALUATION OF BIM IMPLEMENTATION REQUIREMENTS AFFECTING IRAQI CONSTRUCTION FIRMS

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(CIVIL ENGINEERING)

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SUPERVISOR'S DECLARATION

We hereby declare that We have checked this thesis and in our opinion, this thesis is adequate in terms of scope and quality for the award of the degree of Master of Engineering/ Master in Civil Engineering.

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STUDENT'S DECLARATION

I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

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LIST OF ABBREVIATIONS AND SYMBOLS

2-D	Two dimensions: x, y
3-D	Three-dimensional: x, y, z (the height, length and width)
4-D	Four-dimensional; 3D model connected to a time line (fourth dimension)
5-D	Five-dimensional; 4D model connected to cost estimations
6-D	Six-dimensional; 6D model which is 5D plus site
n-D	A term that covers any other dimension
AEC	Architecture, Engineering, and Construction
AIA	American Institute of Architects
ANOVA	Analysis of variance
MEP	Mechanical, Electrical and Plumbing
BIM	Building Information Modelling
CA1	Company A no.1
CB	Company B
CC1	Company C no.1
CAD	Computer Aided Design
CPM	Critical Path Method
RII	Relative Important Index
RFI	Requests for Information
ICT	Information and Communications Technology
IEA	Iraqi Engineers Association
ISO	International Standard Organization
IT	Information Technology
SPSS	Statistical Package for the Social Sciences
UAE	United Arab Emirates
UK	United Kingdom
USA	United States of America
W	Weight of each factor given by the respondents ranging from 1 to 5
A	Highest weight
N	Number of respondents participating in the questionnaire
P	Process element
M	Management element
T	Technology element
H	People element
Cα	Cronbach's coefficient alpha
Df	Degree of Freedom

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ABSTRAK

Industri pembinaan merupakan industri yang penuh dengan cabaran. Sama seperti negara-negara lain, industri pembinaan di Iraq juga tidak terkecuali menhadapai cabaran seperi lebihan kos, kelewatan dan kualiti yang rendah. Walau bagaimanapun, perkembangan teknologi di dalam sektor pembinaan telah memberikan penyelesaian bagi menghadapai cabaran berkenaan dan antaranya ialah perlaksanaan Building Information Modelling (BIM). Di Iraq, penggunaan BIM masih berada pada peringkat yang rendah dan salah satu sebab ialah kebanyakkan syarikat tidak mempunyai maklumat yang tepat berkaitan dengan kriteria perlaksanaan BIM. Ini membawa kepada matlamat kajian untuk mengkaji dan mengenal pasti kriteria yang diperlukan bagi melaksanakan BIM di dalam sesebuah syarikat. Bagi mencapai matlamat kajian, kaedah pengumpulan data kualitatif dan kuantitatif telah digunakan bagi membangunkan rangka kerja kriteria perlaksanaan BIM. Ia dimulakan dengan pembangunan rangka kerja teori berdasarkan kepada kajian literatur. Hasilnya, sebanyak 13 kategori keperluan perlaksanaan BIM telah dikenal pasti dan mereka ialah isu perundangan, polisi, halangan perubahan, masa dan kos, pengurusan professional, kepimpinan, pengetahuan dan kemahiran, perisian, peralatan, pendidikan dan latihan, perancangan, keperluan daripada klien dan penerimaan staf. Rangka kerja teori ini kemudiannya digunakan sebagai asas untuk meneroka kriteria perlaksanaan BIM secara terperinci di Iraq melalui kajian kes. Di dalam kajian kes ini, tiga syarikat telah terlibat. Kaedah temu duga semi struktur digunakan terhadap subjek yang terdiri daripada 5 orang jurutera secara keseluruhan. Analisis kandungan telah digunakan untuk mengenal pasti kriteria-kriteria keperluan perlaksanaan BIM di dalam ketiga-tiga syarikat berkenaan dan hasilnya 31 kriteria telah dikenal pasti. Selepas itu, rangka kerja konsep dan borang soal selidik dibangunkan untuk tujuan validasi. Pada peringkat validasi, sebanyak 230 set soalan telah dihantar kepada responden bagi menentukan dan menilai tahap kepentingan setiap kriteria keperluan BIM. Walaubagaimana pun, hanya 53 responden sahaja yang menjawab soalan berkenaan. Daripada jumlah 53 berkenaan, Analisa ANOVA telah dijalankan untuk menilai dengan menggunakan ujian t dan nilai-p. Hasilnya, nilai p yang diperolehi adalah tidak lebih daripada 0.05. Untuk menentukan tahap kepentingan setiaa kriteria perlaksanaan BIM pula, kaedah Analisa Kepentingan Indeks Relatif (RII) digunakan berbentukan perisaian SPSS 22. Hasilnya, kesemua faktor memberikan nilai RII yang tinggi iaitu melebihi 0.50 dengan faktor Pelarasan Kontrak Mengikut Keperluan Pelaksanaan BIM dan Kepuasan Kakitangan Mengenai Pelaksanaan BIM dalam projek-projek mereka, kedua-dua telah mencatat nilai RII daripada 0.875 diikuti dengan faktor Keperluan Pasaran Pembinaan Untuk Melaksanakan dan Menggunakan BIM dalam Projek mempunyai nilai RII = 0,856. Nilai RII terendah pula diberikan oleh faktor Pemilihan Kualiti Peralatan yang Sesuai untuk Melaksanakan BIM dengan nilai RII 0,675. Elemen proses adalah yang paling penting dengan RII purata = 0,837, manakala yang terendah ialah elemen teknologi dengan RII = 0,777. Sebagai sumbangan kepada pengetahuan teori sedia ada, kajian ini telah menyumbang kepada pemahaman tentang keperluan pelaksanaan BIM di Iraq dan mengisi jurang pengetahuan dalam penggunaan teknologi moden dalam industri pembinaan Iraq. Adalah diharapkan bahawa keperluan ini dapat diambil kira dan memberi panduan bagi pelaksanaan BIM dalam syarikat-syarikat pembinaan Iraq. Selain itu, kajian juga mencadangkan bahawa kerajaan Iraq perlu memainkan peranannya dalam melaksanakan BIM, dengan menggalakkan syarikat-syarikat pembinaan dan membuka pintu untuk pelaburan kepada syarikat-syarikat asing yang melaksanakan BIM dalam projek-projek mereka dalam Iraq. Selain itu, pada peringkat intitusi pendidikan, BIM perlu dimasukkan di dalam kurikulum pengajian di Iraq, untuk melahirkan generasi yang boleh menyumbang kepada perlaksanaan BIM secara khusus dan seterusnya menambah baik industry pembinaan.

