BIM Education for Quantity Surveying Student in Nigerian Polytechnic

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Abstract— Building Information Modeling (BIM) is a latest innovative technology that emerged recently in the construction industry which improves productivity and efficiency in the construction industry The Building Information Modeling (BIM) is one of the developed paradigm shifts and it is a technology-enabled innovative means of virtually designing, constructing, and managing construction projects by simulating a virtual model. It is not encouraging looking at the potentials of BIM in enhancing construction efficiency but yet, is faced with setback due to lack of knowledge of the BIM. Therefore the study aimed at educating quantity surveying students of Nigeria polytechnic by introducing BIM education in their curriculum. Descriptive statistics is used for data interpretation and presentation. The researcher submitted an online questionnaire survey titled ''BIM Education for Quantity Surveying Student in Nigeria Polytechnic'' sixty six respondents both registered and non registered Quantity surveyors responded to the online questionnaire. The researcher adopted descriptive statistic in the analysis and data was presented in figures and tables. From the findings, it was discovered that Building Information Modeling (BIM) is an important technology in the whole of construction industry since majority of the respondents agreed that Quantity Surveyors use BIM for the preparation of Bill of quantities, it saves time and minimize risk, promote technological application in the construction industry and it should be encourage to establish zonal BIM training centers across the country and BIM should be included in the polytechnic curriculum. It was therefore recommended that BIM education should be integrated in the polytechnic curriculum for Quantity surveying graduating students, in order to ensure adequate knowledge of BIM towards improving productivity and efficiency in the Nigeria construction industry, Government should adopt the use of BIM in all her public project and zonal BIM training centers should be establish for polytechnic lecturers.

Keywords: BIM, Quantity Surveyors, Education.

I. INTRODUCTION

Building Information Modeling (BIM), Lean Practices, Sustainability, Prefabrication, Business Process Reengineering (BPR), Total Quality Management (TQM), among others are being adopted and implemented in the construction industry to combat some of the major challenges encountered in the industry and affect its capability to achieve value for money. The Building Information Modeling (BIM) is one of the developed paradigm shifts and it is a technology-enabled innovative means of virtually designing, constructing, and managing construction projects by simulating a virtual model (Saka & Chan, 2019). Building Information Modeling (BIM) is a latest innovative technology that emerged recently in the construction industry which improves productivity and efficiency in the construction industry (Wong & Fan, 2013; Ryal-Net & Kaduma, 2015). According to the United State of America National Building Information Standard (2007) cited in Wong & Fan, 2013) define BIM in three folds;

1. BIM as a product- is a dataset that is structured to describing a building
2. BIM as a process- in the act of creating building information model.
3. BIM as a system that comprises of the communication structure and business work that increase efficiency and quality of work.

BIM as perceived by the Associated General Contractors of the America (AGC) is a development that uses computer software model to simulate operation of facility and the construction. (Azhar et al., 2012).

Building Information Modeling (BIM) is accepted widely by construction expert according to prior research BIM and 4D approaches provides a faster and effective information and communication among parties in the construction and also improved innovative solutions from better design and construction, a lot of benefits (Fan et al., 2014). Construction Industry in the past has experienced steady declined in its labor productivity to be precise 50years (Teicholz, 2013) cited in Ahn et al., 2016) making construction works becoming too complex, to address this issues, Ahn et al., 2016; Azhar et al., 2012) suggest that proactive majors be put in place by construction practitioners and academicians in advocating the use of BIM as essential information technology tool to improved and support construction efficiency and success of a project. BIM is among the five top enabling technologies of communication and information technology applications in the engineering, architecture and construction industry (Ahn et al., 2016; Lu et al, 2015). According to Stewart , (2012) cited in Ali et al., 2016) he postulate that the Quantity Surveying profession is in array with Building Information Modeling drive and have more Take-off quantities research with the BIM and also produce new standard , with the compatibility of the software in mind. (Ali et al., 2016; Mccuen, 2008; Steward, 2012) emphasize that BIM collaboration principle will not be complete without a strong input of the cost expert in the BIM model at 4D and 5D. There are many challenges faced by implementing BIM in education. Among which are;

