BIM Awareness and Adoption by Construction Organizations in Nigerian

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Abstract

Building Information Modeling (BIM) processes is gaining ground in the construction industry especially in the developed countries. Similarly, the professionals in developing economies such as Nigeria are expected to braise themselves with the current trend knowledge acquisition such as BIM. To ensure adequate planning for the construction industry adoption of BIM by professionals in Nigeria, it is important to determine the current level of awareness and adoption of BIM in the industry. Questionnaire survey was administered to construction industry practitioners to elicit information about their level of awareness and application of BIM. Descriptive analysis was used to analyze data collected from the survey. It has been established that the size of organization has effect on the transmission of information and knowledge from one level to another. As such the variables used in the analysis are the size of organizations', organizations turnover and industry professionals. Results of data analysis shows that the traditional Design-Bid-Build approach is still the most common approach and significant differences exist in the level of BIM utilization for projects among the professional group. Similarly, the design information exchange format utilized by various organizations varied based on the size and turnover of organizations. On the level of awareness and understanding of BIM, the results shows that the size of organisations influences level of awareness and understanding of BIM among respondents.

Keywords:
Awareness, Building Information Modelling; Organisations; practitioners.

1. Introduction

Evidence abound to show that the supply chains in the construction industry are fragmented and a strong autonomy exists in a wide variety of subgroups within a construction project team (Davies 2008). However, Information Technology (IT) tools are mostly used in isolation by various practices and the level of integration among various disciplines is low (Olatunji, et al., 2010; Keat, 2012; Bui, et al., 2016). Consequently, project information generated and communicated is less reliable and difficult to reuse on another project. Adoption of IT tools such as BIM in the construction industry has the potential for greater efficiency and cost savings (Tahir et al., 2018). However, the use of BIM in Nigeria is still at the early stage and the direction of construction industry's wide implementation is still being defined (Abubakar, et al., 2014; Amuda-Yusuf, et al., 2017).

Adoption and usage of BIM have the potential of removing the problem of lack of collaboration affecting the construction sector, removing wastage and creating efficiencies both at the design and construction stages (Eadie, Browne, Odeyinka, & Mckeown, 2014; Eadie, Odeyinka, Browne, Mckeown, & Yohanis, 2013). This is because, BIM is based on information schema which makes the activities in the construction industry readable by machine. This capability enables automation of various design, construction management, quantity surveying and procurement processes while reducing design and construction errors (Fung, Salleh, & Rahim, 2014). Therefore, BIM offers the potentials for risk reduction, enabling sustainable procurement systems for the industry and encouraging adoption of lean approaches for project delivery. However, for BIM to be routinely used in the construction industry, literature observed that there would be need for adoption of common standard and operational protocol among other issues.
According to Kori and Kiviniemi (2015), the changes required by BIM cannot be achieved by a single unit but an inevitable transition that requires participation from the building industry to improve its productivity by ensuring participation from the building clients, designers, builders and product manufacturers. Ugwu and Kumaraswamy (2007) stated that IT systems are characterized with interaction of different variables in a complex multi-dimensional space. This multi-dimensional space includes organizational, externalities, technology and software, and knowledge dimensions. Ugwu & Kumaraswamy (2007) proposed the adoption of a

complex adaptive systems view of construction IT projects which they claimed is pivotal to explaining the complex web of issues in the real world of information systems development and applications in construction organisations and other sectors.

Previous research studies conducted on BIM has focused on input of BIM adoption and barriers affecting its adoption in the Nigeria construction industry (Abubakar, Ibrahim, Kado, & Bala, 2014; Amuda-Yusuf, Adebiyi, Olowa, & Oladapo, 2017). To enable industry stakeholders, understand the level of awareness and adoption of BIM by professionals, organizations and various institutions in the industry. It is important to identify BIM tools and standards used by industry practitioners. The aim of this study therefore is to examine the level of awareness among professionals and organizations in the Nigerian construction industry.

2. Conceptualization of BIM

Building Information Modelling (BIM) is a process for generating, exchanging and managing a constructed facility's data throughout its life cycle. While BIM is solidly rooted in technological advances, partially transferred from other industries, it extends into the realm of social exchanges between organizational actors. As a transformative approach to designing, constructing and operating in the built environment, BIM includes a wide range of concepts, tools and workflows which needs to be learned and applied by industry stakeholders (Succar & Sher, 2013). Various models have been espoused by authors to describe maturity models of BIM at industry level. The models are adopted to differentiate adoption and awareness levels by the practitioners.

