



Assessment of Impact of Building Information Modelling (BIM) As a Project Delivery Tool in Nigeria Construction Industry

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Abstract: *This project assessed the impact of using Building Information Modelling (BIM) as a project delivery tool. Identification of new performance key indicators was created in the assessment of BIM-assisted projects. A sequential approach method was employed in data acquisition with qualitative content and quantitative descriptive analysis using Relative Important Index (RII) used to establish level of professionals understanding of BIM applications and its importance in Construction project Performance in Nigeria. The findings identified the needs for improvement on usage of BIM infrastructure for construction project performance and timely delivery within the cost limit. It was also revealed that the BIM applications is advantageous in the areas such as visualization of what is to be constructed, improving communications and coordination, cost and resources savings. It is recommended that Nigeria construction companies should intensify efforts on adoption and implementation of BIM in construction projects executions for timely delivery of project in any circumstances.*

Key words: *BIM, project delivery tools, Construction performance and Relative Important Index*

1.0 INTRODUCTION

Building information modelling (BIM) is widely acceptable and used as most efficient and reliable technologies in solving the difficulties in Architectural, Engineering, and Construction designs in construction industry (Durdyev *et al.*, 2021; Azhar, 2011). Adoption and acceptance of BIM in the Architectural, Engineering, and Construction (AEC) business has made easy the coordination and collaboration of professionals across multiple disciplines in the industry and as well as reduced the industry's difficulties to more manageable level (Chan *et al.*, 2019). The architectural elements designs, geographic information, cost analysis, schedule of project work, material quantities and inventories, spatial linkages and other attributes of construction program are all incorporated into a BIM model (Chan *et al.*, 2018; Azhar, 2011). Adoption of BIM enables project stakeholders to effectively work together from conception to completion of the project (Oesterreich *et al.*, 2019).

BIM is being promoted as the ideal tool for collaboration in construction, and multiple studies investigate the need for increased understanding and efficiency of BIM in the technical and operational sense. Despite the development of strategies to investigate the benefits of BIM in terms of construction project performance, research on adoption in Nigeria construction industry is still sparse due to the newness of BIM, the complexity of projects, and the lack of standard, unified efficiency measures. For these reasons, the study investigated the level of application and impact of Building Information Modeling (BIM) in Nigeria construction Industry and how it affects construction performance.

2.0 METHODOLOGY

This study's technique was a sequential mixed method approach that included both qualitative and quantitative research methodology. A total of sixty (60) copies of questionnaire were given out to Construction companies operating in Nigeria of which fifty two (52) copies of questionnaire were retrieved amounting to 86.7% of all the questionnaires and this was used for the analysis. The simple percentage and frequency were employed to analyze the respondents' biodata and their responses to opinion questions. Specifically twelve (12) construction companies operating in Nigeria were randomly selected in order to

acquire the greatest possible viewpoint on the present application level of BIM as a tool in project delivery and to provides equal opportunity to all members of the population and eliminates any possibility of bias.

Table 1.0: List of Randomly Selected construction companies

S/N	Companies	Head Office Address	Year of Establishment in Nigeria
1	Reynolds Construction Company (Nigeria)Ltd (RCC)	28 Ebitu Ukiwe Street Jabi District, Abuja FCT, Nigeria	1956
2	Olubi Construction Company	No 20 Irerinde Street Osogbo Osun State	2007
3	Abija Construction Company Nigeria Ltd	Gbongan Road, Osogbo, Nigeria.	1975
4	Tecno Katagum Construction Company	266a Kofo Abayomi Street V/island Lagos	1980
5	Igaby Lussy Nigeria Limited	Flat 9, Block B, Pankshin Close off Emeka. Anyoaku Street, Area 11, Garki Abuja	2010
6	Interfem Construction Company	QGRP+49X, Motigbenuayo Close Osogbo Local Government, 230262, Osogbo	2007
7	Trapetti Construction and Engineering Company	NO.2, Oregonroad, Oregon, Alausa, Lagos, Lagos	2005
8	Element Construction and Engineering Company	Kilometre 4 New, Ikirun Road, Kobongbogboe, Osogbo	2008
9	Temidat Integrated Services	Lagos Mainland, Lagos, Nigeria	2014
10	Excel Building and Construction Company Limited	10 Awosuru Road, Gbongan Ibadan Road ,Osogbo, Osun State.	2008
11	Magabat International Ltd	G.R.A, Urimi Police Station, 7B Nagwamatse Road, Ungwan Rimi 802125, Kaduna	2013
12	Ramussal International Limited	G.R.A, Urimi Police Station, 7B Nagwamatse Road, Kaduna	2005

