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Assessment of Building Information Modelling Awareness and Usage Levels in Abuja and Kaduna

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Building Information Modelling (BIM) has the potential to improve information sharing across the entire value chain, time and costs savings, improved quality, transparency and accountability in decision making, increased sustainability, and improved end-user satisfaction. Several developed countries in Europe and North America are aware, widely accepted and adopted BIM. However, developing countries like Nigeria are still using conventional construction practices. The objective of the study is to assess the current status of BIM awareness level and usage in Abuja and Kaduna State. Primary data was collected using structured close-ended questionnaires among building construction professionals in architectural firms in Abuja and Kaduna. The study revealed that there is high level of awareness of BIM but with low level usage in construction among professionals. In a related development, lack of government support, high cost of hardware and software, insufficient skills on BIM tools, lack of technical expertise and absence of clear standards and guidelines were the major barriers to BIM usage. As the largest client, government's lack of demand contributed to the low level of usage. It is therefore recommended among others that the Federal Government should make BIM compulsory for its projects that exceed certain threshold values in order to encourage the usage among construction professionals.

Keywords: Building Information Modelling, Awareness, Architecture, Engineering and Construction (AEC).

Introduction

BIM is a process of production of the current digital model of a building or infrastructure that enables AEC professionals to create and share the right information at the right time to efficiently plan, design, construct and manage buildings and infrastructure during and after the design, and construction in order to improve efficiency and decision making (Autodesk, 2020; Build Up, 2018 & Chartered Institute of Building, 2016). It is a combination of computer software applications, systems, materials used, economy and processes about work practices used by AEC sector professionals and clients (McAdam, 2010 & Simbai, 2015).

BIM adoption and implementation is progressing globally. A growing number of architects, engineers and contractors are using building information modelling (BIM). UK is the world leader in BIM implementation, followed by USA where 72% of construction firms are using BIM, 500,000 houses were designed with BIM in 2017 in France. Spain introduced a BIM mandate on public sector projects in 2018 and mandatory use in infrastructure projects by July 2019 (Cupastone, 2020; IndiaCADworks, 2020 & Zigurat, 2018).

Several initiatives have been taken by nations for BIM adoption and implementation. For instance, as of April 2016, all UK government construction suppliers tendering for centrally-procured

government projects must be working at BIM Level 2 which involves developing building information in a collaborative 3D environment with data attached, but created in separate discipline models. Basically, if you don't do BIM you will not get work from the government (Zigurat, 2018). In New Zealand, a nationwide alliance of industry and government known as BIM Acceleration Committee, BAC in New Zealand was established in February 2014 to coordinate efforts to increase the use of BIM in the country (BAC, 2019). BuildingSMART Canada, bSC (2014) released a 'roadmap' in 2014 to lead the transformation in achieving lifecycle BIM modelling in Canada. CanBIM, Canada BIM Council, began offering certification in 2014. It was designed to be an 'industry-wide benchmarking platform' and now provides four levels of Certification for individuals as well as Educational Course and Program Certification (Canada BIM Council, 2016).

In spite of the pace set by developed countries, developing countries like Nigeria, the inefficient and error-prone practices based on 2D drawings traditional approach is still the most common approach (Ganiyu *et al.*, 2018; Hamma-adama *et al.*, 2017; Kori, 2015). Previous research on BIM in Nigeria shows that there is paucity of research on BIM status and lack of trained and skilled persons on BIM tools (Onungwa *et al*, 2017 & Abubakar *et al.*, 2013*).* Most of the research focused on awareness among professionals and organization, BIM adoption and barriers affecting its adoption in the Nigeria construction industry (Ganiyu *et al.*, 2018; Amuda-Yusuf *et al.*, 2017; Abubakar *et al.*, 2014). The objective of this study is to examine specifically BIM awareness level and usage in Abuja and Kaduna. It is to also identify major barriers plaguing the adoption and implementation of BIM.

Literature Review

Denmark was one of the earliest adopters of BIM in the world. Denmark first mandated BIM for public projects in 2007 and extended the requirement to all projects in 2011. Countries like UK successfully mandated the full deployment in 2016, France in 2017, Singapore in 2015 and Finland in 2012 (McAuley *et al.*, 2017 in Cao *et al.*, 2019). However, countries like United States of America (USA) and Sweden represent partial BIM mandates, where BIM use was mandated only in certain regions and by specific government authorities (Tahrani *et al.*, 2015). Italy and Germany have specified plans to mandate BIM in 2019 and 2020 respectively (McAuley *et al.*, 2017). The 2020 National BIM Report (Figure 1) in UK revealed that 73% of the industry is now aware of and using BIM, 26% are just aware while only 1% is neither aware of nor using. Almost a quarter (23%) of those 'using' BIM stated that they do so on all projects. Additionally, almost half (46%) do so for the majority of projects, for those that have adopted BIM, it is becoming part of how they work (NBS, 2020).

