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Diffusion of Innovations: The Status of Building Information Modelling Uptake in Nigeria

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Authors' contributions

This work was carried out in collaboration between all authors. Author MH designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author HS revised the first draft. Author TK supervised the entire study. All authors read and approved the final manuscript.

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ABSTRACT

Aim: This study evaluated Building Information Modelling (BIM) awareness and adoption in Nigeria through the line of enquiry known as the 'diffusion of innovations' and its possible uptake.
Study Design: The study is quantitative in nature and the primary data fetched through questionnaire survey within Nigerian construction industry.
Place and Duration of the Study: Conducted within North-west, North-central and Lagos, Nigeria for a period of 4 months.
Methodology: A quantitative approach was adopted to x-ray the Nigerian construction industry; a structured questionnaire was used across the Architecture, Engineering and Construction (AEC). The generated data were analysed through descriptive statistics (in percentages) and presented in charts and graphs.
Results: The result revealed that 59.5% are aware of BIM technology; 22.8% are aware and currently using BIM and the remaining 17.7% neither aware nor using BIM; consequently, the industry was evaluated just within the *Late Majority* in terms of awareness and just entered the *Early Majority* in terms of BIM technology adoption.

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Conclusion: Nigeria is at least five years behind US, UK and South Africa. In addition to lagging behind by at least five years, it is also behind by about 10% and 50% for UK and US respectively. The study also discovers the most significant barriers to BIM adoption as lack of BIM experts and lack of collaboration by its team stakeholders. The industry is likely to take the UK pattern in adopting the BIM and Recommendations are made based on the findings of the research.

Keywords: Adoption; BIM; collaboration; diffusion of innovations; integration.

1. INTRODUCTION

Engineering businesses are recognising that the effective and integrated management of design information is a vital component to achieving engineering and business goals. This project is an opportunity to contribute to setting the agenda of research and industrial practice in this key area: Building Information Modelling (BIM). BIM technology has now reached maturity level in several countries around the world. NBS [1] defined BIM as a way of working and also the means by which everyone can appreciate a building via the use of a digital model which draws on an array of data assembled collaboratively, throughout the stages of procuring a building and its lifecycle. BIM is the most significant information technology development and a paradigm shift in Architecture, Engineering and Construction (AEC), therefore gaining recognition as a powerful tool to deliver benefits across the construction industry and Facility Management [2]. Moreover, BIM is a tool or system of visualisation and documentation/communication [2,3].

BIM potentiality as a system is not limited to the effective management of primary data, but also offers effective and detailed monitoring, and facility performance analysis that can support innovative and more cost effective management of complex facilities [4]. It can be realized that many *"countries are increasingly using BIM for innovative approaches to construction relationships, which is likely to give them a competitive advantage in an increasingly globalised economy"* [5 p896].

The objectives of this study are to evaluate BIM awareness and adoption levels; compare the awareness and adoption levels with some countries; project its adoption pattern and identify critical barriers to its adoption in Nigeria. The primary data of this research were gathered through questionnaire survey and aimed at Nigerian contractors and consultants (architects, engineers and quantity surveyors); the approach to the research was quantitative in nature. The results were analysed and compared with surveys conducted independently in other countries that studied BIM adoption rates. The adoption rates were examined in terms of the line of enquiry known as the 'diffusion of innovations' to produce status in Nigeria.

2. LITERATURE REVIEW

2.1 Procurement of Construction Works in Nigeria

Procuring building works in Nigeria comes in two to three different ways: public (government), established private developers (registered) and private/owned individuals (unregistered). The government approach is generally via one of these two methods of procurement: *Traditional* or *Design and Build;* established private developers generally procure building work by *Design and Build* or in a form of *novated* way (adopt designs from designers and be responsible for construction based on the adopted design). While the private/owned individual operates a sort of direct labour which means the owner takes direct ownership of every aspect of works (engaging individuals for every work).

2.2 Traditional Procurement Route

Traditional procurement route is a method of contracting where a client appoints an architect to lead the design team (consultants) which comprises structural, electrical and mechanical engineers. Rowlinson [6] prescribed that the architect typically receipts the client's brief then develop that to architectural form of drawing, from preliminary to detailed architectural drawing. The same applied to the structural, electrical and mechanical designs (from preliminary to detailed); the various elements and items of the building can subsequently be taken-off and come up with bill of quantities by the quantity surveyor appointed by the client. All the above processes are done at pre-contract stage; after which contractors are invited to tender for the construction part (post contract stage). Their tenders are to be examined, compared and the successful contractor (the feasibly lowest bidder) is appointed for the construction works under the supervision of the consultants headed by the architect. It can be observed that a successful contractor is expected to mobilize to site and start work within some few days with limited knowledge or understanding of the building to be built [6,7]. Moreover, perhaps not reasonably acquainted with the client and other project participants especially the consultants; in this process, the standard forms of contract is used which has been adopted by federal ministry of works, traditional building contract based on '*joint contract tribunal – JCT'* [8]. This standard form of contract clearly defines what is to be built, the various parties' roles and the terms of bargain between them. Similarly, it stipulates the requirements by the client, specifies the measures to be taken to guarantee compliance and available remedies to each party in an incident of default [7]. The traditional procurement method is widely used in Nigeria [9]. It is not that, the traditional method of contracting is completely ineffective, but other procurement methods could be better and suitable when used on similar projects [10].