Source: Field Report, 2022

3.0 RESULT AND FINDINGS

The obtained results from data analysis are presented below. The data analysed include bio demographic information of the respondents, Key drivers for BIM adoption and implementation on a construction project, Key areas for assessing Construction Performance and Impact of adoption of BIM to enhancing performance on construction projects

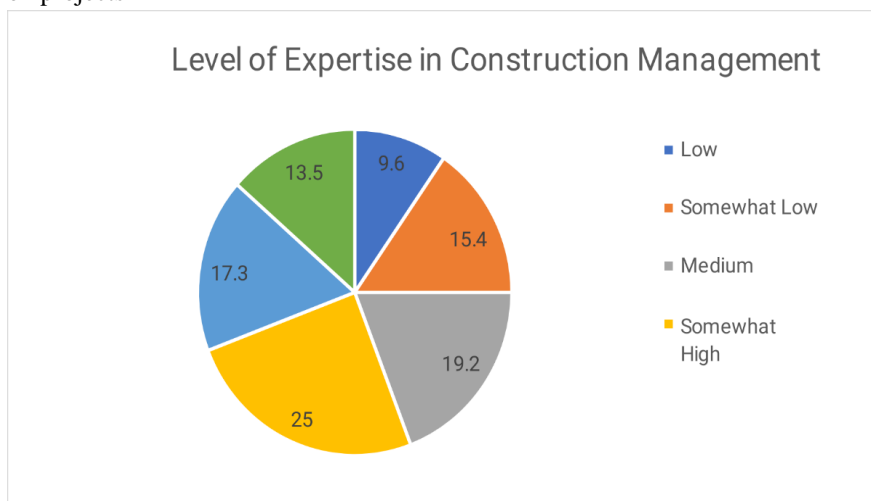


Figure 1.0: Level of Expertise in Construction Management of the respondents

Above figure shows the confidence of the respondent in their expertise, 5 respondents which represent 9.6% of the total populations had low confidence as experts, 8 respondents which represent 15.4% of the total populations had somewhat low confidence as experts, 10 respondents which represent 19.2% of the total populations had medium confidence as experts, 13 respondents which represent 25.0% of the total populations had somewhat high confidence as experts, 9 respondents which represent 17.3% of the total populations had high confidence as experts, while 7 representing 13.5% of the respondents considered themselves as experts. The result thus shows that most of our respondents had somewhat high confidence as experts.

