# Measuring Building Information Modelling (BIM) Competencies among Architectural Practitioners in Edo State, Nigeria

**Otobo Victor. Amhenya**
Department of Architecture Technology
National Institute of Construction Technology and Management, Uromi, Edo State, Nigeria

Abstract

Implementing Building Information Modeling (BIM) is an innovative and transformative strategy within the construction sector. Exploring competency in BIM is a fundamental building block of architectural capability in contemporary society. The present study measured Building Information Modelling (BIM) competencies among architectural practitioners in Edo State, Nigeria. The study adopted a cross-sectional survey design, and architectural practitioners (n=59) in Edo State responded to the research questionnaire. The results of the Likert-type scale administered to the respondents revealed that only 11% have low BIM competence. In comparison, 31% of respondents demonstrated moderate competence, and 54% demonstrated high competence in BIM. Thus, the data show positive results for BIM competence.

***Keywords:*** BIM, competencies, architectural, technology

## Introduction

The introduction of Building Information Modeling detailed a vision for a new method of construction collaboration that focuses on database-first technology. Building Information Modeling (BIM), also called n-D Modeling or Virtual Prototyping Technology, is a revolutionary development that is quickly reshaping the Architecture- Engineering-Construction (AEC) industry (Azhar et al., 2012). Building information modeling (BIM) has become increasingly popular in construction projects in recent years (Ali et al., 2022). Building Information Modeling (BIM) has facilitated greater collaboration among project stakeholders, which is one of the most significant and vital developments in this industry. (Samimpay & Saghatforoush, 2020). Building Information Modeling (BIM) is a relatively new development within the construction sector that expedites the resolution of project issues.

BIM in architecture pertains to the utilization of data accessible to building or construction owners to oversee and function buildings. Despite the structure's completion, the information contained in this data empowers governmental bodies, municipalities, and proprietors to make informed decisions by utilizing the model's information. The construction process involved using blueprints and drawings to provide specifics regarding the building's layout. Visualizing dimensions and requirements using this 2D method proved to be quite challenging. Afterward, CAD (Computer Aided Design). Later, CAD evolved into 3D, rendering blueprints more realistic. BIM, or building information modeling, is now pervasive in the architectural industry, but it transcends simple 3D modeling.

Architects use the BIM methodology to manage all the information related to an architectural project by producing digital design simulations. BIM includes 4-D (time) and 5-D (space), whereas CAD only produces 2 or 3-dimensional drawings that do not differentiate between their elements (costs). By automating tasks like programming, conceptual design, detailed design, analysis, documentation, manufacturing, construction logistics, operation and maintenance, renovation, and/or demolition, users can manage information intelligently throughout the life cycle of a project.

Software designed for Building Information Modeling (BIM) in architecture enables communication and information exchange over the entire lifecycle of an architectural project by leveraging emerging technologies. The phases encompass all aspects, including construction, completion, and planning. 3D CAD models are the typical source of the digital twin of a structure or undertaking. Supplementary software may furnish CAD models with pertinent data pertaining to building components or features. Architects can potentially mitigate the risk of error associated with data duplication and gain valuable, original insights by utilizing a unified Building Information Modeling (BIM) project model. By integrating simulation software into Building Information Modeling (BIM) models, additional physical phenomena can be documented, the performance of buildings can be assessed, and validation of design decisions can be provided to clients and other project stakeholders.

BIM plays a crucial role in architecture by granting architects, engineers, and building simulators access to an expanding volume of data early in the project schedule. Numerous disparate literatures have emphasized the importance of BIM in the field of architecture (Abdelhameed, 2018; Agirbas, 2020; Ajtayné Károlyfi et al., 2021; Banerjee & Nayaka, 2022; Boje et al., 2021; Clausen, 2021; Enshassi et al., 2018; Maina, 2018; Moreno et al., 2019; Öztürk et al., 2023; Salgado, 2022; Wu & Tang, 2022). The benefits are manifold and encompass a reduction in costs and risks, encouragement of collaboration, and improvement of the design procedure. BIM can have a significant favorable influence on the productivity and efficiency of construction projects. Hence, BIM competence is increasingly essential in architecture engineering and construction education. The objective of the present study was to assess the Building Information Modelling (BIM) competencies among architectural practitioners in Edo State, Nigeria.