ABSTRACT

Construction industry is one of a challenging industry. Similarly, to other countries, the construction industry in Iraq is facing the same repeating challenges of cost overrun, delays and low quality. The advancement of technology in construction industry, nevertheless has provide many solutions to minimize the challenges and one of them is Building Information Modelling (BIM). In Iraq, the use of BIM is still relatively low and one of the factor is many of the companies have limited information and knowledge regarding to the BIM implementation requirements. This is therefore has directed to the aim of this research which is to determine and identify the BIM implementation requirements. To achieve the aim of this research, mixed method by combining qualitative and quantitative approach were engaged. It was started by conducting literature reviews to develop BIM theoretical framework. 4 elements (Process, Management, Technology, and people) include 13 categories were identified in the literature review by comparing seven BIM implementation models and there were (legal issues, Policy, Resistance to change, Time and cost, Professional management, Leadership, Knowledge and skills, Software, Hardware, Education and training, Planners who understand BIM, Request from owner, and Acceptance by staff). The theoretical framework was later on be used as a basis to explore in depth BIM implementation requirements in case studies that involved three companies. In the case studies, three contractors and five respondents with civil engineering and architects background were involved. By engaging semi structure interview and content analysis method, 31 BIM implementation requirements were identified. Succeeding after that, a conceptual framework was developed. In validation process, a quantitative approach was engaged by first developing a questionnaire, based on the conceptual framework. The questionnaire was then sent to 230 respondents to determine the importance of each BIM implementation requirement. From that number, only 53 respondents that replied back to the researcher. The analysis of variance ANOVA was later been conducted for data to find out the variance differences among the specialists who participated in the questionnaire by using p-value. The results show that no statistical differences among the participant's answers after identifying the p-value which was > 0.05. Meanwhile, Relative Importance Index method (RII) was used to determine the importance of each BIM implementation requirement, by adopting the SPSS software version 22. The results from the questionnaire showed that all the 31 implementation requirements were important, with factor "*Adjustment the Contract According to BIM implementation requirements"* and "*satisfaction of staff on the implementation the BIM in their projects"*, both have scored RII value of 0.875 followed by factor "*requirements of construction market to implement and apply the BIM in the projects"* has value RII= 0.856, then "*Importance of a new roles and responsibilities in the companies to adopt BIM"* and "*Adoption the agreed standards in BIM implementation"*, both have RII=0.852. The lowest RII value belongs to "*selection of appropriate hardware quality for using it by operators*" with RII value 0.675. Process element is the most important with average RII= 0.837, while the lowest importance is technology element with RII= 0.777. This study has contributed to knowledge by providing the understanding of BIM implementation requirements specifically in Iraq and fill the knowledge gaps in the adoption of modern technologies in the Iraqi construction industry. These requirements can be used as a guideline to assist the BIM implementation and application in Iraqi construction companies. The study recommended that the Government of Iraq must play active role in the adoption of the BIM, by encouraging the construction companies and open the door for investment to the BIM experienced foreign companies to implement BIM in Iraq.

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