Perception of Construction Professionals On the Challenges for The Adoption of Building Information Modeling in Nigeria Construction Industry

Ilori, J.O [2]Adekeye, A.W. & [3]Mbamalu, C.F.
[1]Department of Quantity Surveying, The Federal Polytechnic, P.M.B. 420, Offa, Kwara State, Nigeria.
[1]E-mail: ilorijacob@gmail.com; Phone Number: (+234)8033303823
[2,3]Department of Civil Engineering, The Federal Polytechnic, P.M.B. 420, Offa, Kwara State, Nigeria.
[2]E-mail: adeke089@gmail.com; Phone Number: (+234)8053522507
[3]E-mail: chibuezembamalu@gmail.com; Phone Number: (+234)8060753472

ABSTRACT

There has been an emergent attention to Building Information Modeling (BIM) globally due to its benefits to various stages of a building's life cycle and it is perceived as an innovative approach that is gradually being implemented across the globe. The study sought to identify the challenges for the adoption of BIM in Nigeria construction industry and to determine the level of their criticality through the level of agreement amongst construction professionals on the identified challenges with a view to improving adoption of BIM in Nigeria Construction Industry. A quantitative research approach was adopted for the study employing a cross-sectional survey of 120 construction professionals who are major practitioners in Nigeria construction industry. Questionnaires were self-administered to the respondents and 79 responses were retrieved and found valid for analysis, representing a response rate of 66%. Percentile, mean internal score (MIS), Analysis of Variance (ANOVA) and Cronbach's alpha test were employed in the analyses and testing of the level of agreement amongst construction professionals on the data generated. The study revealed that the level of adoption of BIM is very low from the perception of all the considered construction professionals. The findings indicate that lack of experience and training, lack of skilled personnel, unavailability of appropriate technology and infrastructure are the most top challenging factors affecting the adoption of BIM in Nigeria construction industry. The study finally recommended the need to increase training, awareness of BIM; the integration of BIM into the Academic curriculum; and for the Nigeria Government to facilitate the implementation of BIM in Infrastructure projects, in order to ensure adequate knowledge of BIM in Nigeria Construction Industry.

Keywords: Adoption, BIM, Construction professionals, Nigeria, Perception.

iSTEAMS Proceedings Reference Format
Ilori, J.O., Adekeye, .A.W. & Mbamalu, C.F. (2019): Perception of Construction Professionals On the Challenges for The Adoption of Building Information Modeling in Nigeria Construction Industry. Proceedings of the 19th iSTEAMS Multidisciplinary Conference, The Federal Polytechnic, Offa, Kwara State, Nigeria. 7th – 9th August, 2019. Pp 143-150. www.isteams.net/offa2019 - DOI Affix - https://doi.org/ 10.22624/AIMS/iSTEAMS-2019/V19N2P16

1. INTRODUCTION

A large amount of information is usually generated on most construction projects which need to be communicated and shared among project stakeholders. This becomes necessary in case of more complex projects due to the nature of the projects. The traditional approach of dealing with information and information flow by manual manner hardly satisfies such demand (Ding, *et al.*, 2015). Doloi, *et al.*, (2012) opined that improper information flow among participating parties is responsible for poor coordination, reworks and scope changes in construction projects. This also leads to delay of schedule (Hwang, *et al.*, 2013; Kaliba, *et al.*, 2009). As a result, building information modeling (BIM) has been put forward to respond to this challenge.

Building Information Modeling (BIM) is an approach to construction that supports the continuous and immediate availability of project design scope, schedule, and cost information that is of high quality, reliable, integrated. BIM is a significant technological innovation in the architecture, engineering, and construction (AEC) industry and simulates the construction project in a virtual environment. According to Succar (2009), BIM can be understood as a set of interacting policies, processes and technologies generating a methodology to manage the essential building design and project data in digital format throughout the building life cycle, and it can be used in every stage of a construction project from inception to demolition. Therefore, BIM has a main role of coordinating and integrating the exchange of information and knowledge between different disciplines and phases within the project. Eastman, *et al.*, (2011) advised that individual firms should adopt BIM to improve their designs and construction practices, in order to gain a competitive advantage in the marketplace.