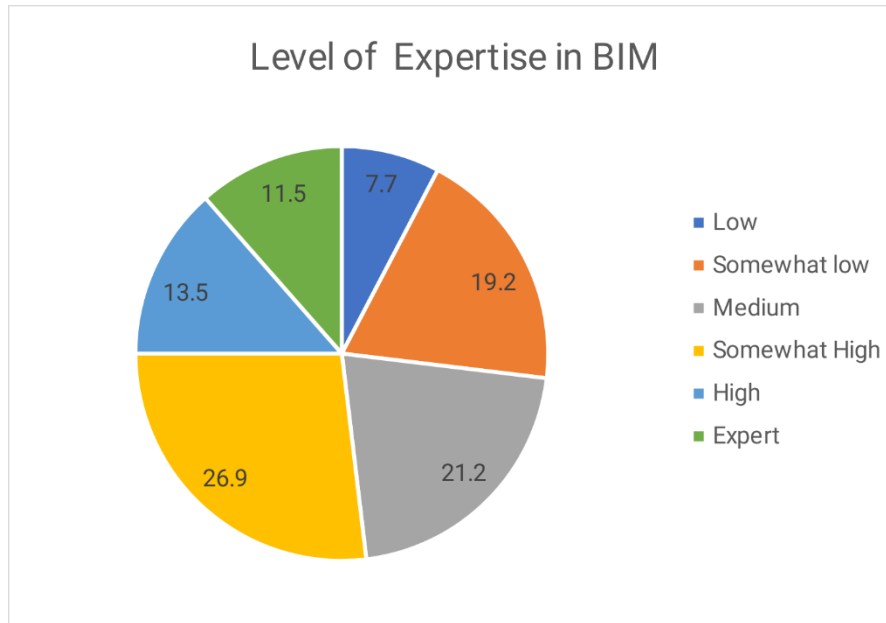


Fig. 2.0 Chart Showing the Level of Expertise in BIM of the Respondents

The analysis from figure 2.0 indicate that 4 respondents which represent 7.7% of the total populations had low confidence as experts, 10 respondents which represent 19.2% of the total populations had somewhat low confidence as experts, 11 respondents which represent 21.2% of the total populations had medium confidence as experts, 14 respondents which represent 26.9% of the total populations had somewhat high confidence as experts, 7 respondents which represent 13.5% of the total populations had high confidence as experts, while six (6) representing 11.5% of the respondents considered themselves as experts. The result thus shows that most of our respondents had somewhat high confidence as experts in the BIM.

Table 2.0: Key drivers of BIM adoption and implementation on a construction project

S/No	BIM Driver	SA	A	U	D	SD	RII	Ranking
1	BIM software cost	10	12	9	11	10	0.6038	7 th
2	Adoption and implementation of BIM receives government enforcement support.	9	6	12	13	12	0.5500	9 th
3	Increasing BIM tools investment	12	12	9	8	10	0.6314	6 th
4	Pressure from competitors	7	14	10	9	12	0.5808	8 th
5	Client compulsion	11	14	10	8	9	0.6385	5 th
6	Accessibility of BIM programs for training	8	9	10	11	14	0.5462	10 th
7	Benefits associated with BIM expertise	12	14	8	10	8	0.6462	4 th
8	Require construction workers to be BIM expertise	15	20	7	5	5	0.7346	1 st
9	Developing a BIM project delivery organizational structure	12	15	12	7	6	0.6769	3 rd
10	BIM training grant supply plan	13	16	9	8	6	0.6846	2 nd

Source: Field Survey, 2022

The perception of the respondent regarding the key drivers of BIM adoption and implementation on a construction project in Table 2.0 established that Key drivers of BIM adoption and implementation on a construction project is Require construction workers to be BIM expertise and BIM training grant supply plan were ranked 1st and 2nd with Relative Important Index (RII) of 0.734 and 0.684 respectively. Developing a BIM project delivery organizational structure was ranked 3rd with Relative Important Index (RII) of 0.6769 while Benefits associated with BIM expertise and Client compulsion were ranked 4th and 5th with Relative Important Index (RII) of 0.6462 and 0.6385 respectively. Furthermore, Increasing BIM tools investment, BIM software cost and Pressure from competitors were ranked 6th, 7th and 8th with Relative Important Index (RII) of 0.631, 0.6038 and 0.580 respectively. Lastly, Adoption and implementation of BIM receives government enforcement support and accessibility of BIM programs for training were ranked 9th and 10th with Relative Important Index (RII) of 0.5500 and 0.5462 respectively.

Table 3.0: Key areas for assessing Construction Performance using BIM application

S/No	Key areas for assessing Construction Performance	SA	A	U	D	SD	RII	Ranking
1	Data Management	13	17	6	8	8	0.6731	7th
2	Communication Efficiency	12	18	7	9	6	0.6808	6th
3	Communication Mode	14	18	9	7	4	0.7192	1st
4	Communication Intensity	11	15	9	10	7	0.6500	11th
5	Coordination Instrument	13	15	11	7	6	0.6846	4th
6	Open Data Exchange	13	16	6	9	8	0.6654	8th
7	Material Administration (e.g. waste reduction)	14	16	6	9	7	0.6808	5th
8	Labour Administration (e.g. lost time, idle time)	10	17	8	9	8	0.6462	12th
9	Management of Subcontractors	9	16	9	10	8	0.6308	14th
10	Management of Costs	11	18	6	10	7	0.6615	9th
11	Timeline Control	13	15	10	11	3	0.6923	3rd
12	Work Improvements	10	14	11	9	8	0.6346	13th
13	Quality Control	12	17	10	9	4	0.6923	2nd
14	Earlier Detection of Problems	12	14	9	10	7	0.6538	10th