2.1 Stages of BIM Application

The Bew-Richard presented a model that identifies basic CAD (Computer Aided Drafting) as **Phase 0** which implies "no BIM maturity". This phase is a replacement for traditional drawing board where design information is presented using lines and curves on a 2D plane. The final drawings contain no intelligence such as layering and models. This phase is the use of unmanaged CAD and 2D with hard paper or electronic paper are used as exchange mechanism (BIM Industry Working Group (BIWG) (2011) this phase of maturity can be regarded as infant industry (Jayasena and

Weddikkara, (2013). Similarly, Succar (2009) presented a three-stage linear BIM maturity model. The stage one of the model is referred to as the pre-BIM stage which represents the conventional building practices, or the industry before the implementation of BIM. This stage includes both manual and computer-based documents such as CAD drawings and spreadsheet schedules. Under the pre-BIM stage, even 3D CAD is not considered as stage of maturity of BIM. This implies that, until and unless the modelling is object-based, it will not be considered as a BIM maturity phase. While, Khosrowshahi & Arayici, (2012) considered that the pre-BIM stage would be characterized by 2D drafting, document-based linear workflows, one-directional electronic communication, and lack of interoperability

Under the Bew-Richard's model, Phase 1 is characterized with the use of intelligence on basic CAD usage as the entry into early BIM maturity level. This embodies the use of a managed CAD with 2D or 3D drawings with the introduction and application of information standards such as those introduced by the UK Construction Project Information Committee (CPIC) and supported standards. The UK Uniclass establishes the methodology for managing the production, distribution and ensuring reliability and improving quality of construction information including that generated by CAD systems, using a well organised system for collaboration and specified naming convention. The standards is used by all parties involved in the preparation and use of such information throughout the design, construction, operation and deconstruction of projects and throughout the entire life cycle of the project. Owen et al. (2010) emphasized on the need to get maximum benefit of innovative technologies by ensuring improvements in terms of people, process and technology for better productivity in the industry. The features of these are collaborative processes, enhanced skills, integrated information and automated systems, and knowledge management. This is the ultimate goal of BIM adoption at industry level and it is referred to as phase 2 and 3 in the BIM maturity models .

While the benefits of BIM adoption cannot be disputed, there are several concerns about its success as well as the strategies to be adapted in it implementations in various developing countries (Abubakar et al., 2014; Olatunji, Sher, Gu, & Ogunsemi, 2010). The future adoption of BIM technology in the lifecycle of construction projects in Nigeria construction industry is inevitable, but there is currently lack of clear roadmap for BIM implementation in Nigerian construction industry. The rate of BIM adoption in developed countries is increasing and many countries have released policies to implement mandatory BIM adoption("Collaborative Building Information Modelling (BIM): Insights from Behavioural Economics and Incentive Theory. Report for Royal Institution of Chartered Surveyors," 2015; Eadie et al., 2013; "How can Building Iformation Modelling (BIM) Support the New Rules of Measurement (NRM) Report for Royal Institution of Chattered Surveyors," 2014; Rogers, Chong, & Preece, 2015). The shortage of IT literate personnel as well as the absence of National BIM implementation programs is affecting BIM implementation in the context of developing countries (Bui, Merschbrock, & Munkvold, 2016; Kori & Kiviniemi, 2015). According to Morlhon, et al., (2014) a transition as well as technical mind-set is compulsory to achieve the benefits that BIM offers. He pointed out that, the challenge of seamless data interchange is possibly the major barrier to the widespread adoption of building information modelling. However, these assertions would need to be contextualized especially in developing countries such as Nigeria.

3. Methodology

The research was designed to investigate industry practices and the level of BIM awareness among practitioners in the building and construction industry. Online questionnaire based survey involving the various professionals in the building and construction industry in Nigeria was used for data collection. Email address of participants in this survey were obtained through the member list of the various professional bodies which includes, Nigerian Institute of Quantity Surveyors (NIQS), Nigerian Society of Engineers (NSE), Nigerian Institute of Architects (NIA) and Nigerian Institute of Builders. The questionnaire was administered through emailed to 241 respondents out of which 151 responded (Table 1). The responses were received in the period between June to July 2015. The data collected was coded and analyzed using SPSS (20). Chi-Square Tests were conducted to examine the level of agreement among industry practitioners on some questions bothering on industry practices. Also analysis of variance (ANOVA) test was used to assess group mean difference. The essence of this is to determine whether or not significance differences exist among the different groups (profession groups, organization size and turnover) on BIM awareness.