absence of BIM in school curriculum, lack of BIM reference materials, inadequate resources and time to develop the curriculum, lack of technical knowhow and skills on BIM software and reluctance among the department and students on the need to advance and transform in line with new paradigm shift of technology based curriculum (Ali et al., 2016; Amuda-Yusuf, 2018). Also, there is limited research into Building Information Modeling (BIM) potentials in the Quantity Surveying profession (Fung et al., 2014; Ali et al., 2016). In another study, Kherun N. et al., (2016) opine that, Academia is rated number two among motivators of BIM implementation. BIM has a potential of integrating into project lifecycle that will lead the way towards becoming a standard for industry's construction projects and a tool in the project procurement in future time to come. Therefore, there will be a new paradigm in the roles of quantity surveyors on construction procurement that would be base on BIM (Bodea & Purnu, 2018;Gayathri Nagalingam et al, 2013). According to Alufohai, (2012) cited in (Ryal-Net & Kaduma, 2015) postulate that movement in adopting BIM in both public and private sector in Nigeria across construction professionals (quantity surveyors, building engineers, architectures etc) appears to be very slow although, Architectures adopted it to some extent. It's rather not encouraging looking at the potentials of BIM in enhancing construction efficiency, reducing both corruption and dispute and saving cost of construction. It is therefore traced that the major setback of BIM implementation within Nigerian construction industry is the lack of knowledge of BIM amongst the major stakeholder's couple with benefits to improve efficiency and productivity within the construction industry (Ryal-Net & Kaduma, 2015). There are a lot of issues of building collapse and structural failures day in day out which have become worrisome within the Nigerian construction industry (Onungwa et al., 2017) Hence, when the use of BIM model is adopted, it will go a long way in addressing the said problems. Most of the research focused on the use of BIM in the construction industry in Nigeria, for instance, Ryal-Net & Kaduma, (2015) studied assessment of Building Information Modeling knowledge in the Nigerian construction industry, but, this research looks into the BIM education for quantity surveying students in Nigerian Polytechnics. On these note, introducing BIM education in the curriculum of quantity surveying students in Nigerian Polytechnics become paramount because it will increased rapid awareness, effective utilization and adoption of BIM in Nigeria construction industry.

A. Quantity Surveyors Roles in Construction Organization Using Building Information Modeling

Quantity Surveyors plays vital role in all phases of the construction process, from inception to the completion of building (Nagalingam et al., 2013). Among the roles are; procurement advice, cost planning, preliminary cost estimate, measurement of quantities, Bill of quantities preparation, building process etc. traditionally, all the above mention roles were processed manually, as such, is prone to so many mistakes and waste of time. However, issues of time and errors can simply be addressed and eradicated by keying into the process of BIM.

B. Procurement Advice

Boon, (2009) cited in Nagalingam et al., (2013) postulate that potentials of BIM in realizing additional work early in design process is key in settling up the model, develop and to analyze alternative design solution. Timing of payments and adjustment of fees is necessary to facilitate. The procurement method which allows early involvement of the contractor is also necessary in realizing its potentials. Quantity surveyors involvement in providing procurement advice to their clients need to take account of these issues especially in a situation where the practice of BIM is evolving rapidly.

C. 5D Cost Planning

The BIM provides some facilities that the quantity surveyor can provide cost plan automatically throughout the elements of the building. It delivers cost certainty through realistic and precise cost estimation throughout the construction phase of the building project (Bodea & Purnu, 2018;Mitchell B, 2013; Nagalingam et al., 2013). The main goal of 5D cost planning is to make sure clients gets efficient and economical project with regard to agreed brief and within budget.

D. Preliminary Cost Estimate

Building Information Modeling offers accurate and reasonable quantity take-off, cost modifications and additions at the early design process with target to avoiding budget overruns and to save time. The process will allow engineers and architect in seeing cost effectiveness of their design changes within reasonable time and help in curbing excessive waste of resources. However, if BIM is shared with the contractors, it will drastically reduce the time for details estimate since it is precise and save estimators time (Nagalingam et al., 2013).

E. Bill of Quantity Preparation

Building Information Modeling (BIM) 4D model is capable of executing so many functions of Quantity Surveying automatically. The system computerize measurement of building quantities from drawings thereby facilitating the work of Quantity Surveyor in having design document that include exact quantities and materials via electronic format. With this model, BOQ is generated automatically without much stress and can be applied to creating report in essential format.