2.3 Design and Build Method

The design and build method of procurement is also referred to as integrated procurement approach in which a contracting firm takes obligation for all aspects of the project [11]. Rowlinson [6] outlines the features of design and build contract as:

- i a contract that is signed before the building has been defined by full documents;
- ii a contract in which design is not fully completed before construction commences;
- iii a contract where bill of quantities is not normally prepared so variations are priced according to a schedule.

The continues growth of the design and build (integrated) method in the UK and elsewhere as an alternative procurement method to the traditional method is as a result of the new paradigm shift from fragmented method to integrated system as well as the belief pointing to integrating the design and construction [12]. Despite all the claimed potential benefits of time and cost overrun, reduction of errors and omissions, less misunderstanding, rapid reaction to scope changes, as well as production of buildable designs [12,13], the client has reduced his professional representation and also tend to have fewer checks on cost and quality [13] and therefore quality assurance in all aspect could be compromised.

2.4 Building Information Modelling

Considering BIM as a complete 3 dimensional digital depiction of a building system or subsystem, and a sophisticated technology comprising both accurate building model and incorporated information (in database) of the building components, requires recognition beyond a 3D of it being sample representation of a building or its components [14,15,16]. BIM remains the most potential development in the world of construction industry [17].

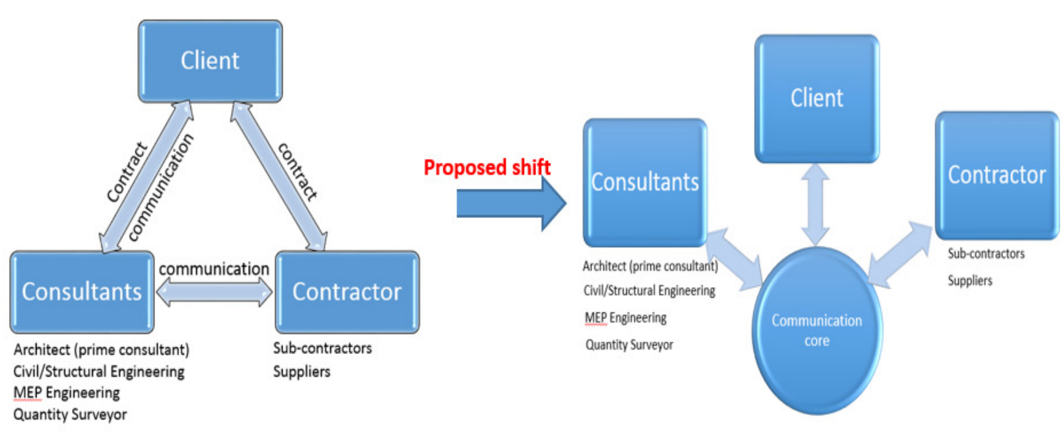

Fig. 1. Schematic of traditional procurement route

BIM has gone beyond being just a drawing and documentation tool. It is not solely about software, but represents a more collaborative method of working [16]. This process is also transforming the way cities are designed, and life cycle performance of buildings and systems [18]. The benefits of using BIM during the building design stage have been well-publicized and are fuelling its adoption rate among architects worldwide - transforming their drawing-based processes to model-based processes. Even though as adopted at design and construction stages in countries like United States (US), UK, Finland, Germany and Norway; BIM effective usage still remained unaware especially as a platform for facility management which along inclined to the entire facility life cycle. Beaven [18] stated that,

> *"The benefits of using information from a building model for facilities management are likewise compelling - fuelling the discussion surrounding building lifecycle management and nudging facilities management towards model-based processes"*.

BIM is the latest software technology being introduced throughout the built environment and related manufacturing industry. Manufacturing industry has long realised the benefits of use of BIM, i.e. automobile industry recorded significant success from its adoption [19]. However, the construction industry is generally known to be resistive to changes [20]; and most constructors are not ready for new innovations, preferred to sticking to the traditional way of doing things [21,22].

Abubakar et al. [23] found that education and training, software availability and enabling environment are the most important factors that will aid the adoption of BIM technology in Nigeria [20,24,25]; while social and habitual resistance to change, legal and contractual constraints as well as high cost of training were found to be the main barriers to BIM adoption in Nigeria. Moreover, adoption rates in Nigeria lag behind considering other nations where BIM implementation evolved. The industry professionals need more awareness to these trends in order to stay competitive in this changing environment. To achieve this paradigm shift, Onungwa [24] recommended more sustained study in this area.

