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Building Information Modeling Software for Project Planning in Construction Industries

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ABSTRACT

Purpose: The aim of this research was to evaluate the application of building information modelling (BIM) software in the context of project planning within the construction sector in Ondo-State. The investigation was guided by three research inquiries.

Methodology: The research adopted a survey research design and targeted a population of 31 construction industries, encompassing 126 Contractors and Building consultants in Ondo-State. For data collection, a structured questionnaire comprising 41 items, developed by the ERASMUS + programme, was utilized. The validity of the instrument was confirmed through assessment by two experts from the Department of Industrial Technical Education (Building/Woodwork), University of Nigeria, Nsukka, and one expert from Bablor Construction Company, Akure South, Ondo-State.

Findings: The results indicated that the utilization of building information modelling (BIM) software remains limited in scope. Consequently, the study proposes several recommendations. These include the organization of educational and training programs focusing on BIM software usage within the construction industry, the enforcement of mandatory BIM adoption for all personnel engaged in the construction process, and the establishment of standardized contract documentation by government or professional bodies. These measures aim to ensure the effective utilization of BIM in construction projects, facilitating improved design, analysis, hazard mitigation, and timely project completion.

Unique Contribution to Theory, Policy and Practice: The study identified strategies that were involved in the teaching of English Language to final year learners in correlation with their class exercises, quizzes and Mock Examination results. The study found that teachers adopted teacher-centered approaches which did not take into consideration individual learning needs and abilities. Through the application of Experiential Learning, it is expected that learners have more meaningful and lasting learning processes, so they can make effective use of their learning. The findings of this research showed that Experiential Learning could increase learners' motivation to become independent learners.

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Introduction

Building Information Modeling (BIM) Software represents the digital formation. (Erin, 2016) described Building Information Modeling (BIM) Software as a software used by designers to create a building project with integrated information in a format that models both the structure and the entire timeline of a project from commencement to eventual demolition. The use of Building Information Modeling (BIM) Software gives architecture, engineering and construction experts the insight and tools to efficiently plan, design, construct and manage buildings and infrastructure in the construction industry. Milyutina (2018) affirmed that Building Information Modeling software is integrated into all stages of building production and sustenance such as data gathering, design, construction, machineries, building operations, repairs and demolition. The construction industry has continued to evolve with time to achieve efficient and effective service delivery. Nazib (2010) described Construction Industry as a sector of economic activity which is concerned with the erection, alteration, repairs, demolition of a building as well as other forms of construction works ranging from civil engineering works such as roads, bridges, dams, sewerage system construction and other related construction. It also includes professional services such as management, architecture, design and facilities management. Technology has made every sector of human endeavour to develop in diverse ways. Similarly, the construction industry is not left behind. Building information modeling software technology has enhances the construction process for easy management and maintenance. Hence, the need for project plan. The project plan clearly defines how the project is executed, monitored, controlled and completed. Fahad (2019) defined project plan as a formal, approved document used to broadly guide a project and facilitate communication among the stakeholders that are involved. A project plan is the work plan.

The world is technologically advanced. Boukaraa & Naamane (2015) reported that over the past few years, the number of Building Information Modeling software technology users and buildings designed using the technology has grown drastically and this trend is expected to continue. However, studies have shown that Ondo-State construction industries is yet to fully adopt the Building Information Modeling software system for building construction project planning. The application of BIM software in building construction project planning improves project planning, visualization, management, workflow and partnership with all building personnel. Nevertheless, in Ondo-state there may be low availability of BIM technology tools and technologies and poor standardization of BIM process in the construction industry that are required to increase productivity, efficiency, quality and sustainability of building construction process. In addition, building construction professionals do not have the required skills and competency to operationalize BIM technology for construction processes. BIM being a rising technology in Nigeria construction industry is expected to deliver many benefits to the industry. Based on this premise, this paper attempts to examine the extent of utilization of BIM by client and building professionals in Ondo-state building construction industries.

Research Aim

The general purpose of this study is to assess the extent of the utilization of Building Information Modelling (BIM) Software for Project Planning in Construction industries.