The use of BIM in a construction project has the potential benefit of improving product quality, and enabling more sustainable designs of buildings (Eastman, *et al*., 2011). Yan and Damian (2008) asserted that using BIM reduces the cost of design and the duration of construction, and improves the relationship between construction owners and designers. Also, the use of BIM improves communications, risk can be shared and reduced, and better decisions lead to increased profits and a better overall experience for stakeholders (Bozoglu, 2016). However, many factors still limit the adoption of BIM in the construction industry as it has its flaws mostly related to professionals' resistance to adoption (Yan and Damian, 2008; Sun, *et al.*, 2017), and this has led to slower adoption than expected. Success story of BIM has been widely reported in developed countries, but in the case of developing countries it seems to be different because changes in construction processes and effective adoption of BIM is largely limited to developed countries (Abubakar, *et al.*, 2014). This is premised on the fact that there is a big difference between ICT implementation and its use between developed and developing countries (Gichoya, 2005). Some of these developing countries are stuffed with limited computer applications, inadequate infrastructure and shortage of skilled manpower (Tse, *et al.*, 2005; Ugwu and Kumaraswamy, 2007). Several authors reported that, the implementation of BIM have been limited to developed countries (Arayici, *et al.*, 2009; Arayici, *et al.*, 2012), and there is a dearth of studies on what constitute challenges to the adoption of BIM particularly in the context of Nigeria construction industry.

According to Abdulahi, *et al.*, (2016), the adoption of BIM in Nigeria has not yet been documented as public available reports in terms of best practice, implementation guide, or framework. Thus, the absence of these documents therefore drives the need to identify the challenges to the adoption of BIM in Nigeria construction industry and this study will educate construction practitioners on the challenges of BIM adoption needed to overcome before effective implementation of BIM in the industry, which will in turn enhance productivity and efficiency of project delivery in Nigeria construction industry. The study will also serve as a resource base for other researchers and improve the body of knowledge. Thus, the aim of this study is to identify the challenges to the adoption of building information modeling (BIM) in the Nigeria Construction Industry and to determine the level of their criticality through the level of agreement among construction practitioners on the identified challenging factors.

2. CHALLENGES FOR THE ADOPTION OF BUILDING INFORMATION MODELING (BIM) IN CONSTRUCTION INDUSTRY

Previous researchers have identified numerous factors affecting the adoption of BIM which are synonymous with the challenges faced by construction professionals in adopting BIM in the execution of construction projects. This study has identified and combined previous studies on challenges to BIM/ICT adoption. The rationale for this is that there is a dearth of studies on challenges to BIM adoption in the context of Nigeria practice and as such, BIM is considered an extension of ICT in the construction industry. The various publications by these researchers were reviewed to theoretically derive challenges to the adoption of BIM in construction industry and based on the literature review; the following challenges were identified and presented in Table 1.

Table 1: Challenges for the Adoption of Building Information Modeling (BIM)

S/No.	Challenges	References
1	Lack of enabling environment	Akerele and Moses (2016); Ezeokoli, Ugochukwu and Okolie, (2016).
2	Lack of trained professionals to handle the tools	Porwal & Hewage (2013); Ezeokoli *et.al*. (2016).
3	Individual/personal disposition	Porwal & Hewage (2013); Akerele and Moses (2016); Ezeokoli *et.al*. (2016).
4	Clients are not requesting the use of BIM	Ezeokoli *et.al*., (2016).
5	Guidance and government support	Rogers, Chong and Preece (2015).
6	Lack of current public policy on BIM	Kori & Kiviniemi (2015).
7	Inadequate opportunity for BIM implementation	Arayici, Khosrowshahi, Ponting & Mihinda (2009).
8	Lack of experience and training	Alufohai (2012); Porwal & Hewage (2013); Rogers, *et al*. (2015).
9	Resistance to change	Arayici *et al*. (2009); Abubakar *et al.* (2014); Rogers *et al.* (2015); Ezeokoli *et.al*. (2016).
10	Uniqueness of each construction project	Ezeokoli *et.al*. (2016).
11	High cost of integrated software/models	Oyediran & Odusami (2005); Alufohai (2012); Porwal & Hewage (2013).
12	Lack of standards to guide implementation	Chan (2014); Ezeokoli *et.al*. (2016).
13	Poor internet connectivity	Alufohai (2012); Porwal & Hewage (2013); Ezeokoli *et.al*. (2016).
14	Frequent power failure	Oladapo (2007); Porwal & Hewage (2013).
15	Lack of awareness and support of the technology by Managers	Porwal & Hewage (2013); Akerele and Moses (2016); Ezeokoli *et.al*. (2016).
16	Cost of required software upgrade	Oladapo (2007); Alufohai (2012).
17	Responsibilities between stakeholders	Alufohai (2012); Porwal & Hewage (2013); Chan (2014); Kori & Kiviniemi (2015).
18	Low level of involvement of BIM users in green projects	Antón and Díaz (2014).
19	Availability of the appropriate technology and infrastructure.	Porwal & Hewage (2013); Ezeokoli *et.al.* (2016).
20	Lack of practical knowledge	Arayici *et al*. (2009); Porwal & Hewage (2013); Ezeokoli *et.al*. (2016).