Table 1 Questionnaire distribution

Professional background	No of questionnaire sent	Percentage to all questionnaires sent (%)	No of responses	Percentage of responses (%)
Architect	52	21.6	23	44.2
Engineer	74	30.7	41	55.4
Quantity Surveyor	95	39.4	78	82.1
Builder	20	8.3	9	45
Total	241	100	151	62.7

4. Data Analysis and Discussion of Results

4.1 Industry Practices

The results in Table 2 showed that all the builders (100%) agree that architects develop building design with CAD and pass on to other project team members. However, 82 .1% and 68.3% of Quantity surveyors and Engineers respectively stated that architects design with CAD and pass on to other project team members. About 31.7% of Engineers and 17.9 % of Quantity Surveyors stated that design input is sought from other project team members by architect before design completion. The Chi-Square Tests show that at .05 level of significance, differences exist in the responses obtained from respondents with respect to their professional background ($X^2 = 6.695^a$, $p<0.05$). Based on professional background, respondents varied in their response on current design information exchange format being used in the industry, what this suggest therefore is that, the traditional design-bid-build is still the most popular practice among the construction industry practitioners.

In terms of CAD data exchange format used by the organizations where these professionals work, results (Table 3) show that all the Architects and Builders (100%) stated that their organizations use Drawing Exchange format (DXF) while 87.8% and 67.9% of Engineers and Quantity Surveyors stated the same. Other formats used by organizations where the Quantity Surveyors work as shown in Table 3 include: Standard for the Technical Exchange of Product Data (STEP) (12.8%) ,

Industry Foundation Class and Initial Graphics Exchange Specification (IGES) 6.4% respectively. Only 12.2% of Engineers agree that their organization use Initial Graphics Exchange Specification (IGES). Chi-Square tests equally show that respondents differ in their opinion on the medium which their company used in receiving/providing design information ($X^2 = 26.087^a$, $p<0.05$).

Table 2 Cross –Tabulation (profession and design information exchange format)

		Information exchange format		Total
		Architect develop building design with CAD and pass on to other project team members	Design input is sought from other project team members by architect before design completion	
Profession	Architect	20	3	23
		87.0%	13.0%	100.0%
	Engineer	28	13	41
		68.3%	31.7%	100.0%
	Quantity Surveyor	64	14	78
		82.1%	17.9%	100.0%
	Builders	9	0	9
		100.0%	0.0%	100.0%
Total		121	30	151
		80.1%	19.9%	100.0%
Chi-Square ($X^2 = 6.695^a$) Sig = .041				

To capture current industry practices, respondents were asked whether they have been involved in a project that utilizes BIM. The results in Table 4 reveal that more than half (50%) of the respondents aside engineers (61%) have not been engaged in project that utilizes BIM.

Looking at the breakdown of the results, only 13% of Architects agree that they have been involved in a project that utilizes BIM, while 32% and 44.4% of Quantity Surveyors and Builders respectively said the same. The Chi-Square tests equally show that significant differences exist in the level of BIM utilization for projects among the professional groups ($X^2 = 16.636^a$, $p<0.05$).

Table 3 Cross –Tabulation (Profession and Use of CAD data exchange format by organization)

Profession	CAD data format used: Drawing Exchange format (DXF)	Industry Foundation Class	Initial Graphics Exchange Specification (IGES)	Standard for the Technical Exchange of Product Data (STEP))	Total
Architect	23	0	0	0	23
	100.0%	0.0%	0.0%	0.0%	100.0%
Engineer	36	0	5	0	41
	87.8%	0.0%	12.2%	0.0%	100.0%
Quantity Surveyor	53	5	5	10	78
	67.9%	6.4%	6.4%	12.8%	100.0%
Builders	9	0	0	0	9
	100.0%	0.0%	0.0%	0.0%	100.0%
Total	121	5	10	10	151
	80.1%	3.3%	6.6%	6.6%	100.0%

Chi-Square ($X^2 = 26.087^a$) Sig = .000

Table 4 Cross –Tabulation (Profession and BIM Utilization)

		Involvement in a project that utilize BIM: Yes	No	Total
Profession	Architect	3	20	23
		13.0%	87.0%	100.0%
	Engineer	25	16	41
		61.0%	39.0%	100.0%
	Quantity Surveyor	25	53	78
		32.1%	67.9%	100.0%
	Builders	4	5	9
		44.4%	55.6%	100.0%
Total		57	94	151
		37.7%	62.3%	100.0%