## Method

The current research adopted a cross-sectional design. Practicing architects, including males and females from different architectural consulting firms and higher education institutions in Edo State, Nigeria, were randomly selected for the study. The participants were approached between October and December 2023 and were asked to participate in the study. They were informed of the purpose of the study and that their participation was entirely voluntary; they were also permitted to withdraw at any time. The consenting individuals were provided with the study instrument, which they were required to complete and promptly return. A total of 68 practicing architects responded to the survey. Nevertheless, nine copies were discarded on account of incorrect filling. The correctly completed questionnaires (59) were therefore statistically analyzed.

Table 1 shows demographic variables.

| Variables | frequency | percentage |
|---|---|---|
| **Gender** | | |
| *Males* | 53 | 89% |
| *Females* | 6 | 11% |
| Highest Education Qualification | | |
| *Ph.D.* | 7 | 9% |
| *M.Sc.* | 24 | 41% |
| *B.Sc.* | 16 | 29% |
| *HND* | 9 | 15% |
| *ND* | 3 | 6% |
| Years of working Experience Less than 5 years | | |
| *1-10 years* | 33 | 47.5% |
| 11-20 years | 19 | 35.5% |
| *21 years and above* | 7 | 17% |

Table 1 above describes the respondents' characteristics. The table shows that most respondents (89%) are males, while (11%) are females. It is shown that the respondents are mostly M.Sc. holders (41%), followed by B.Sc. holders (29%). Also, most respondents have been in architectural activity between 1-10 years, while 19% have spent 11-20 years as architects, and only a few (17%) have practiced beyond 20 years.

The study's main objective was to ascertain the respondents' BIM competency level. Thus, a 5-point Likert-type scale was designed to assess this level. The scale assesses a spectrum of viewpoints ranging from "Very low" to "Very high." Regarding the rating, 1 denotes the lowest, and 5 represents the highest. The result is shown in percentage below.

Table 1 shows respondents' BIM competence.

| Variables | frequency | percentage |
|---|---|---|
| Low | 11 | 17.7% |
| Moderate | 16 | 31.8% |
| High | 32 | 54.5% |

The table above shows the distribution of respondents based on their competence in using BIM. Responses to the open-ended question assessing the level of knowledge, exposure, confidence, and ease of using BIM software in architectural activities showed that only 11% of the respondents have low BIM competence. In comparison, 31% of the respondents showed moderate competence, while 54% showed high competence in BIM. Thus, the data indicates favorable outcomes relating to BIM competence in the research area.

**Discussion**

The present study measured Building Information Modelling (BIM) competencies among architectural practitioners in Edo State, Nigeria. The demographic result showed that most respondents (89%) are males, while (11%) are females, confirming the suspicion that there are losses in the number of female architects (Çivici & Yemişçioğlu, 2021). The data indicates that most respondents (41%) hold an M.Sc., with B.Sc. holders following suit (29%). Additionally, a minority of respondents (17%) have conducted architectural practice for over two decades. Most respondents have been in the field for between one and ten years. 19% have been architects for eleven to twenty years. The results of the Likert-type scale administered to the respondents revealed that only 11% have low BIM competence. In comparison, 31% of respondents demonstrated moderate competence, and 54% demonstrated high competence in BIM. Thus, the data show positive results for BIM competence in the research area. Previous studies have suggested a low knowledge of Building Information Modeling (BIM) in the construction industry, which is associated with low awareness and utilization among stakeholders in Nigeria (Balah & Akut, 2015). Also, others reported low awareness in other countries like Ghana (Leslie Appiah, 2020). The significance of BIM to the architectural profession might be a factor that has influenced this outcome.

## Conclusion

This paper has explored individual competencies in BIM, the fundamental building blocks of architectural capability in contemporary society. Expanding on previous research, several formative software has been introduced to develop an integrated industrial experience of Individual BIM competency. This study indicates that practicing architects in Edo State, Nigeria, are developing competency in BIM, given the technological advancements in the construction industry. Indeed, the result may be fraught with challenges as self-reported competency might be overstated or understated. However, many organizations use self-assessment methods to evaluate their employee BIM competencies. These assessments allow them to understand their current capabilities and identify areas for improvement. Despite this limitation, subjective assessments have been a popular method for assessing performance among researchers (Camps & Luna-Arocas, 2012; Ndofor & Priem, 2011). Also, the sampling method may limit the generalization of the study findings. However, the present research provides the basis for further investigating BIM competence in architecture.