3. RESEARCH METHODOLOGY

This study sought to identify the challenges for the adoption of BIM in Nigeria Construction Industry and determine the level of their criticality through the level of agreement among construction professionals on the identified challenges. This study adopted a quantitative research approach involving a cross-sectional survey method. The data used for this study were collected via well-structured questionnaires which were self-administered to construction professionals. In order to achieve the objective of this study, a total of 20 challenging factors to the adoption of BIM identified from previous studies were included in a questionnaires survey instrument which reflect challenges being faced by construction practitioners in the implementation of BIM in Nigeria. The questionnaire was divided into two main sections. In section A of the questionnaire, the respondent was asked to fill in the space provided with the appropriate respondent's general information: while, in section B of the questionnaire, the respondent was asked to rate the variables for challenges to the adoption of Building Information Modeling (BIM) in Nigeria Construction Industry.

A five-point Likert scale with value 5 = extreme challenge to 1 = not at all a challenge, was used in obtaining the respondent's opinions in the questionnaire. Snowballing sampling technique was adopted because BIM has not been widely used in Nigeria, and the questionnaire was administered to Architects, Engineers and Quantity Surveyors, that either have been involved on projects that utilized BIM or have good knowledge of BIM use on construction projects in Nigeria. This is to ensure that, respondents have the requisite knowledge to respond appropriately to the listed challenging factors to BIM adoption most especially in Nigeria context. Seventy-Nine completed questionnaires were retrieved and found valid for analysis, representing a response rate of 66%. Analysis of the collected data was done using Percentile, mean internal score (MIS), Analysis of Variance (ANOVA). Data processing was done with the aid of Statistical Package for Social Sciences (SPSS 25) software.

4. FINDINGS AND DISCUSSIONS

4.1 Background Information of the Respondents

The result reveals that the most represented professionals are Engineers and Architects with 40.5% and 38.0% respectively. The Quantity Surveyor are represented by 21.5%. Regarding academic qualification, 19.0% hold HND, 35.4% and 31.7% hold B.Sc./B.Tech. and M.Sc./M.Tech. respectively, while 13.9% hold PGD. Furthermore, apart from the encouraging educational qualification of the respondents, the analyses of the respondents' professional qualifications show that they are all professionally qualified with 100.00% of the respondents having attained corporate membership status of their various professional bodies. The respondents have a combined average of 9.1 years of work experience in the built environment. This gave an indication that the respondents are experienced and that data provided by the respondents would be reliable.

4.2 Discussion of Results on the Challenges for the Adoption of BIM in Nigeria Construction Industry

The objective here is to identify the challenges for the adoption of BIM in Nigeria construction industry. The results in Table 2 show the group means score differences among the three professional groups based on 20 items used in measuring challenges to the adoption of BIM in Nigeria construction industry. The items revealed group means ranging from 2.09 to 3.66 as indicated in Table 2. Based on individual groups (architects), results show that 15 out of the 20 items have mean score >3 while the remaining 5 items have scores <3. This implies that architects perceived these 15 items (CH1, CH2, CH7, CH3, CH4, CH6, CH9, CH8, CH5, CH10, CH16, CH19, CH14, CH11, CH13) as challenges to the adoption of BIM in Nigeria construction industry. While, architects do not see these 5 items (CH20, CH12, CH17, CH18, CH15) as challenges to BIM adoption. As for the Engineers, 19 out of 20 items have their mean score >3 which is an indication that they perceived all of them as challenges to the adoption of BIM in Nigeria construction industry, except item CH15 with mean score <3 which the engineers do not see as significant challenge.