Chi-Square ($X^2 =16.636^a$) Sig = .001

Having examined in the previous sections how professional groups in building and construction industry utilized information exchange format and CAD data exchange in their projects, the current section looks at size of organization. The results (Table 4) shows that all respondents from medium (51-100 employee) and large (>100 employee) scale organizations stated that "Architect develop building design with CAD and pass on to other project team members". On the other hand, respondents from small scale organizations (1-50 employee) use two information exchange formation. As shown by results, more than 80% of respondents whose firm size ranged between 11-50 agree that 'Architect develop building design with CAD and pass on to other project team members'. However, more than half (55.9%) of respondents from organizations with <10 employees stated that 'design input is sought from other project team members by architect before design completion' while the rest (44.1%) agree that 'Architect develop building design with CAD and pass on to other project team members'. A further test from Chi-Square show that based on size of organization, design information exchange formation utilized differs ($X^2 = 41.578^a$, $p<0.05$).

Table 5 Cross –Tabulation (Size of Organization and Design Information Exchange Format)

		Information exchange format: Architect develop building design with CAD and pass on to other project team members	Design input is sought from other project team members by architect before design completion	Total
Size of Organization by number of employee	< 10	15	19	34
		44.1%	55.9%	100.0%
	11 -30	35	8	43
		81.4%	18.6%	100.0%
	31-50	16	3	19
		84.2%	15.8%	100.0%
	51-100	19	0	19
		100.0%	0.0%	100.0%
	101-250	19	0	19
		100.0%	0.0%	100.0%
	>250	17	0	17
		100.0%	0.0%	100.0%
Total		121	30	151
		80.1%	19.9%	100.0%

Chi-Square ($X^2 = 41.578^a$) Sig = .000

Again, we examined how respondents responded to the question on CAD data format utilized based on size of organization. A similar pattern of what is obtained for Design Information Exchange Format was exhibited for CAD data format. As could be seen, results in Table 6 showed that all respondents (100%) from medium (51-100 employee) and large scale organization (>100 employee) stated that their organization use Drawing Exchange format (DXF) only, whereas those from small scale organizations (1-50 employee) use more than one CAD data format (ie industry foundation class, Initial Graphics Exchange Specification (IGES, Standard for the Technical Exchange of Product Data (STEP) and others). Thus, it could be said that CAD format utilized by respondents varied based on the size of their organization ($X^2 = 80.256^{a}$, $p<0.05$).

Table 6 Cross –Tabulation (Size of Organization and CAD Data Format)

CAD data format used					Total
Drawing Exchange format (DXF)	Industry Foundation Class	Initial Graphics Exchange Specification (IGES)	Standard for the Technical Exchange of Product Data (STEP)		
< 10	24	0	0	5	34
	70.6%	0.0%	0.0%	14.7%	100.0%
11 -30	28	5	10	0	43
	65.1%	11.6%	23.3%	0.0%	100.0%
31-50	14	0	0	5	19
	73.7%	0.0%	0.0%	26.3%	100.0%
51-100	19	0	0	0	19
	100.0%	0.0%	0.0%	0.0%	100.0%
101-250	19	0	0	0	19
	100.0%	0.0%	0.0%	0.0%	100.0%
>250	17	0	0	0	17
	100.0%	0.0%	0.0%	0.0%	100.0%
Total	121	5	10	10	151
	80.1%	3.3%	6.6%	6.6%	100.0%

The results in Table 7 shows whether or not respondents have been involved in a project that utilized BIM. Based on the breakdown of the results, it could be seen that <40% of respondents from medium (51-100 employee) and large (>100 employee) scale organizations said yes that they have been involved in project that utilizes BIM. On the other hand, the percentage of those that have been involved in BIM project is higher for respondents in small organizations (1-50 employee).

Table 7 Cross –Tabulation (Size of Organization and BIM Utilization in a Project)

		Have you been involved in a project that utilize BIM		Total
		Yes	No	
Size of Organization by number of employee	< 10	15	19	34
		44.1%	55.9%	100.0%
	11 -30	18	25	43
		41.9%	58.1%	100.0%
	31-50	14	5	19
		73.7%	26.3%	100.0%
	51-100	4	15	19
		21.1%	78.9%	100.0%
	101-250	0	19	19
		0.0%	100.0%	100.0%
	>250	6	11	17
		35.3%	64.7%	100.0%
Total		57	94	151
		37.7%	62.3%	100.0%

Chi-Square (X^2 =25.156[a]) Sig = .000

For instance, 73.7% of respondents from organizations that have between 31-50 employee said yes, that they have been involved in a project that has utilized BIM while those that have between 1-30 employee recorded >40%. Going by the results, it is obvious that BIM utilization based on size of organization varied (X^2 =25.156, $p<0.05$).