2.5 BIM Adoption in Other Countries

In spite of progressive adoption of BIM in US, UK and some developed nations, the construction industry is known to be a very conventional/bound by tradition and rigidity group to bring on board [22]. There is however, significant development in the Hong Kong construction industry and, considering the support by the Chinese Government on BIM adoption and implementation, there is still considerably low or slow adoption of BIM in the industry [17]. Moreover, Chan [17] study discovered that about 33% of the study responders believed a lack of training to be a significant reason for insufficient use of BIM; while two-third (67%) felt that use of BIM is not necessary; 2D is sufficient to meet their need. This shows a clear lack of understanding (awareness) of BIM. Similarly, in addressing

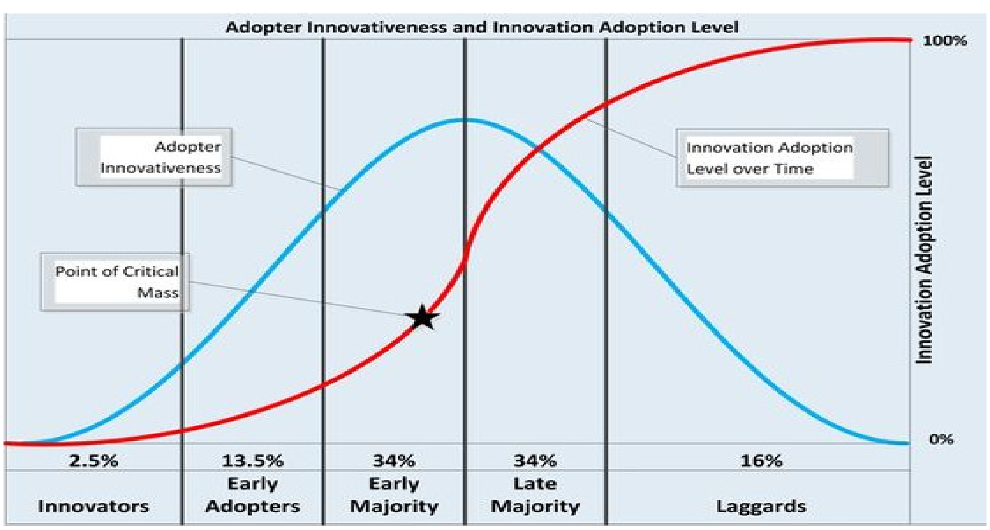

Fig. 2. Innovation diffusion categories

individual perceptions to this great tool in the UK, some perceived BIM as an unrequited addition to the existing work process [26]; this is more of remnants to the high initial cost [22]. Thus, design cost/fee will most likely increase in order to reward BIM usage. Success in terms of positive return on investment (ROI) also encourages the use of BIM.

On the other hand, Wang et al. [25] study reveals highly ambitious view on ROI, with view that the benefit of BIM implementation outweighs its implementation cost. This is highly debatable as the project size/cost has significant influence to the implementation as well as ROI especially for a starter. Small project may not necessarily require BIM as such, implementing BIM while handling small projects posed challenges to ROI.

In the UK and US, much research has been carried out on BIM, especially regarding potential benefits as well as streamlining the stages of its full adoption in their construction industries. However, the NBS [16] National BIM Report lamented the limited expertise and resource that can research and educate the industry in this innovative field (i.e. BIM). Moreover, more countries are building up to BIM adoption (i.e. Ireland, Germany, Finland, Denmark, Norway, France, Canada, Malaysia and China); where nearly 60% of western European countries are frequent users of BIM and 74% of them perceived positive return on their overall investment on its adoption [27].

South Africa is considered more developed than most African countries, including Nigeria. Their level of BIM adoption is higher than any other country in the African continent as a whole [5]. However, South Africa has also encountered setbacks to its implementation, with contractual issues (i.e. procurement route) being one of the major barriers to BIM implementation [15,28].

2.6 The Diffusion of Innovations

Rogers [29] discusses what he has called the ‘diffusion of innovations’ and demonstrates in what way an innovation takes some time to feast, even if it is demonstrably better.

Africa are amongst the contributory factors that slow the BIM adoption process. Considering low infiltration level of BIM technology in developing nations of Africa: 20% in South Africa [5], and 7.0% in Ghana [30] the technology diffusion levels need to be established by the help of diffusion of innovation model.

Rogers [29] described the cumulative diffusion of innovation in an S-curve model, and any adopter falls under one of the following categories: Innovators, early adopters, early majority, late majority and laggards. The graphs below fully described the categories of adopters.

Going by the diffusion of innovation model, Jung and Lee’s [31] survey revealed that the main BIM users worldwide were in third phase (early majority), but those in the Middle East, Africa and South America were found to be in second phase (early adopters).

Africa recorded low and slow awareness and adoption of BIM with about 16% in the second phase [31]. However, South Africa can be considered to be in the fore front of this collaborative innovation with a status of “early majority” i.e. third phase [5], but this status was recorded in what can be referred to as a ‘lonely BIM’ or ‘small BIM’ (mostly at organisational level); hence, the collaboration is quite limited. Thus, the country also has major barriers to the BIM adoption, these include: procurement process, lack of awareness by the government, lack of awareness by the industry itself, and confidentiality of information.

Cox and Alm [32] discuss the idea of inventive destruction (this involve innovation phasing out traditional way of working) and observe that the sustenance of producers depends on their capability to streamline production by introducing newer and better tools that increase productivity. Companies that do not deliver client requirements at competitive prices will eventually lose clients and die.