Nevertheless, for the quantity surveyors, 11 items (CH1, CH2, CH7, CH3, CH4, CH6, CH9, CH8, CH5, CH10, CH20) have their mean scores >3, which is an indication that they perceived them as challenges to the adoption of BIM in Nigeria construction industry. Meanwhile, quantity surveyors see other items (CH16, CH19, CH14, CH11, CH13, CH12, CH17, CH18, CH15) as less significant challenges to the adoption of BIM in Nigeria construction industry. In general, based on individual group it could be deduced from the results, that 10 out the 20 items (CH1, CH2, CH7, CH3, CH4, CH6, CH9, CH8, CH5, CH10) recorded mean scores >3 across all the groups. Considering the overall rating of all the professional groups, they perceived lack of experience and training(CH1), lack of skilled personnel(CH2), availability of the appropriate technology and infrastructure(CH7), lack of awareness and support of the technology by Managers(CH3), lack of practical knowledge(CH4), poor internet connectivity(CH6), high cost of integrated software/Models(CH9), resistance to change(CH8), lack of enabling environment(CH5), cost of required software upgrade(CH10), frequent power failure(CH20), lack of standards to guide implementation(CH16) and uniqueness of each construction project(CH19) as challenges for the adoption of BIM in Nigeria construction industry.

Table 2: Results Evaluation of Professionals on the Challenges for the Adoption of Building Information Modeling (BIM)

Variable coding	Description of Challenges	Architects		Engineers		Quantity Surveyors		Overall rating		Standard deviation	F	Sig.
		MS	Rank	MS	Rank	MS	Rank	MS	Rank			
CH1	Lack of experience and training	3.66	1	3.61	1	3.61	3	3.63	1	1.198	0.051	0.950
CH2	Lack of skilled personnel	3.66	1	3.54	6	3.57	5	3.58	2	1.215	0.261	0.770
CH7	Availability of the appropriate technology and infrastructure.	3.44	9	3.56	3	3.64	1	3.56	3	1.189	0.694	0.500
CH3	Lack of awareness and support of the technology by Managers	3.47	7	3.58	2	3.61	3	3.56	4	1.238	0.383	0.682
CH4	Lack of practical knowledge	3.51	5	3.35	11	3.52	6	3.47	5	1.196	0.609	0.545
CH6	Poor Internet Connectivity	3.45	8	3.41	9	3.46	7	3.44	6	1.352	0.041	0.960
CH9	High Cost of Integrated software/Models	3.52	4	3.55	4	3.28	11	3.43	7	1.203	1.682	0.188
CH8	Resistance to change	3.40	10	3.55	4	3.32	10	3.41	8	1.168	1.025	0.360
CH5	Lack of enabling environment	3.35	11	3.40	10	3.34	9	3.36	9	1.259	0.067	0.935
CH10	Cost of required software upgrade	3.07	15	3.27	12	3.43	8	3.28	10	1.291	1.936	0.146
CH20	Frequent Power Failure	2.85	18	3.00	19	3.62	2	3.21	11	1.331	0.858	0.121
CH16	Lack of Standards to Guide Implementation	3.57	3	3.54	6	2.61	12	3.17	12	1.348	0.798	0.119
CH19	Uniqueness of each construction project	3.49	6	3.51	8	2.52	13	3.10	13	1.381	0.328	0.699
CH14	Guidance and government support	3.23	12	3.18	14	2.37	14	2.87	14	1.302	16.618	0.000**
CH11	Clients are not requesting the use of BIM	3.20	13	3.24	13	2.36	15	2.87	15	1.479	13.200	0.000**
CH13	Responsibilities between stakeholders	3.08	14	3.09	16	2.36	16	2.79	16	1.407	10.170	0.000**
CH12	Individual/personal disposition	2.80	19	3.15	15	2.20	18	2.67	17	1.295	16.224	0.000**
CH17	Lack of opportunity for BIM implementation	2.88	17	3.04	17	2.11	19	2.62	18	1.360	16.316	0.000**
CH18	Lack of current public policy on BIM	2.90	16	3.04	17	2.09	20	2.61	19	1.406	15.960	0.000**
CH15	Low level of involvement of BIM users in green projects	2.51	20	2.94	20	2.29	17	2.55	20	1.302	6.864	0.001**

****There is a statistically significant difference of opinion between the groups.**

4.3 Level of Criticality on the Identified Challenges amongst Construction Professionals for the Adoption of BIM in Nigeria Construction Industry

The objective here is to determine the level of criticality of the identified factors through the level of agreement amongst construction professionals on these identified challenges. This implies that, those challenges with no significant difference in the perception of construction professionals are regarded as critical challenges. In order to achieve this, all the 20 items used in measuring challenges to adoption of BIM were subjected to analysis of variance (ANOVA). The ANOVA conducted on the results showed there was no significant difference in the level of agreement among the three groups of professionals on 13 out of 20 identified challenges to BIM adoption in Nigeria construction industry as their Sig. p values were greater than 0.05.