In a recent survey (which is the sixth in a series of researches) conducted by BIM Acceleration Committee, BAC (2019) about the use of BIM in New Zealand for both industry and client, 97% of the industry group have used BIM in the last 12months, 94% plan on using BIM in the next 12months, half of all the project (59%) use BIM in some ways. In addition, BIM Professionals dropped back to 73% (see Figure 2). Architects and engineers have maintained a stable proportion of projects using BIM (BAC, 2019).

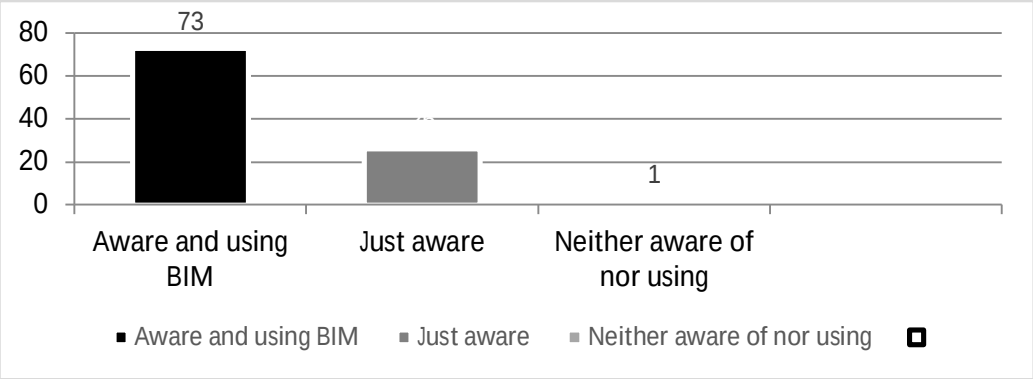

Figure 1: BIM awareness and usage in UK (NBS, 2020)

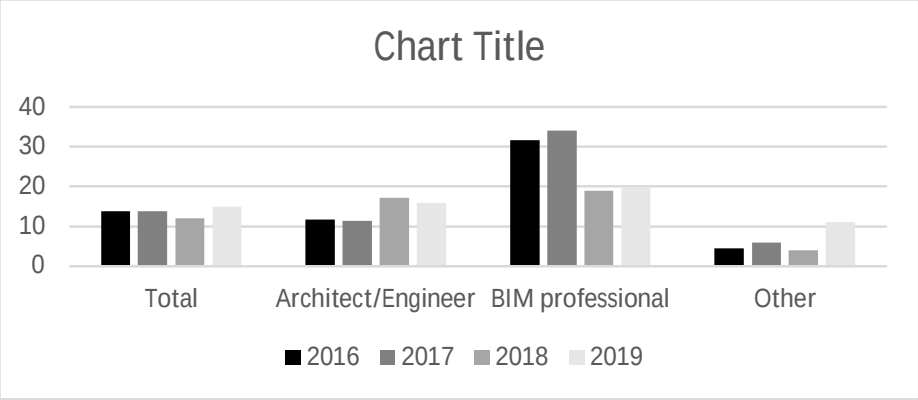

Figure 2: Average number of projects using a BIM execution plan (industry group) in New Zealand (BAC, 2019)

The second Annual BIM Survey in Canada conducted by Building Tall (2019), BIM awareness and belief was assessed in terms of confidence in BIM knowledge and skills. The study revealed that in 2019 and 2018, confidence in BIM knowledge and skills were 83% and 63% respectively. In terms of categorization according to discipline, BIM specialist have the highest rank in confidence in knowledge and skills, 92% and 85% respectively Figure 3 (Building Tall, 2019).

In 2012 and 2013 the Australian Institute of Architects and Consult Australia released a total of 27 "Practice Guides" on BIM. Each of the guidance papers offers a baseline level of information to the industry. The effort was aimed to offer practical, entry level information to assist those in the supply chain who were new to the concepts behind BIM and their effects on the construction sector (Australasian BIM Advisory Board, ABAB, 2020 & United-BIM, 2020). In 2002, Finland implemented BIM technology. BIM implementation is highest in the country because, in 2007, 93% of architectural firms and 60% of engineering firms were using BIM in their routine (United-BIM, 2020).