3. RESEARCH METHODOLOGY

The purpose of the survey was to determine the level to which CAD technologies and integrated construction process are currently being used by the construction industry in Nigeria. These results were then compared to the status and uptake of these technologies in some of examined countries in the literature review (US, UK and South Africa). The primary data generated from questionnaire survey is analysed with descriptive statistics (in percentages) based on common practises in this area of research [20,24,25,33,34,35].

3.1 Precedents

In order to gather comparable results, the questions were aimed at gathering similar information to that available from other countries. The NBS survey has done extended research on BIM report in the UK and surveys by Froise [5] in 2014 in South Africa. Fig. 3 below described adoption rate of three different regions according to Froise [5]:

Two modern precedent studies are relevant to this research so as to match the Nigerian situation with those of other countries. Firstly, surveys piloted by the NBS in the UK from 2011 to 2017 [1,15,16,36,37,38,39] these analysed sequential BIM use and perceptions of professionals in the industry. Secondly, is a Froise [5] survey that compares the Europe, USA and South Africa markets and looks at BIM awareness, usage and perceptions levels, and take-up among architects and contractors, this was conducted in 2014.

The United Kingdom (UK), the United States (US) and South Africa are selected as sample countries to test BIM awareness and adoption. This selection is a reflection of two main principles or measures [40]: (a) the resemblance between the two developed nations (UK and US) in their construction markets in terms of applicable technologies and terminology; and also the two developing nations (South Africa and Nigeria), (b) the availability of reasonably wide BIM adoption surveys (BEIIC, 2010 in Australia, NBS survey from 2011 to 2017 in the U.K. and McGraw-Hill Construction, 2013 [41] in the U.S.).

3.2 Survey Questionnaire

The type of questions used were generally close-ended and multiple choice, although there was also an opportunity to answer an open-ended question especially where further information may be required or the respondent may want to provide different or additional information.

The following section shows the result of a survey that examined different aspects of the use of BIM in Nigeria. The questionnaires were sent to contractors and consultants mostly from general building category in Nigeria predominantly from the following zones: North-west, North-central and South-west in descending order of quantity followed by very few from North-east and South-east; due difficulty in gaining contact information for the North-east and South-east, therefore the result may not reflect the true picture of the industry in those regions.

A total of 133 questionnaires were sent, out of which a total of 80 responses were received; this represents 60.15% response rate, hence this vindicated the 55% for paper-based response rate according to Ballantyne [42]. The responses received from contractors were 5 which represents 6.25% of the responses, architects returned 30 (37.5%), quantity surveyors returned 6 (7.5%), engineers returned 36 (45%) and Clients returned 3 (3.75%).

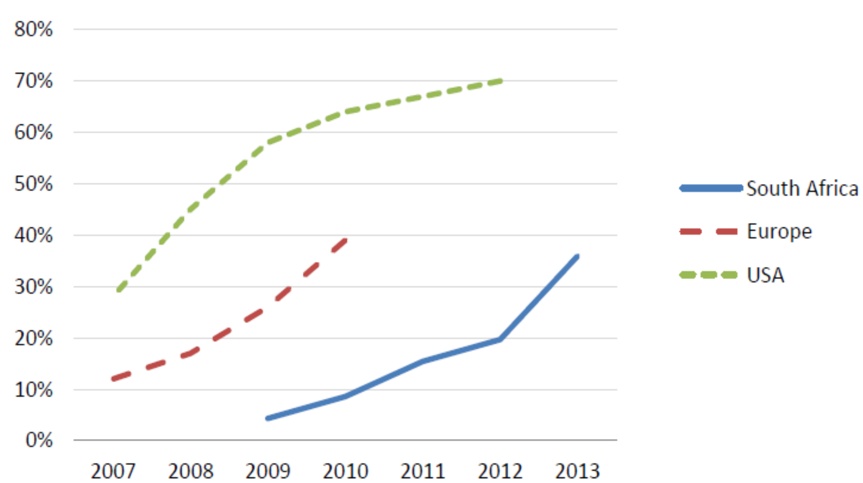

Fig. 3. BIM adoption

The questionnaire was structured under three sections: demographic profile; CAD usage; and BIM awareness, adoption and barriers to its adoption. The profile of respondents is important to gauge their professionalism, level of involvement and educational qualification. While on the other hand, questions on CAD were tendered to explore the level of CAD technology usage and to what extent. The final section looked into BIM awareness, usage, confidence level, barriers and procurement routes adopted.

4. ANALYSIS AND DISCUSSION

4.1 Survey Findings

The survey results were analysed and the findings are presented below. An initial observation was the substantial difference in the response rates for the surveys, where same method of notification and delivery was used. The difference may potentially credited to the awareness levels of the five different groups, where architects were substantially more aware than other professionals of the BIM concept considering architects as a single entity, however engineers recorded higher numbers, but this is associated with number of disciplines involved in the engineering (civil, electrical and mechanical) profession.

4.2 Demographic Profile of Respondents

The details of the respondents involved in the questionnaire survey are provided in Table 1. The details include the respondents' affiliations, company sizes and practicing experience.