Global acceptability of Building Information Modeling

Building Information Modeling (BIM) is gaining global recognition in the construction market of so many countries at various level of usage (Yahaya Makarfi et al., 2016). It faced a lot of challenges on a global scale of countries that adopted BIM (Ali et al., 2016). Most of the developed countries are embracing BIM as catalyst of gaining operational efficiency and high rise of adoption in the last few years. As reported, in some industry's publication and academic literature, the rate of BIM adoption is globally visible in developed economies and research activities focusing on BIM is also in the increased. This is the other way round in the developing countries. Despite the huge number of construction activities which seem logically expected in leveraging gains that can be

achieve from the use of BIM which is enormous. (Yahaya Makarfi et al., 2016; McGraw-Hill, 2014). According to McGraw-Hill, (2014) cited in Makarfi Y & Mohammed A, (2016) United State of America is taking the lead with about 71%, United Kingdom with 54%, Europe 46%, Australia 40%, India 18%, China 15% etc of the BIM adoption in the world.

Building Information Modeling in Africa

Saka & Chan, (2019) opine that Building Information Modeling is still at infant stage in Africa. And with the growing demand of BIM in Africa, Milla SA announces the 5th BIM Africa 2020 conference with the aim in exchanging best practice and to critically scrutinize new developments innovative solutions for the complete construction value chain was discussed which will increase the quality and efficiency of the African construction market. Among the questions raised were; what opportunities does BIM bring to companies?, what potentials does visual planning and realization offers for day to day professional life?. Many experts that attended the conference responded to those questions and show how professional BIM projects can be strategically built. From the point of view of the project participants in planning, construction production and operation, practical demonstrations is given on how digital modeling options can be used to work even more efficiently and economically in the construction market. Building Information Modeling (BIM) offers student advocacy program for the year 2019. The program is targeting undergraduate students of tertiary institution studying courses related to Quantity surveying, Architecture, engineering and construction. Student's advocacy program is designed to teach and create awareness of BIM, its tools and its processes. A team of 25 students were selected from across African tertiary institutions for training virtually on BIM and how to present a BIM awareness and training program in their various institutions. Saka & Chan, (2019) postulate that BIM has it first publication in Africa in 2010. It has been on the increase ever since the first publication. He further asserts that, North Africa which comprises of Egypt, Morocco and Algeria has the highest number of BIM publications with about 52 documents. The second is West Africa with about 26 BIM publications shared across Nigeria, Cote D'ivoire and Ghana. While Southern part of Africa clinch third position with 13 number of BIM publications, from South Africa and Zambia. And lastly, Central Africa with only 2 publications from Cameroun and Central Africa Republic between 2010 to 2018.

Building Information Modeling in Nigeria

According to Alufohai, (2012) cited in Ryal-Net & Kaduma, (2015) movement in adopting BIM on both public and private sector in Nigeria across construction professionals (Quantity Surveyors, Architects, Building Engineers etc) appears to be very slow, although, Architectures adopted it to some extent. It is rather not encouraging looking at the potentials of BIM in enhancing construction efficiency, reducing both corruption and dispute and saving cost. It is therefore traced that the major setback of BIM full implementation within Nigeria construction market is the lack

of knowledge of BIM amongst the major stakeholders' couple with benefits to improve efficiency and productivity within the construction market

BIM and the Construction Industry in Nigeria

Building Information Modeling is contributing towards enhancing the relationship that is between the constructions professionals and the building owner, although dispute sometimes arises as a result of scope of work, cost and time overruns, building modification and some cost associated issues that are more common between the parties. The main challenge in the public sector that is retarding productivity and efficiency is corruption and poor budget. In Nigeria, construction projects is faced with unnecessary inflation of cost, as such, the implementation and adoption of BIM will go a long way in enhancing transparency by allowing parties to the construction or stakeholders have better idea and true scope of the work (Alufohai, 2012) cited in Ryal-Net & Kaduma, (2015).

Government Recognition of Building Information Modeling

In Nigeria generally, Building Information Modeling implementation by the government shows very little efforts. To ensure the implementation and widespread of the BIM in Nigeria in both private and public construction project, government should be sensitized on new paradigm and importance of the BIM in our construction market in order to key into the new technology and play important role in its implementation. According to a research by Zahrizan et al., 2013; Olugboyega et al., 2016; Haron, et al, 2013) opine that, private sectors are in forefront in the BIM implementation though with some hiccup during implementation . To ensure the BIM implementation, there should be some push and pull element from the parties in the construction industry.

Fig. 1.