The first continent-wide BIM Survey in Africa, Africa BIM Survey, ABS (Research and Development Committee Africa BIM Initiative, 2020) was carried out after a pilot survey between November 2019 and May 2020 with 500 respondents across the various regions in Africa: West Africa, 72.96%; Southern Africa, 6.29%; East Africa, 6.29%; North Africa, 6.92% and Central Africa, 7.55%. The demographic profile of respondents showed that organizations with 3-5 and 6-15 employees had large percentage of the respondents with more than 30% and about 25% representation respectively. Whereas, a combined representation of about 20% of the respondents were from firms with over 100 employees. This might be related to the fact that the SMEs are the backbone in the

construction industry and often represent about 80-90% of firms in the industry. The survey further showed that Architects constitute the majority of participants with 20%, Civil Engineers and Cost Consultants (Quantity Surveyors) provided the largest representation of respondents. Before the survey 90.43% of the respondents have heard of BIM, while 44.96% have adopted BIM for projects with 30% having had full in-house BIM implementation in projects. The survey further showed that BIM adoption across Africa was slow. The major motivation for BIM adoption in from the survey was the fear of being left behind a globally connected world, with government intervention seen as a major driver. The major barriers identified included lack of training; lack of government support; lack of in-house expertise; lack of a legal framework; and cost.

Methodology

The aim of the paper is to assess Building Information Modelling awareness and usage levels in Abuja and Kaduna with a view to providing a wider picture of the current situation, major challenges and offer recommendations that will improve BIM adoption and implementation in the country. The survey research was conducted using structured questionnaires self-administered to the following professionals: architects, supervisors, project managers, site engineers and building contractors in Abuja and Kaduna. Abuja was selected because it is the next city with highest concentration (only second to Lagos, Kaduna was also selected for the study because it falls among the states in the north with high concentration of architects (ARCON, 2016). A total of 190 structured questionnaires were purposively administered to respondents in Abuja and Kaduna. However, only 147 were duly completed, returned and valid for the study. The data collected were analysed using percentile and mean score. Mean: logic to determine a cut-off mean of 3. The sum of the weight of 5,4,3,2 and 1 is 15, which is divided by 5 (number of response category: it follows from this that a response can be considered as significant when the mean score is equal or greater than 3 ($\geq$3). A response is considered insignificant if the mean score is equal or less 3 ($\leq$3).

Results and Discussion

Demographic profile of respondents

Table 1 below presents the demographic profile of the respondents involved in the survey. The details include, year of establishment, educational level, job title, type of firm, form of ownership, number of employees and types of projects carried out.

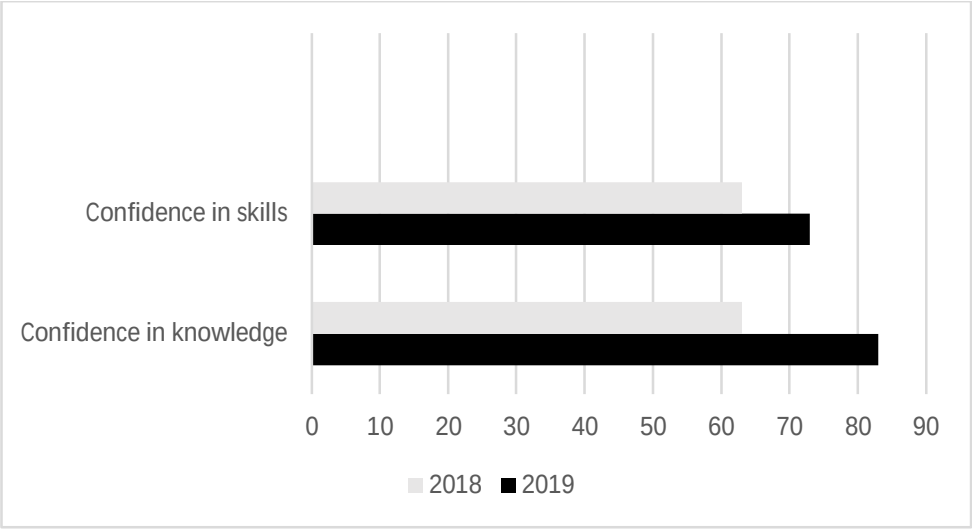

Figure 3: Confidence in knowledge and skills in BIM among AEC in Canada (Building Tall, 2019)