## References

Abdelhameed, W. (2018). BIM in architecture curriculum: a case study. *Architectural Science Review, 61*(6). https://doi.org/10.1080/00038628.2018.1483888

Agirbas, A. (2020). Teaching construction sciences with the integration of BIM to undergraduate architecture students. *Frontiers of Architectural Research*, *9*(4). https://doi.org/10.1016/j.foar.2020.03.007

Ajtayné Károlyfi, K., Szalai, D., Szép, J., & Horváth, T. (2021). Integration of BIM in architecture and structural engineering education through common projects. *Acta Technica Jaurinensis, 14*(4). https://doi.org/10.14513/actatechjaur.00641

Azhar, S., Khalfan, M., & Maqsood, T. (2012). Building information modeling (BIM): Now and beyond. *Australasian Journal of Construction Economics and Building*, *12*(4). https://doi.org/10.5130/ajceb.v12i4.3032

Balah, M., & Akut, L. (2015). Assessment of Building Information Modeling (BIM) Knowledge in the Nigerian Construction Industry. In *International Journal of Civil & Environmental Engineering IJCEE-IJENS* (Vol. 15).

Banerjee, A., & Nayaka, R. R. (2022). A comprehensive overview on BIM-integrated cyber physical system architectures and practices in the architecture, engineering and construction industry. In *Construction Innovation* (Vol. 22, Issue 4). https://doi.org/10.1108/CI-02-2021-0029

Boje, C., Kubicki, S., & Guerriero, A. (2021). A 4D BIM System Architecture for the Semantic Web. In *Lecture Notes in Civil Engineering* (Vol. 98). https://doi.org/10.1007/978-3-030-51295-8_40

Camps, J., & Luna-Arocas, R. (2012). A matter of learning: How human resources affect organizational performance. *British Journal of Management*, *23*(1). https://doi.org/10.1111/j.1467-8551.2010.00714.x

Çivici, T., & Yemişçioğlu, Ş. (2021). One of the Barriers that Female Architects Face in their Career Development: Glass Ceiling Syndrome. *Online Journal of Art and Design*, *9*(3).

Clausen, R. (2021). Bim in landscape architecture: A report. *Journal of Digital Landscape Architecture, 2021*(6). https://doi.org/10.14627/537705032

Enshassi, A. A., Abuhamra, L., & Alkilani, S. (2018). Studying the benefits of building information modeling (BIM) in architecture, engineering and construction (AEC) industry in the Gaza strip. *Jordan Journal of Civil Engineering*, *12*(1).

Leslie Appiah, B. (2020). Assessment of Building Information Modeling (BIM) Awareness, Knowledge and Its Adoption in the Ghanaian Construction Industry. *Journal of Civil, Construction and Environmental Engineering*, *5*(6). https://doi.org/10.11648/j.jccee.20200506.11

Maina, J. J. (2018). Barriers to effective use of CAD and BIM in architecture education in Nigeria. *International Journal of Built Environment and Sustainability*, *5*(3). https://doi.org/10.11113/ijbes.v5.n3.275

Moreno, C., Olbina, S., & Issa, R. R. (2019). BIM is used by the architecture, engineering, and construction (AEC) industry in educational facility projects. *Advances in Civil Engineering*, *2019*. https://doi.org/10.1155/2019/1392684

Ndofor, H. A., & Priem, R. L. (2011). Immigrant entrepreneurs, the ethnic enclave strategy, and venture performance. *Journal of Management*, *37*(3). https://doi.org/10.1177/0149206309345020

Öztürk Akbıyık, S., & Arslan Selçuk, S. (2023). Analysis of Global Research Trends on BIM Studies in the Field of Architecture. *Iconarp International J. of Architecture and Planning*. https://doi.org/10.15320/iconarp.2023.245

Salgado, M. S. (2022). BIM and the future of architecture teaching. *IOP Conference Series: Earth and Environmental Science*, *1101*(5). https://doi.org/10.1088/1755-1315/1101/5/052024

Samimpay, R., & Saghatforoush, E. (2020). Benefits of Implementing Building Information Modeling (BIM) in Infrastructure Projects. *Journal of Engineering, Project, and Production Management*, *10*(2). https://doi.org/10.2478/jeppm-2020-0015

Wu, K., & Tang, S. (2022). BIM-Assisted Workflow Enhancement for Architecture Preliminary Design. *Buildings*, *12*(5). https://doi.org/10.3390/buildings12050601