From the above figure therefore, the push element shows that Nigerian government should make a reasonable effort in mandating the use of this new technology (BIM) in all her construction projects across the country. While the pull element shows the industry players should try and also implement the BIM usage in their small scale projects. And institutions of learning can introduce BIM education in the tertiary institutions specifically in the built environment departments. By so doing, it will provide a lot of information and confidence to BIM implementation. Without the push and pull of BIM implementation, it will continue to remain stagnant. Z. Zahrizan et al , 2013; Olugboyega et al., 2016)

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assert that, some of the developed countries like the US, UK, Singapore, Denmark, Hongkong etc have since established a policy that public projects should adopt the use of BIM in their construction industry.

Building Information Modeling Benefits to Quantity Surveyor

Building Information Modeling (BIM) has vast benefits throughout the lifecycle of the construction project. At pre-construction, construction and post construction stage. At the pre- construction stage of construction project BIM helps in creating time based simulation, increase the quality and performance of building, it reduces errors when generating building drawing , extraction of accurate cost estimate and BOQ. At construction stage, BIM serves as substantial cost and time savings, it detects clash, minimize errors. At post construction stage, BIM helps in controlling the whole cost and data(Ryal-Net & Kaduma, 2015).

Importance of Building Information Modeling to Quantity surveying practice

Fung et al,(2014) cited in Ali et al., (2016) postulate some major Quantity Surveying BIM capabilities as thus; Automatic quantification for BOQ preparation, it generate cost estimate accurately for different designs variables , cost plan are updated easily with more details, designs variables cost implications can easily be generated , designs errors were reduced drastically with the help of clash detection, at the feasibility stage cost appraisal can be done easily, it improves the visualization of design for better understanding , Quantity Surveying can extract quantities from BIM model when preparing preliminary cost plan, it manage and store information and data centrally. Therefore, according to report by the royal institute of chartered surveyors (RICS), the use of BIM in construction industry has improves accuracy , efficiency and also relevance of quantity surveying profession (Withers, 2014) cited in Ali et al., 2016; Z. Zahrizan et al, 2013).

Building Information Modeling and Take-off Quantities

Taking-off Quantities also known as Quantity take-off are measurement of labor and materials that is needed to complete any type of construction project. It is developed at pre-construction stage by a quantity surveyor. However, Building Information Modeling helps in transforming the traditional methods of take-off to a new paradigm of technology which offers solutions to many challenges of traditional taking-off .although, it is not able to claim all the overriding solutions completely (Ali et al., 2016; Olatunji & Sher, 2014).

Some Quantity Surveying BIM Software

Software Name	Company	Usage	Focus
AQTO	Autodesk	Quantity Take-offs	Generating take-offs from multiple environments both 2D & 3D
Vico Takeoff Manager	Vico Software	Quantity Take-offs	Quantity Take-offs, feeding into
DProfiler	Beck Technology	Conceptual Estimates	Conceptual 3D modeling with cost

			estimating and life cycle operational costs forecasting
Visual Applications	Innovaya	Estimating	Extracting quantities and building estimates from ADT & Revit files
Project Wise Navigator	Bentley	Scheduling	Linking 3D model to popular project schedule applications (e.g. MS Project or Primavera)
Visual Simulation	Innovaya	Scheduling	Linking 3D model to popular project schedule applications (e.g. MS Project or Primavera)

II.   PRESENTATION OF RESULT

The result was presented in three folds. Table one which housed background information of the respondents in terms of sex, age, and qualifications of the respondents, table two presented the professional profile of the respondents and lastly table three ex-rayed the Building Information Modeling (BIM) profile.

DATA ANALYSIS
BACKGROUND DATA OF RESPONDENT

Table 1

S/NO	Items	Frequency	Percent
Sex	Male	55	83.3
	Female	11	16.6
Age	20-40 years	52	78.8
	41-above	14	21.2
Qualification	ND	8	12.1
	HND/Degree	45	68.2
	PGD/Master	11	16.7
	PhD	2	3.0

Table 1 indicated that among the participants that respondent to the questionnaire, 55 were male which represented 83.3%, 11 females making 16.6% respectively. This implies that all sex in the Quantity Surveying profession in Nigeria is represented. Therefore, 52 respondents with age between 20–40years represent 78.8% and only 14 with age from 41 and above. It shows that most of the respondents are within their youthful age and ready to embrace the new technological trend in the construction industry. The qualification of the respondents was National Diploma (ND), Higher National Diploma (HND)/Degree, Post Graduate Diploma (PGD)/Master and PhD respectively. The table therefore showed 8 ND Holder made up 12.1%,   45 HND/Degree made up of 68.2%, 11 PGD/Master constituted 16.7% and 2 PhD holders made up 3.0% respectively. This shows that participants of the study cut across all qualification.