Figure 4: Awareness on BIM (Research and Development Committee Africa BIM Initiative (2020)

Table 1: Demographic profile of respondent and firms

Item	Response	Percentage (%)
Year of Establishment		
1- 5 years	15	10.20
6-10 years	37	25.16
11-15 years	34	23.12
16-20 years	28	19.04
21 years above	33	22.44
Educational level		
OND/HND	24	16.32
BSc	35	23.80
MSc	81	55.08
BArch or PhD	7	4.76
Job title		
Consultant	53	36.04
Designer	39	26.52
Supervisor	16	10.88
Project Manager	10	6.80
Site Engineer	9	6.12
Contractor	20	13.60
Type of firm		
Consultancy	61	41.48
Construction	56	38.08
Academic	23	15.64
Others	7	4.76
Forms of ownership		
Sole Principal	69	46.92
Partnership	68	46.24
Limited liability company	10	6.80
No. of employees		
1–5 staff	101	68.68
6–10 staff	28	19.04
11–15 staff	8	5.44
Over 16 staff	10	6.80
Type of project		
Residential	56	38.08
Commercial (including offices)	23	15.64
Hospitality (hotels, restaurants etc.)	16	10.88
Educational	16	10.88
Healthcare	14	9.52
Cultural/entertainment (theatres, museums)	4	2.72
Civic building	3	2.04
Religious buildings	14	9.52
Transportation (airports, garages) and urban projects	1	0.68

BIM awareness levels and usage

Table 2 showed respondents BIM awareness level, awareness and usage and awareness and not using. All respondents (100%) who participated in the survey are aware of BIM and BIM technology in Abuja and Kaduna. However, only 3.40% of respondents are using BIM technology with majority, 96.60% of the respondents not using it.

The result in Table 2 revealed high level of BIM awareness in terms of knowledge on BIM concept agrees with the findings of African BIM Survey (Research and Development Committee Africa BIM Initiative, 2020) which revealed that 90.43% of AEC professions have heard of BIM, 99%, UK (National BIM Report, 2020), 97% in New Zealand (BAC, 2019), 83% in Canada (Building Tall, 2019) where the majority of respondents and BIM users were architects. However, the findings of this study differ from the study conducted by Usman *et al.* (2020) which indicated that the level of awareness is low among construction consultants in Abuja. The result in Table 2 showed that BIM usage was low. This is similar to the findings by Usman *et al.* (2020) where usage was also low in Abuja. A study by Hamma-adama *et al.* (2017) and Hamma-adama and Kouider (2018) revealed low adoption too with majority of AEC professionals just being aware of the concept of BIM. This is further buttressed by Dalhat (2020) and Solomon (2018) who indicated that the awareness level of BIM technology among Nigerian AEC industry professionals was high, yet not being applied by most of the professionals. In a related development, Olanrewaju *et al.* (2020) asserted that BIM awareness level was only high at the design stage of a building life cycle while it was extremely low at the construction and facility management stages. However, another study by Hamma-adama and Kouider (2019) showed there was an increase in the awareness level and usage among architects. This is different with the findings of National BIM Report in UK where 73% of the industry was now aware of and using BIM (NBS, 2020).

Barriers to BIM implementation

Table 3 showed ten (10) barriers to BIM adoption and implementation generated in literature. Using mean score with a scale of 1-5, with a cut-off mean of 3- logic to determine the mean: the sum of the weight of 5,4,3,2 and 1 is 15, which is divided by 5 (number of response category: it follows from this that a response can be considered as significant when the mean score is equal or greater than 3 ($\geq$3). A response is considered insignificant if the mean score is equal or less 3 ($\leq$3). The most five (5) influential barriers out of ten (10) include lack of government demand (MS: 4.94), high cost of hardware and software (MS: 4.94), insufficient skills on BIM tools (MS: 4.91), lack of technical expertise (MS: 4.90), lack of government support (MS: 4.79) and absence of clear standards and guidelines (MS: 4.76).

The findings are similar to African BIM Report (2020), Hamma-adama and Kouider (2019) and Solomon *et al.* (2020) where the major barriers identified include lack of training, lack of government support, lack of in-house expertise, lack of a legal framework and cost of hardware and software.