These challenges are; lack of experience and training(CH1), lack of skilled personnel(CH2), availability of the appropriate technology and infrastructure(CH7), lack of awareness and support of the technology by managers(CH3), lack of practical knowledge(CH4), poor internet connectivity(CH6), high cost of integrated software/Models(CH9), resistance to change(CH8), lack of enabling environment(CH5), cost of required software upgrade(CH10), frequent power failure(CH20), lack of standards to guide implementation(CH16) and uniqueness of each construction project(CH19), and what this result suggests therefore is that, these items are most critical challenges to the adoption of BIM in Nigeria construction industry because all the group of professionals shared the same view on these items

with their Sig. p values greater than 0.05. However, the professionals (groups) held different opinions on 7 out of the 20 items considered at 5% significant level. These challenges considered less critical are: guidance and government support (CH14), clients are not requesting the use of BIM(CH11), responsibilities between stakeholders(CH13), individual/personal disposition(CH12), lack of opportunity for BIM implementation (CH17), lack of current public policy on BIM(CH18) and low level of involvement of BIM users in green projects (CH15).

5. CONCLUSION AND RECOMMENDATIONS

This research sought to assess the challenges for the adoption of BIM in Nigeria construction industry, through the identification of various challenges impeding BIM adoption and determine the level of agreement amongst the professional groups on the challenges identified in order to indicate the level of criticality of those challenges with no significant difference. The research findings show that lack of experience and training, lack of skilled personnel, availability of the appropriate technology and infrastructure, lack of awareness and support of the technology by managers, lack of practical knowledge, poor internet connectivity, high cost of integrated software/models, resistance to change, lack of enabling environment, cost of required software upgrade, frequent power failure, lack of standards to guide implementation and uniqueness of each construction project are challenges to BIM adoption in Nigeria construction industry.

The findings further show that all these challenges are perceived to be critical based on significance test of level of agreement carried out on the group of construction professionals. It therefore becomes imperative for Nigeria construction professionals to devise strategies in handling these challenges in order to improve performance at both organisational and project levels. The study therefore, recommends the need to increase training, awareness of BIM; the integration of BIM into the Academic curriculum; and for the Nigeria Government to facilitate the implementation of BIM in Infrastructure projects, in order to ensure adequate knowledge of BIM in Nigeria Construction Industry.