4.3 Awareness of BIM

It can be noticed that there is a significant dissimilarity amongst architects and engineers, and the rest (especially, the contractors) when it comes to BIM awareness. 34.8% of those aware are architects and 51.5% of those aware are civil, electrical and mechanical engineers, while only 6.1% is the contribution of the contractors in terms of BIM awareness. Below (Fig. 4) is a chart presenting BIM awareness.

Table 1. Demographic profile of respondents (N = 80) variables category

		n	**%**
Respondent affiliation	Architect	30	37.50
	Client	3	3.75
	Contractor	5	6.25
	Engineering	36	45.00
	Quantity Surveyor	6	7.50
Company size	Less than 10 technical staff	24	30.00
	10 - 15 technical staff	17	21.25
	More than 15 technical staff	39	48.75
Practicing experience	Less than 5 years	20	25.00
	5-10 years	30	37.50
	11-15 years	18	22.50
	More than 15 years	12	15.00

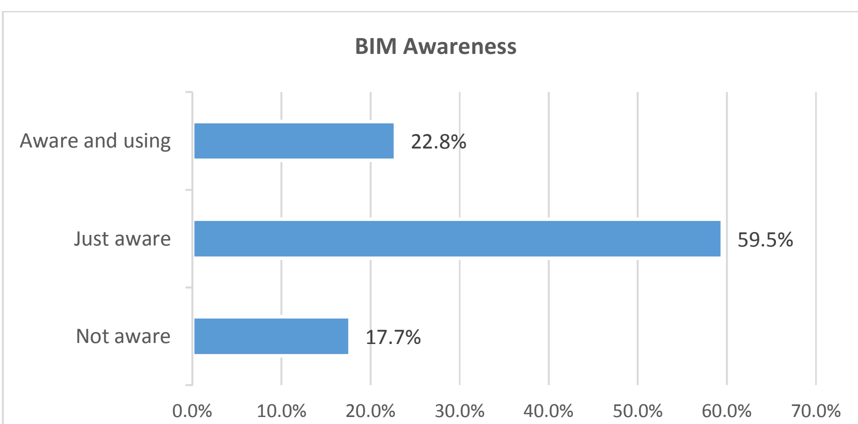

Fig. 4. BIM awareness

Generally, refer to the above (Fig. 4), the awareness level is in the late majority (59.5% + 22.8% = 82.3%); but the adoption is just in early majority (22.8%).

4.4 Use of BIM

Most architects (61.9%) are aware of BIM, but only 26.9% use some form of BIM. Other than the clients, all the professions are at least aware of BIM to reasonably 50% but the adoption has a lot of disparities; the awareness to adoption are 57.5% to 27.5%; 60% to 20%; 66% to 0% for engineers, contractors and quantity surveyors consecutively. Fig. 5 below is presenting the awareness and adoption percentages independently.

The results were compared with surveys conducted in other countries. The most recent is the National BIM survey, conducted for 2017 [39] which reveals 97% BIM awareness (nearly universal) and 62% adoption; therefore, the gap is too wide to be compared, therefore the nearer survey findings is the 2012 NBS report where 79% BIM awareness was recorded and 31% adoption [15].

For the US construction industry, 2012 survey by McGraw-Hill was also considered, where McGraw-Hill [41] found that BIM adoption recorded up to 71% in the USA, which demonstrates very high adoption rate of 7.33% a year with respect to 49% adoption in the 2009 [27].

Thus, the last country is South Africa, the findings by Froise and Shakantu [5] reveals that 58% were considered to be familiar with BIM with an average of 20% adoption. With the above findings, the chart below (Fig. 7) presented combination of the surveys' results.