Table 2: BIM technology awareness and usage in Nigeria

Item		Response	Percentage (%)
Are you aware of BIM concept and BIM technology?	Yes	147	100
	No	0	0
	Total	**147**	**100**
Are you aware and using BIM technology?	Yes	5	3.40
	No	142	96.60
	Total	**68**	**100**
Aware but not using BIM technology		142	96.60

Table 3: Barriers to BIM Implementation

Barriers	Total score	Mean score	Rank
Lack of government demand	336	4.94	1
High cost of hardware and software	336	4.94	1
Insufficient skills on BIM tools	334	4.91	2
Lack of technical expertise	333	4.90	3
Lack of government support	326	4.79	4
Absence of clear standards and guidelines	324	4.76	5
Cost of training	320	4.71	6
No known research and development body	296	4.35	7
Legal issues (ownership of data)	254	3.74	8
Risks and challenges with the use of BIM	250	3.68	9

Conclusion

There was high level of BIM awareness in terms of knowledge on BIM concept without sufficient skills on how to use BIM tool among professions in architectural firms. The level of BIM usage was low. Some of the major barriers to BIM usage in Abuja and Kaduna included lack of government support, high cost of hardware and software, insufficient skills on BIM tools, lack of technical expertise and absence of clear standards and guidelines.

The Federal Government should make BIM compulsory for its projects that exceed certain threshold values in order to encourage the usage among AEC professionals. In addition to this, Government should collaborate with ARCON and NIA to provide training through workshops that provide hands-on experience on BIM and BIM tools that will give professional sufficient skills and technical expertise to use it. The Federal Government should provide clear standards and guidelines on BIM in order to provide a framework for BIM adoption and implementation.

Finally, the Federal Government should subsidize the price of BIM hardware and software to make it affordable and accessible to AEC professional.

References

Abubakar, M., Ibrahim, Y. M. & Bala, K. (2013) Readiness of Nigerian building design firms to adopt building information modelling (BIM) technologies. *The 5th International Conference for Construction Engineering and Project Management*, 1-2 March, Singapore.

Abubakar, M., Ibrahim, Y., Kado, D., & Bala, K. (2014). Contractors' perception of the factors affecting Building Information Modelling (BIM) adoption in the Nigerian construction industry. *Computing in Civil and Building Engineering*, 167-178.

Amuda-Yusuf, G., Adebiyi, R.O., Olowa, T. & Oladapo, I.B. (2017). Barriers to Building Information Modelling adoption in Nigeria. *Journal of Research Information in Civil Engineering*, 14(2), 1574-1591

Australian BIM Advisory Board, ABAB (2020) Australian BIM strategic framework. http://www.abab.net.au/wp-content/uploads/2020/01/ABAB_Australian_BIM_Strategic_Framework_Feb_2019.pdf

Autodesk (2020). BIM. Retrieved from www.autodesk.com/solution/bim.

BIM Acceleration Committee (2019). BIM in New Zealand-an industry-wide view 2019. Retrieved from www.biminnz.co.nz.

Build Up (2018). What is BIM? The European portal for energy efficiency in building; 2018. http://www.buildup.eu/en/news/what-bim

Building Tall (2019). 2nd annual BIM report Canada wide survey 2019. Retrieved from https://rescon.com/affiliations/Second-Annual-BIM-Survey-V3-Web.pdf.

buildingSMART Canada. (2014, November 26). Roadmap to lifecycle Building Information Modeling in the Canadian

AECOO Community. Retrieved from buildingSMART Canda: https://www.buildingsmartcanada.ca/wp content/uploads/2015/01/ROADMAP_V1.0.pdf

Canada BIM Council. (2016). Certification program. Retrieved from Canada BIM Council: http://www.canbim.com/certification

CIOB (2016). BIM for construction. https://www.ciob.org/bimconstruction

Cupastone (2020). Current state of BIM in the major countries of the world. https://cupastone.com/bim-countries-world/

Dalhat, N. (2019). Level of BIM awareness and application in the Nigerian architecture, engineering and construction (AEC) industry. *Research Gate.*

Ganiyu, A. Y., Adebiyi, R. T., & Muhammad, I. B. (2018). BIM Awareness and Adoption by Construction Organizations in Nigerian. *Journal of Research Information in Civil Engineering*, *15*(2), 2205-2224.

Hamma-adama M, Salman HS, & Kouider T. (2017). Diffusion of innovations: the status of building information modelling uptake in Nigeria. *Journal of Scientific Research & Reports*, 17(4), 1-12. DOI: 10.9734/JSRR/2017/38711.