REFERENCES

1. Abdulahi, A., Abdullahi, M. and Musa, U. (2016). *Developing Information Requirement Model for BIM-Based Quantity Take-off Using Building and Engineering Standard Method of Measurement 3 (BESMM3)*. Abuja, NBRRI.
2. Abubakar, M., Ibrahim, Y., Kado, D. and Bala, K. (2014). Contractors Perception of the Factors Affecting Building Information Modeling (BIM) Adoption in the Nigerian Construction Industry. *Computing in Civil and Building Engineering*, 167-178.
3. Akerele, A. O. and Moses, E. (2016). Assessment of the Level of Awareness and Limitations on the Use of Building Information Modeling in Lagos State. *International Journal of Scientific and Research Publications*, 6(2), 229-233.
4. Alufohai, A. (2012). Adoption of building information modeling and Nigeria's quest for project cost management. *Nigerian Institute Quantity Surveyors*, 1(1), 6-10.
5. Antón, L.A. and Díaz, J. (2014). Integration of LCA and BIM for Sustainable Construction. *International Journal of Social, Behavioral, Educational, Economic, Business and Industrial Engineering*, 8, 1378-1382.
6. Arayici, Y., Egbu, C. and Coates, P. (2012). Building Information Modeling (BIM) Implementation and Remote Construction Projects: Issues,Challenges, and Critiques. *Journal of Information Technology in Construction (ITcon),* 17, 75-59.
7. Arayici, Y., Khosrowshahi, F., Ponting, A. and Mihinda, S. (2009). Towards Implementation of Building Information Modelling in the Construction Industry. Istanbul,Turkey: *Fifth International Conference on Construction in the 21st Century (CITC-V)*.
8. Bozoglu, J. (2016). Collaboration and Coordination Learning Modules for BIM Education. *Journal of Information Technology in Construction (ITcon),* 21, 152-163.
9. Chan, C. T. W. (2014). Barriers of Implementing BIM in Construction Industry from the Designers' Perspective: A Hong Kong Experience. *Journal of System and Management Sciences*, 4(2), 24-40.
10. Ding. Z., Zuo. J., Wu, J. and Wang, J. (2015). Key Factors for the BIM Adoption by Architects: A China Study, *Engineering, Construction and Architectural Management*, 22(6), 732-748.
11. Doloi, H., Sawhney, A., Iyer, K.C. and Rentala, S. (2012). Analysing Factors Affecting Delays in Indian Construction Projects. *International Journal of Project Management*, 30(4), 479-489.
12. Eastman, C., Teicholz, P., Sacks, R. and Liston, K. (2011). *BIM handbook: A Guide to Building Information Modeling for Owners, Managers, Designers, Engineers, and Contractors*. John Wiley & Sons, Inc., 337-338.
13. Ezeokoli, F.O., Ugochukwu, S.C. and Okolie, K.C. (2016). Actualization of a Cashless Construction Industry in Nigeria: Perceptions of Stakeholders in Anambra State. *International Journal of Multidisciplinary Research and Development*, 3(1): 246-253.
14. Gichoya, D. (2005). Factors Affecting the Successful Implementation of ICT Projects in Government. *The Electronic Journal of e-Government*, 3(4)4, 75-184.
15. Hwang, B.G., Zhao, X. and Ng, S.Y. (2013). Identifying the Critical Factors Affecting Schedule Performance of Public Housing Projects. *Habitat International*, 38, 214-221.
16. Kaliba, C., Muya, M. and Mumba, K. (2009). Cost Escalation and Schedule Delays in Road Construction Projects in Zambia. *International Journal of Project Management*, 27(5), 522-531.
17. Kori, S.I.A. and Kiviniemi, A. (2015). Toward Adoption of BIM in the Nigerian AEC Industry; Context framing, Data Collecting and Paradigm for Interpretation. *Paper Presented at the 9th BIM Academic Symposium & Job Task Analysis Review*, Washington, DC.
18. Oladapo, A.A. (2007). An Investigation into the Use of ICT in the Nigerian Construction Industry. *Special Issue Construction Information Technology in Emerging Economies, ITcon*, 12, 261-277.
19. Oyediran, S.O. and Odusami, K.T. (2005). A Study of Computer Usage by Nigerian Quantity Surveyors. *Journal of Information Technology in Construction*, 10, 291-303.

20. Porwal, A. and Hewage, K.N. (2013). Building Information Modeling (BIM) Partnering Framework for Public Construction Projects. *Automation in Construction*, 31, 204-214.
21. Rogers, J., Chong, H.Y. and Preece, C. (2015). Adoption of Building Information Modeling Technology (BIM): Perspectives from Malaysian Engineering Consulting Services Firms. *Engineering, Construction and Architectural Management*, 22(4), 424-445.
22. Succar, B. (2009). Building Information Modelling Framework: A Research and Delivery Foundation for Industry Stakeholders. *Automation in Construction,* 18, 357-375.
23. Sun, C., J. Shaohua, J. Miroslaw, P.M. Qing and Liyin, S. (2017). A Literature Review of the Factors Limiting the Application of BIM in the Construction Industry. *Technological and Economic Development of Economy,* 23 (5), 764-779.
24. Tse, T., Wong, K. and Wong, K. (2005). The Utilization of Building Information Models in nD Modeling: A Study of Data Interfacing and Adoption Barriers. ITCON, 10, 85-110.
25. Ugwu, O. and Kumaraswamy, M.M. (2007). Critical Success Factors for Construction ICT Projects- Some Empirical Evidence and Lessons for Emerging Economies. ITCON, 12, 231-249.
26. Yan, H. and P. Damian (2008). Benefits and Barriers of Building Information Modeling. 12th International Conference on Computing in Civil and Building Engineering, Beijing, China.