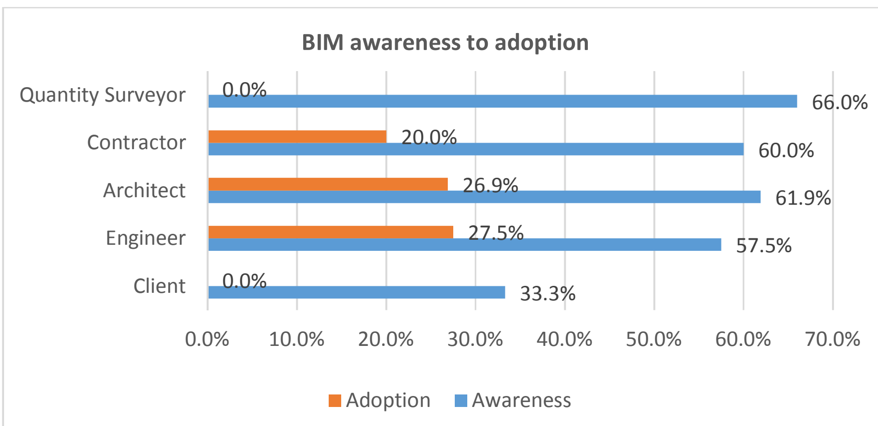

Fig. 5. BIM awareness and adoption

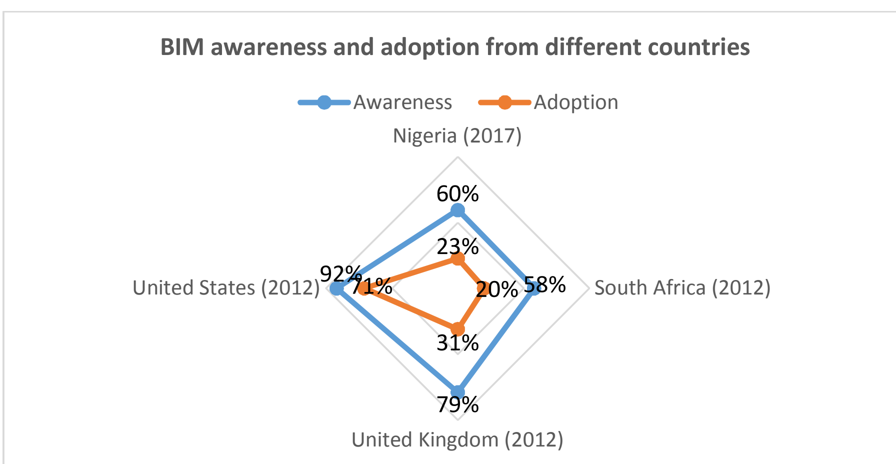

Fig. 6. BIM awareness and adoption variations

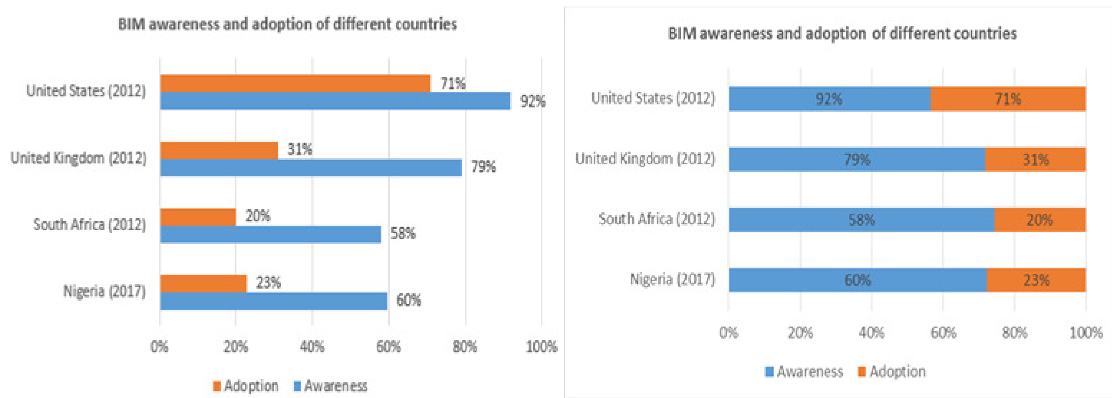

Fig. 7. BIM awareness and adoption from different countries

Refer to Rogers [37] that adoption of innovation generates self-pressure towards the rate at which the innovation diffuses. The adoption rate is expected to progress (faster) since it is still below 50%, although it will keep on slowing down before the adoption reaches 50% (where the adoption curve flattens), at the same time the awareness level becomes extensive through the adopting group.

The figure (Fig. 8) presents comparative adoption level of BIM in Nigeria in relation to UK, US and South Africa. As of 2017, Nigeria is five years plus 50% behind United States in BIM adoption (71%, US-2012 against 22.8%, Nigeria-2017). While UK BIM adoption in 2012 was 31% which is 8.2% more than its adoption today (2017) in Nigeria (31%, UK-2012 against 22.8%, Nigeria-2017); hence Nigeria is five years plus 8.2% behind UK on BIM adoption in 2017. For a developing country closer to Nigeria (South Africa), Nigeria is approximately five years behind South Africa in BIM adoption (20%, South Africa-2012 against 22.8%, Nigeria-2017). For the purpose of unifying the year in comparative study, 2012 was selected as benchmark due to sufficiency and reliable data available in that year.

4.5 Barriers to Adopting BIM

Several studies revealed varieties of barriers to BIM adoption in the developing countries, even the most recent findings revealed same barriers [20,24,25,30,33]; the common and the most barriers are: lack of trained personnel (expertise) on BIM, lack of collaboration between diverse professionals (team members), Insufficiency in knowledge or understanding of the BIM concept itself and lastly public sector commitment. The finding here has realised a similar outcome, having lack of experts the most significant (55%) barrier to BIM adoption and proceeded by lack of collaboration by other stakeholders (22.5%) see Fig. 9. This finding fully examined the critical barriers where the two alone gulped over 70% of the barriers. Perhaps, other barriers are no longer significant due to further developments.