Hamma-adama, M. & Kouider, T. (2019). What are the barriers and drivers towards BIM adoption in Nigeria? In Skibniewski, M.J. and Hajdu, M. (eds.) *Proceedings of the 2019 Creative construction conference (CCC 2019), 29 June – 2 July 2019*, Budapest, Hungary. Budapest: Diamond Congress Ltd [online], pages 529-539. Retrieved from https://2019.creative-construction-conference.com/downloads/

Hamma-adama, M. & Kouider, T. 2018. A review on building information modelling in Nigeria and its potentials. *International Journal of Civil and Environmental Engineering*, 12(11), 1113-1119.

IndiaCADworks (2020). Successful BIM adoption for architects. Retrieved from https://www.indiacadworks.com/blog/successful-bim-adoption-for-architects/

Kori, S A & Kiviniem, A. (2015) Toward adoption of BIM in the Nigerian AEC industry; context framing, data collecting and paradigm for interpretation. *In*: *9th BIM Academic Symposium and JT Analysis Review*, 7-8 April 2015, Washington DC: USA: NIBS.

McAdam, B. (2010). Building information modelling: the UK legal context. *International Journal of Law in the Built Environment*. 2(3). pp.246-259.

McAuley, B., Hore, A. & West, R (2017). BICP Global BIM study – Lessons for Ireland's BIM Programme. Construction IT Alliance Limited. In Cao, Y., Zhang, L.H., McCabe, B. and Shahi, A. (2019). The benefits of and barriers to BIM adoption in Canada. *Proceedings of the 36th International Symposium on Automation and Robotics in Construction (ISARC) 2019*. Pp 152-158.

NBS (2020). The 10th Annual BIM Report. **NBS Enterprises Ltd, UK.** Retrieved from https://www.thenbs.com/knowledge/national-bim-report-2020.

Olanrewaju, I.O., Babarinde, S.A. & Salihu, C. (2020). Current state of Building Information Modelling in the Nigerian construction industry. *Journal of Sustainable Architecture and Civil Engineering*, 2(27), 63-77 DOI 10.5755/j01.sace.26.2.25142

Onungwa, I.O, Uduma-Olugu, N. & Igwe, J.M. (2017) Building information modelling as a construction management tool in Nigeria. *WIT Transactions on the Built Environment*, 169, 25-33.

Research and Development Committee Africa BIM Initiative (2020). Africa BIM Survey: ABS. https://bimafrica.org/reports

Simbai, C. (2015). *A study on the BIM adoption readiness and possible mandatory initiatives for successful*

implementation in South Africa. Unpublished MSc thesis, Faculty of Engineering and the Built Environment, University of the Witwatersrand, Johannesburg

Singh, I. (2017). BIM adoption and implementation around the world: Initiatives by major nation. Retrieved from http://www.geospatialworld.net/.

Solomom, U. & Olabode, E.O. (2018). Adoption of Building Information Modelling (BIM) in the Nigerian Architecture, Engineering and Construction (AEC) Industry. A Review. *Pertanika Journal of Science & Technology*, 26(1).

Solomon, O.B., Chika, U. & Adebayo, O.A. (2020). Barriers to BIM implementation and ways forward to improve its adoption in the Nigerian AEC firms. *International Journal of Building Pathology and Adaptation*, https://doi.org/10.1108/IJBPA-05-2019-0047

Tahrani, S., Poirier, E. A., Aksenova, G. & Forgues, D. (2015). Structuring the adoption and implementation of BIM and integrated approaches to project delivery across the Canadian AECO industry: Key drivers from abroad. In *Proceedings of the Construction Specialty Conference of the Canadian Society for Civil Engineering*, pages 059:1-10, Vancouver, Canada, 2015.

United-BIM (2020). Leading countries with BIM adoption. https://www.united-bim.com/leading-countries-with-bim-adoption/

Usman, S.A., Mamman, A.I., Inuwa, M.I. & Ashiru, A.M. (2020). Awareness Level of Building Information Modelling tools to construction consultants in Abuja, Nigeria. *International Journal of Latest Technology in Engineering, Management & Applied Science (IJLTEMAS*), IX(I), 72-77.

Ziggurat Global Institute of Technology (2018). BIM in the UK: Success in progress. https://www.e-zigurat.com/blog/en/bim-in-the-uk/.