Source: Field Survey, 2022

The results in table 3.0 show that communication mode, Quality Control and Timeline Control were ranked 1st, 2nd and 3rd with Relative Important Index (RII) of 0.7192, 0.6923 and 0.6923 respectively. Coordination Instrument, Material Administration (e.g. waste reduction) and Communication Efficiency were ranked 4th, 5th and 6th with Relative Important Index (RII) of 0.6846, 0.6808 and 0.6808 respectively while Data Management and Open Data Exchange were ranked 7th and 8th with Relative Important Index (RII) of 0.6731 and 0.6654 respectively. Furthermore, Management of cost, Earlier Detection of Problems and Communication Intensity were ranked 9th, 10th and 11th with Relative Important Index (RII) of 0.6615, 0.6538 and 0.6500 respectively. Lastly, Labor Administration (e.g. lost time, idle time), Work Improvement and Management of Subcontractors were ranked 12th, 13th and 14th with Relative Important Index (RII) of 0.6462, 0.6346 and 0.6308 respectively.

Table 4.0: Impact of Adoption of BIM to enhancing Performance on Construction Projects

S/No	Impact of Adoption of BIM to enhancing Performance on Construction Projects	SA	A	U	D	SD	RII	Ranking
1	Have you worked with BIM before?	12	14	9	10	7	0.6538	6 th
2	Has your company's BIM implementation resulted in any productivity losses?	9	8	10	13	12	0.5577	8 th
3	BIM implementation expenses will surpass the financial benefits of BIM.	12	13	9	8	10	0.6346	9 th
4	The use of BIM will aid in the development of tender and contract documentation.	12	15	9	7	9	0.6538	7 th
5	BIM implementation will be simple for infrastructure projects.	13	16	5	8	10	0.6538	10th
6	Additional training is required to utilize BIM tools for implementation.	13	18	9	6	6	0.7000	1 st

7	A BIM expertise should be introduced at your organization to assist and advice during the transition.	13	14	9	8	8	0.6615	4 th
8	Your projects make use of 3D modeling.	13	15	7	10	7	0.6654	3 rd
9	Will the implementation of BIM changes the responsibilities of the quantity surveyor?	14	16	6	9	7	0.6808	2 nd
10	BIM performance profits you or your current construction projects	12	16	7	10	7	0.6615	5 th

Source: Field Survey, 2022

The results in table 4.0 revealed that need for Additional training is required to utilize BIM tools for implementation and how implementation of BIM changes the responsibilities of the quantity surveyors were ranked 1st and 2nd with Relative Important Index (RII) of 0.7000 and 0.6808 respectively. Use of 3D modelling in projects and BIM expertise should be introduced at your organization to assist and advice during the transition were ranked 3th and 4th with Relative Important Index (RII) of 0.6615 and 0.6654 respectively. Furthermore, BIM performance profits you or your current construction projects, Have you worked with BIM before and the use of BIM will aid in the development of tender and contract documentation were ranked 5th, 6th and 7th with Relative Important Index (RII) of 0.6615, 0.6538 and 0.6538 respectively. Lastly, has your company's BIM implementation resulted in any productivity losses, BIM implementation expenses will surpass the financial benefits of BIM and BIM implementation will be simple for infrastructure projects were ranked 8th, 9th and 10th with Relative Important Index (RII) of 0.5577, 0.6346 and 0.6538 respectively.

4.0 CONCLUSION

The above analysis revealed that the utilization of BIM integrated tools such as softwares are rarely adopted by most of construction companies in Nigeria, especially the local construction companies despite the significance of BIM for assessing Project Success. Construction companies are enjoyed to maximize the emerging building technology that is becoming a more prevalent global endeavor. Using BIM models, it becomes clear that the integrated project delivery technique has several inherent green benefits over traditional construction methods, as well as greater certainty that project performance objectives will be reached or surpassed. Previous research has shown that including sustainable project objectives throughout design and construction programming leads in reduced project delays, costs, and rework. As previously stated, construction companies face pressure from competitors and hurdles in producing cost efficiency, high quality designs and completed sustainable building projects.

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