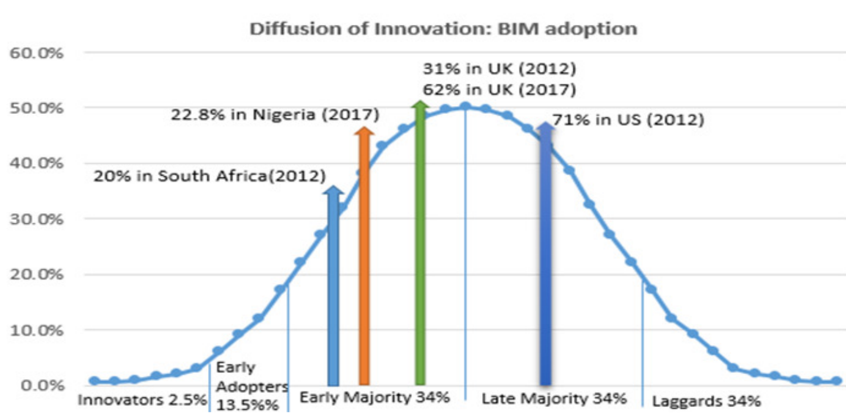

Fig. 8. Innovation adoption curve: Summary of BIM adoption from four countries

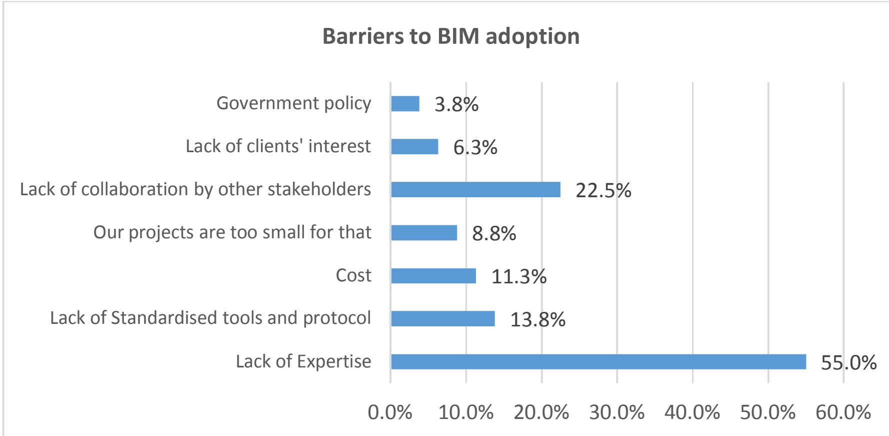

Fig. 9. Barriers to BIM adoption in Nigerian Construction Industry

5. CONCLUSIONS AND RECOMMENDATION

The investigation reveals that there is reasonable awareness on BIM technology, although many are aware of the tools without knowing it as BIM, and without knowing it as a process; therefore no clear understanding of BIM by the industry professionals.

It can be seen that BIM adoption in Nigerian construction industry is lagging behind all the three countries (US, UK and South Africa) by at least five years. In addition to lagging behind by at least five years, it is also behind by about 10% and 50% for UK and US respectively. The adoption to awareness pattern of Nigerian construction industry is more like that of the UK and South Africa, but followed nearly like the UK's pattern of 31:79 in 2012 while Nigerian pattern of 23:60 in 2017 (approximate adoption to awareness ration of 2:5).

Finally, Nigerian construction industry has just entered the *Early Majority* (not up to a critical mass point) in adopting BIM technology and just entered the *Late Majority* in its awareness. It can be seen that only two significant barriers were realised in the study; hence, others may have been improved in the recent years. The industry is expected to follow the UK trend, but the adoption process needs to be streamlined to achieving the adoption rate of 6% (average) achieved by the UK construction industry yearly. All these came up due to a streamlined process to achieving BIM mandate in the UK, and also the UK's major clients are progressively insisting on a BIM platform for their new facilities, while the government is driving the process by creating a conducive atmosphere to the BIM utilization and requiring that new public buildings are produced in a collaborative environment using BIM.

Further comprehensive study into training and retraining is recommended; streamline adoption process with detailed maturity level (with capability and competency sets) also recommended facilitating the development of model/framework for its effective adoption.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. National BIM Report. BIM task group: Report. London: RIBA Enterprises Ltd; 2016.
2. Mitigating Construction Project Risk Using Building Information Modelling (BIM). Proceedings of 4th West Africa Built Environment Research (WABER) Conference in Abuja, Nigeria; 2012.
3. Sabol L. Building information modeling & facility management. IFMA World Workplace. 2008;2-13.
4. Mitchell J, Schevers H. Building information modelling for FM using IFC. Proc., CRC Construction Innovation; 2006.
5. Froise T, Shakantu W. Diffusion of innovations: An assessment of building information modelling uptake trends in South Africa. Journal of Construction Project Management and Innovation 2014;4(2):895-911.