Professional Profile
Table 2

Items	N	Mean	Std. Deviation
Are you a registered Q/S?	66	1.6970	• .46309
If yes, Are you practicing?	66	1.8636	• .82063
Duration of practice	66	1.8788	• .90324
Nature of practice	66	1.4394	• .50012

Staff Strength	66	1.6970	•	.78387
Nature of firm	66	2.9697	•	1.88083
If no, Reason for not registering	66	1.7121	•	1.06360
Are you interested to register in future?	66	1.0303	•	.17273
Valid N (listwise)	66			

The Data presented in table 2 indicated that all the responses turn to be positive which means, the average scores of the respondents were equal or greater than 1. Which signifies that majority of the respondents were registered Quantity Surveyors (M=1.6970), majority of the registered QS are practicing (M=1.8636), They have being practicing between one to five years duration (M=1.8788), Majority were Dependent in the nature of their practice (M=1.4394), Majority of them has between one to five staff strength (M=1.6970), Most of the respondents nature of firm were, QS firm, Building firm and others (M=2.9697), also, some of the respondent who are yet to register show some interest to practice but due to financial problem they could not register (M=1.0303).

Building Information Modeling Profile

Table 3

Items	N	Mean	Std. Deviation
Are you interested to establish a firm?	66	1.0455	.20990
Staff Strength	66	2.2273	.83750
Nature of work	66	1.1970	.40076
Measure challenges	66	2.1364	.82063
BUILDING INFORMATION MODELING; Do you know BIM?	66	3.8182	1.02145
BIM education is highly essential	66	4.2273	.95749
BIM is an important technology	66	4.1818	.92668
QS use BIM for BOQ preparation	66	3.8333	.95407
BIM should be incorporated in polytechnic curriculum	66	4.3333	.70892
Zonal BIM training centers should be establish in Nig.	66	4.3939	.62950
BIM promote collaboration between professionals	66	4.1212	.77491
BIM save time and minimize risk	66	4.2121	.75480
BIM promoting technological application in construction industry	66	4.1364	.94277
BIM promote quality of work and ease difficult task	66	4.1818	.72130
BIM lead to high skill acquisition	66	4.0303	.80326
Valid N (listwise)	66		

Most of the Data presented in table 3 indicated that majority of the respondents know BIM (M=3.8182), Agreed that BIM education is highly essential (M=4.2273), BIM is an important technology (M=4.1818), many of them agreed that Quantity Surveyors use BIM for bill of quantities preparation (M=3.8333), majority of the participants support the inclusion of BIM in the polytechnic curriculum (M=4.3333), Zonal BIM training centers be establish in Nigeria (M=4.3939), Most of the participants agreed that BIM promote collaborations among the professionals (M=4.1212), BIM save time and minimize risk (M=2121), Many of them also agreed that BIM is promoting technological application in construction industry (M=4.1364), it also promote quality of work and ease difficult

task (M=4.1818) and lastly, the respondents agreed BIM lead to high skill acquisition (M=4.0303).

Discussion of Findings

Based on the research findings, it was discovered that Building Information Modeling (BIM) is an important technology in the whole of construction industry since majority of the respondents agreed that Quantity Surveyors use BIM for the preparation of Bill of quantities, it saves time and minimize risk, promote technological application in the construction industry, also promote collaboration among professionals, also promote quality of work and ease difficult task, it lead to high skill acquisition as such, BIM education is highly essential, it should be encourage to establish zonal BIM training centers across the country and BIM should be included in the polytechnic curriculum.

III. CONCLUSION /RECOMMENDATION

From the findings of the study it was recommended that, BIM education should be integrated in the polytechnic curriculum for Quantity surveying graduating students, in order to ensure adequate knowledge of BIM towards improving productivity and efficiency in the Nigeria construction industry, Government should adopt the use of BIM in all her public project, construction organizations should also facilitate the enforcement of BIM usage by organizing seminars and workshops to the players in construction industry in lieu of educating them on the advantages and uses of the new technology for both private and public projects, BIM zonal training centers should also be establish to train quantity surveying lecturers. Therefore, it was concluded that Building Information Modeling (BIM) is an important technology in construction industry for promotion of collaboration among professionals, promote quality of work and ease difficult task.