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Methodology

A descriptive survey design was adopted for this study. The study was carried out in Ondo- State. The population of the study consisted of 126 Contractors and Building consultants in construction industries in Ondo-State. These questionnaires were administered among a randomly selected sample group, comprising of practicing professionals in the construction industries in the study area. These professionals include contractors (main and sub), Building Consultants (architects, builders, quantity surveyors, project managers, structural engineers, electrical engineer, and mechanical engineer). The instrument used for the study was a structured questionnaire with four sections A, B, C and D. Section A elicited demographic information of the respondents while Section B, C and D had 41 item statements that sought information to answer the research questions. The responses were designed based on 4-point scale which ranges from 4 to 1. The responses to research question 1 and 2 comprised of the following -*Strongly Agreed (SA) = 4, Agreed (A) = 3, Disagreed (D)= 2 and Strongly Disagreed (SD)= 1*; while Research question 3 had responses of: *Highly Utilized (HU) = 4, Utilized (U) = 3, Not Utilized (NU) = 2* and *Highly Not Utilized (HNU) = 1*; The questionnaire was face validated by three experts; two experts from the Department of Industrial Technical Education (Building/Woodwork), University of Nigeria, Nsukka, and one expert from Bablor Construction Company, Akure South, Ondo-State. The data collected from the study was analyzed using mean for answering the research questions and t-test for testing the hypotheses at probability level of 0.05 and 95 degree of freedom (df). Any item with a mean value of 2.50 and above was regarded as Agreed upon/utilized while any item with a mean below 2.50 was regarded as Disagreed/Not utilized. Data analyses were carried out using SPSS 22.0 as statistical packages. The statistical tools we employed are mean, Cronbach's alpha, independent samples t-test. The SPSS was used to determine the mean and independent samples t-test. For the test of significance, the probability (*p*) value was used in comparison with the alpha value of .05, and at other relevant levels.

Research Findings

The data for answering Research question 2 are presented in Table 1

Table 1: Mean and t-test Analysis of the Responses of Contractors and Building Consultants on the benefits

S/N	Item Statements	X	Decision	t-cal	Df	Sig.	H_0
1	Using BIM will improve productivity of on-site work	3.28	Agreed	.55	40	.58	NS
2	Using BIM will enhance construction planning	3.11	Agreed	.91	40	.37	NS
3	Using BIM will enable planning and visualizing the entire project during preconstruction	3.14	Agreed	.90	40	.38	NS
4	Using BIM will communicate information to all stakeholders involved in the building project	3.16	Agreed	.11	40	.91	NS
5	Using BIM will reduce cost and mitigation risk	3.19	Agreed	.70	40	.48	NS
6	Using BIM will improve the building quality	3.23	Agreed	1.05	40	.30	NS
7	Using BIM will coordinate and detect clash	3.19	Agreed	.70	40	.48	NS
8	Using BIM will help in project control	3.14	Agreed	1.57	40	.14	NS
9	Using BIM will save time in the construction process	3.21	Agreed	1.21	40	.23	NS
10	Using BIM will detect potential hazard in the construction process	3.14	Agreed	1.17	40	.26	NS
11	Using BIM will hasten the project development	3.09	Agreed	.67	40	.50	NS
12	Using BIM will enhance safety management	3.23	Agreed	.49	40	.62	NS

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13	Using BIM will help in project management	3.19	Agreed	.50	40	.62	NS
14	Using BIM will check the logistics and functioning of building construction project	3.07	Agreed	1.08	40	.28	NS
15	Using BIM will enhance safety control	3.26	Agreed	.38	40	.70	NS

Note **X** = Grand Mean; **T-cal =** T-Calculated**,** Strongly Agreed (SA) = 4, Agreed (A) = 3, Disagreed (D)= 2 and Strongly Disagreed (SD)= 1; **NS** = Not Significant; **H_0** = Null Hypothesis; **df**= Degree of freedom

The data for answering Research question 3 are presented in Table 3

Table 3: Mean and t-test Analysis of the Responses of the challenges faced in Building Information Modelling (BIM) software applications for Project Planning in Construction industries in Ondo-State

S/N	Item Statements	X	Decision	t-cal	Df	Sig.	H_0
1	Client unawareness of BIM	3.16	Agreed	.70	40	.49	NS
2	High cost of training for Users	2.83	Agreed	1.39	40	.17	NS
3	Low availability of BIM technology	3.07	Agreed	.47	40	.64	NS
4	Poor government support	2.69	Agreed	.26	40	.79	NS
5	Poor standardization of BIM process in the construction industry	2.88	Agreed	.17	40	.86	NS
6	Industries/Building consultant's resistance to trends	3.04	Agreed	.93	40	.35	NS
7	Poor BIM structure in the construction industry	2.85	Agreed	.79	40	.44	NS
8	Poor knowledge of BIM by professionals	2.95	Agreed	.86	40	40	NS
9	No requirement of BIM technologies for typical projects (small projects)	2.98	Agreed	1.28	40	.21	NS
10	Computer illiterate	2.25	Agreed	.64	40	.53	NS

Note **X** = Grand Mean; **T-cal =** T-Calculated**,** Strongly Agreed (SA) = 4, Agreed (A) = 3, Disagreed (D)= 2 and Strongly Disagreed (SD)= 1; **NS** = Not Significant; **H_0** = Null Hypothesis; **df**= Degree of freedom