6. Rowlinson S. Comparison of contracting systems for industrial buildings. Managing Construction Worldwide: The Organization and Management of Construction. CIB W-65. 1987;1:55-65.
7. Rwelamila P, Talukhaba A, Ngowi A. Project procurement systems in the attainment of sustainable construction. Sustainable Dev. 2000;8(1):39.
8. Okuwoga AA. Cost–time performance of public sector housing projects in Nigeria** The views expressed in this paper are those of the author and not of the United Nations. Habitat International. 1998;22(4): 389-395.
9. Ojo S. An evaluation of procurement methods in building projects in South Western, Nigeria. An Unpublished M.Sc (Construction Management) Thesis, Obafemi Awolowo University, Ile-Ife; 1999.
10. Okunlola Ojo S, Aina O, Yakeen Adeyemi A. A comparative analysis of the performance of traditional contracting and design-build procurements on client objectives in Nigeria. Journal of Civil Engineering and Management. 2011;17(2): 227-233.
11. Moore DR, Dainty AR. Integrated project teams' performance in managing unexpected change events. Team Performance Management: An International Journal. 1999;5(7):212-222.
12. Kwakye A. Construction project administration in practice. Routledge; 2013.
13. Molenaar K, Zimring C, Augenbroe G. Guide to project delivery for federal buildings. Georgia Institue of Technology. 1998;3.
14. Memon AH, Rahman IA, Memon I, Azman NIA. BIM in Malaysian construction industry: Status, advantages, barriers and strategies to enhance the implementation level. Research Journal of Applied Sciences, Engineering and Technology. 2014;8(5):606-614.
15. National BIM Report. BIM task group: Report. London: RIBA Enterprises Ltd; 2012.
16. National BIM Report. BIM task group: Report. London: RIBA Enterprises Ltd; 2015.
17. Chan CT. Barriers of implementing BIM in construction industry from the designers' perspective: A Hong Kong experience. Journal of System and Management Sciences. 2014;4(2):24-40.
18. UK construction industrys responses to government construction strategy BIM deadline and applications to civil engineering education. Proceedings of 1st Civil and Environmental Engineering Student Conference; 2012.
19. Egan J. Rethinking construction, construction task force report for department of the environment, transport and the regions. Ed: HMSO, London; 1998.
20. Onungwa IO, Uduma-Olugu N, Igwe JM. Building information modelling as a construction management tool in Nigeria. WIT Transactions on The Built Environment. 2017;169:25-33.
21. Latham M. Constructing the Team, HMSO, London; 1994.
22. Walasek D, Barszcz A. Analysis of the adoption rate of Building Information Modeling [BIM] and its Return on Investment [ROI]. Procedia Engineering. 2017;172:1227-1234.
23. Abubakar M, Ibrahim Y, Kado D, Bala K. Contractors' perception of the factors affecting Building Information Modelling (BIM) adoption in the Nigerian Construction Industry. Computing in Civil and Building Engineering. 2014;167-178.
24. Onungwa IO, Uduma-Olugu N. Building information modelling and collaboration in the Nigerian construction industry. Journal of Construction Business and Management. 2017;1(2):1-10.
25. Wang C. Assessment of BIM implementation among MEP firms in Nigeria. International Journal of Advances in Applied Sciences. 2015;4(3):73-81.
26. Howard R, Restrepo L, Chang C. Addressing individual perceptions: An application of the unified theory of acceptance and use of technology to building information modelling. Int J Project Manage. 2017;35(2):107-120.
27. Hill M. The business value of BIM in Europe: getting building information modeling to the bottom line in the United Kingdom, France and Germany. The Graw Hill Companies; 2010.
28. Building Information Modelling (BIM): Barriers in adoption and implementation strategies in the South Africa construction industry. International Conference on Emerging Trends in Computer and Image Processing (ICETCIP'2014); 2014.
29. Rogers EM. Diffusion oj'Innovations 5th Edition; 2003.

30. Asiedu E. Assessing the capacity of construction consultants to adopt building information modeling in Ghana; 2017.
31. Jung W, Lee G. The status of BIM adoption on six continents. International Journal of Civil, Environmental, Structural, Construction and Architectural Engineering. 2015;9(5):444-448.
32. Cox M, Alm R. Creative destruction. Retrieved from The concise encyclopedia ofeconomics; 2013.
Available:http://www.econlib.org/library/Enc/CreativeDestruction.html
33. Dim N, Ezeabasili A, Okoro B. Managing the change process associated with Building Information Modeling (BIM) implementation by the public and private investors in the nigerian building industry; 2015.
34. Ebiloma DO, Daibi-Oruene WD, Bumaa FN. Application of multiple regressions on the impact of Building Information Modelling adoption drivers on sustainable construction in Nigeria; 2017.
35. Ugochukwu S, Akabogu S, Okolie K. Status and perceptions of the application of building information modeling for improved building projects delivery in Nigeria. American Journal of Engineering Research (AJER). 2015;4(11):176-182.
36. BIM Industry Working Group. A report for the government construction client group building information modelling (BIM) working party strategy paper. Communications. London, UK; 2011.
37. National BIM Report. BIM task group: Report. London: RIBA Enterprises Ltd; 2013.
38. National BIM Report. BIM task group: Report. London: RIBA Enterprises Ltd; 2014.
39. National BIM Report. BIM task group: Report. London: RIBA Enterprises Ltd; 2017.
40. Kassem M, Succar B, Dawood N. A proposed approach to comparing the BIM maturity of countries; 2013.
41. Construction M. The business value of BIM infrastructure. Smart Market Report; 2012.
Available:http://download.autodesk.com/us/bim_infra/Business_Value_of_BIM_for_Infrastructure__SMR_2012.pdf
42. Moving student evaluation of teaching online: Reporting pilot outcomes and issues with a focus on how to increase student response rate. Australasian Evaluations Forum: University Learning and Reaching: Evaluating and Enhancing the Experience, UNSW, Sydney; 2005.

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