REFERENCES

[1] Z. Z. (2013). Exploring the Adoption of Building Information Modelling (Bim) in the Malaysian Construction Industry: a Qualitative Approach. *International Journal of Research in Engineering and Technology*, *02*(08), 384–395. https://doi.org/10.15623/ijret.2013.0208060

[2] Ahn, Y. H., Kwak, Y. H., & Suk, S. J. (2016). Contractors' Transformation Strategies for Adopting Building Information Modeling. *Journal of Management in Engineering*, *32*(1). https://doi.org/10.1061/(ASCE)ME.1943-5479.0000390

[3] Ali, K. N., Mustaffa, N. E., Keat, Q. J., & Enegbuma, W. I. (2016). Building Information Modelling (BIM) educational framework for quantity surveying students: The Malaysian perspective. *Journal of Information Technology in Construction*, *21*(November), 140–151.

[4] Amuda-Yusuf, G. (2018). Critical success factors for building information modelling implementation. *Construction Economics and Building*, *18*(3), 55–73. https://doi.org/10.5130/AJCEB.v18i3.6000

[5] Azhar, S., Khalfan, M., & Maqsood, T. (2012). Building information modeling (BIM): Now and beyond. *Australasian Journal of Construction Economics and Building*, *12*(4), 15–28. https://doi.org/10.5130/ajceb.v12i4.3032

[6] Bodea, N., & Purnu, A. (2018). Legal implications of adopting Building Information Modeling (BIM). *Tribuna Juridică*, *8*(15), 63–72.

[7] Fan, S. L., Skibniewski, M. J., & Hung, T. W. (2014). Effects of building information modeling during construction. *Journal of Applied Science and Engineering*, *17*(2), 157–166. https://doi.org/10.6180/jase.2014.17.2.06

[8] Nagalingam, G., Jayasena, H. S., & Ranadewa, K. A. T. O. (2013). Building information modelling and future quantity surveyor's practice

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in Sri Lankan construction industry. *The Second World Construction Symposium 2013: Socio-Economic Sustainability in Construction*, *June*, 81–92. http://www.suranga.net/publications/2013_bm_future_qs.pdf

[9]   Olugboyega, O., Aina, T., & Aina, O. O. (2016). Analysis of Building Information Modelling Usage Indices and Facilitators in the Nigerian Construction Industry Frontiers in Construction Management View project A conceptual framework for selecting construction systems for construction projects delivery . *Olugboyega & Aina / Journal of Logistics, Informatics and Service Sciences*, *3*(2), 1–36. https://www.researchgate.net/publication/323401438

[10] 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. https://doi.org/10.2495/BIM170031

[11] Ryal-Net, M. B., & Kaduma, L. A. (2015). Assessment of Building Information Modeling (BIM) Knowledge in the Nigerian Construction Industry. *International Journal of Civil & Environmental Engineering IJCEE-IJENS*, *15*(06), 60–69. http://ijens.org/Vol_15_I_06/151105-1506-9393-IJCEE-IJENS.pdf

[12] Saka, A. B., & Chan, D. W. M. (2019). A scientometric review and metasynthesis of building information modelling (BIM) research in Africa. *Buildings*, *9*(4). https://doi.org/10.3390/buildings9040085

[13] Wong, K. din, & Fan, Q. (2013). Building information modelling (BIM) for sustainable building design. *Facilities*, *31*(3), 138–157. https://doi.org/10.1108/02632771311299412

[14] Yahaya Makarfi, D. R., And, I., & Abdullahi, M. (2016). Introduction To Building Information Modelling Presented At A 3-Day Workshop/ Annual General Meeting Of The Nigerian Institute Of Quantity Surveyors, Port-Harcourt.

[15] Zahrizan, Z., Ali, N. M., Haron, A. T., Marshall-Ponting, A., & Hamid, Z. A. (2013). Ijret_110208060. Exploring the Adoption of Building Information Modelling (Bim) in the Malaysian Construction Industry: A Qualitative Approach, eISSN pISS, 2319–1163.

[16] https://www.for9a.com/en/opportunity/BIM-Africa-Student-Advocacy-Program-for-Architecture-Engineering-and-Construction-Students (Access on 6/7/20)