The data for answering Research question 4 are presented in Table 4

Table 4: Mean and t-test Analysis of the Responses of the extent to which Building Information Modelling (BIM) software are utilized for Project Planning in Construction industries in Ondo-State

S/N	Item Statements	X	Decision	t-cal	Df	Sig.	H_0
1	I use BIM for pre-project planning services	2.52	U	1.25	40	.22	NS
2	I use BIM for Project Management	2.95	U	1.24	40	.22	NS
3	I use BIM for Project control	2.38	NU	.13	40	.89	NS
4	I use BIM to reduce cost and mitigation risk	2.47	NU	.86	40	.40	NS
5	I use BIM to detect clash in the construction process	2.71	U	.61	40	.54	NS
6	I use BIM to communicate information to all the stakeholders involved in the construction process	2.52	U	.51	40	.61	NS
7	I use BIM to improve the building quality	2.40	NU	.31	40	.75	NS
8	I use BIM in safety management and control	2.80	U	.05	40	.95	NS
9	I use BIM to save time in the construction process	2.57	U	.19	40	.84	NS
10	I use BIM to detect potential hazard in the construction process	2.38	NU	.12	40	.89	NS
11	I use BIM to hasten the project development	2.42	NU	.49	40	.62	NS
12	I use BIM to check logistics and functioning of building construction project	2.47	NU	1.55	40	.14	NS
13	I use BIM to plan and visualize the entire project during preconstruction	2.57	U	.82	40	.42	NS
14	I use BIM for construction sequencing	2.54	U	.67	40	.50	NS
15	I use BIM for forensic analysis	2.66	U	.23	40	.81	NS

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16	I use BIM for facilities management	2.19	NU	.71	40	.48	NS
17	I use BIM for conceptual design support	2.30	NU	.40	40	.68	NS

Note **X** = Grand Mean; **T-cal =** T-Calculated**,** Highly Utilized (HU) = 4, Utilized (U) = 3, Not Utilized (NU) = 2 and Highly Not Utilized (HNU) = *1*; **NS** = Not Significant; $\mathbf{H_0}$ = Null Hypothesis; **df**= Degree of freedom

Discussion of results

The findings of the study showed that BIM software are utilized for project planning in construction industries in Ondo-state but the usage is very low as expected. This is in line with Azhar S, Hein M and Sketo B (2008), they stated that BIM software adoption has been much slower than anticipated. It also showed that BIM software are not been utilized for project control, cost and mitigation risk reduction, improvement of building quality, detection of potential hazard in construction process, for hastening project development, checking logistics and functioning of building construction project, facilities management and conceptual design support for project planning in construction industries in Ondo-state which simulate the operation of a construction project. Hence, the need for the government and professional bodies to make BIM software application compulsory for project planning.

The findings of the study also revealed the challenges faced in BIM software application for project planning in Ondo-State such as client's unawareness of BIM software, high cost of training, low availability of BIM technology and poor standardization of BIM process in the construction industry. This is in line with Brewer, Gajendran and Goff (2012), they stated that, technical challenges, skills and training challenges, legal and procedural challenges, cost challenges, are challenges for using BIM on construction.

Finally, the study revealed the benefit of BIM software application for project planning Hence, the importance of BIM software cannot be overemphasized in achieving high building quality, innovative virtual design and project management in the modern world. This is in line with (Qian, 2012) who stated that BIM enhanced project collaboration and control among stakeholders, improved productivity, better project quality and performance, faster project delivery, reduced wastages, reduced construction costs, new revenue and business opportunities.

Conclusion

Based on the findings of the study, it was revealed that the adoption of Building information modeling software technology is low in Ondo-State and this paper shows that Building information modeling software is an innovative way to practically design and manage project plan. BIM adoption is needed to enhance building performance and operation. This paper shows that BIM software can be used for project planning, design, preconstruction and construction phases in building construction process. These capabilities have empowered BIM to play a significant role in project planning and management. Therefore, BIM is imperative to stimulate construction project planning and the construction process to analyze and resolve issues and ensure that the project is completed timely.

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Recommendations

Based on the findings of the study, the following recommendations were made:

- Education and training programme on BIM software should be organized to sensitize all building teams on the importance of BIM software technology.
- Appropriate BIM software technology and infrastructure should be provided by the construction project managers.
- Building Information Modeling software technology should be made compulsory by the government and professional bodies for all building contractors or personnel involved in construction process.
- A standard contract document should be integrated to building regulations by the government or professional bodies for project managers to ensure the usability of BIM for construction project.

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