Company turnover and return on investment are not considered in critical government investments, however this could have significant effect in the private sector (Ugwu and Kumaraswamy, 2007). In view of this, turnover could affect the way organizations manage their information. The results in Table 8 reveal the information exchange format that organizations avail themselves with based on their turnover.

All (100%) of respondents from organizations with turnover < 1million and >100 million Naira utilized only one information exchange format (ie 'Architect develop building design with CAD and pass on to other project team members'). On the contrary, respondents from organizations whose turnover ranged between 1-100million Naira utilized two information exchange format (ie 'Architect develop building design with CAD and pass on to other project team members' and 'Design input is sought from other project team members by architect before design completion'). For instance, 77.6% of those with turnover in the range of 11-50 million Naira stated that Architect develop building design with CAD and pass to other project team members while the rest (22.4%) said that design input is sought from other project team members by architect before design completion. Similarly, 89.3% of those with turnover in the range of 51-100million Naira agreed that Architect develop building design with CAD and pass to other project team members while the rest (10.7%) noted that design input is sought from other project team members. The Chi-Square test equally showed that significant differences exist in the information exchange format being used based on turnover rate of organization ($X^2 = 34.180^a$, $p<0.05$).

Table 8 Cross –Tabulation (Turn Over and Information exchange format)

		Information exchange format		Total
		Architect develop building design with CAD and pass on to other project team members	Design input is sought from other project team members by architect before design completion	
Turnover of Organization	< N1M	14	0	14
		100.0%	0.0%	100.0%
	N1-10M	10	14	24
		41.7%	58.3%	100.0%
	N11-50M	45	13	58
		77.6%	22.4%	100.0%
	N51-100M	25	3	28
		89.3%	10.7%	100.0%
	N101-250M	25	0	25
		100.0%	0.0%	100.0%
	>250M	2	0	2
		100.0%	0.0%	100.0%
Total		121	30	151
		80.1%	19.9%	100.0%
			Chi-Square ($X^2 = 34.180^a$)	Sig = .000

In terms of CAD data format used, results in Table 9 exhibit similar pattern with the results on information exchange format discussed in the previous section. Organizations with <1million and >100million Naira turnover utilized only one CAD data format (Drawing Exchange format (DXF)) while those with turnover in the range of 1million to 100million Naira used two or more CAD data format. Going by the results, it is obvious that CAD data format used by organizations based on their turnover differ. Put differently, there is a significance difference in CAD data format used with respect to turnover ($X^2 = 64.083^{a,}$ $p<0.05$).

Table 9 Cross –Tabulation (Turnover and CAD data format used)

Turnover of organization	CAD data format used					Total
	Drawing Exchange format (DXF)	Industry Foundation Class	Initial Graphics Exchange Specification (IGES)	Standard for the Technical Exchange of Product Data (STEP))	Others	
< N1M	14	0	0	0	0	14
	100.0%	0.0%	0.0%	0.0%	0.0%	100.0%
N1-10M	19	0	0	0	5	24
	79.2%	0.0%	0.0%	0.0%	20.8%	100.0%
N11-50M	38	5	10	5	0	58
	65.5%	8.6%	17.2%	8.6%	0.0%	100.0%
N51-100M	23	0	0	5	0	28
	82.1%	0.0%	0.0%	17.9%	0.0%	100.0%
N101-250M	25	0	0	0	0	25
	100.0%	0.0%	0.0%	0.0%	0.0%	100.0%
>250M	2	0	0	0	0	2
	100.0%	0.0%	0.0%	0.0%	0.0%	100.0%
121	5	10	10	5		151
80.1%	3.3%	6.6%	6.6%	3.3%		100.0%

Lastly on industry practices, we examined the level of BIM utilization based on turnover of organization (Table 10). The pattern exhibited in the result is not consistent. However, one salient point from the breakdown of the results is that the total number of respondents who stated that they have not been involved in a project that utilized BIM is more (53.6%) than those that said yes (43.4%). Among those that stated that they have been involved in a BIM project are respondents from organizations with turnover in the range of 1-10million Naira which also recorded the highest percentage (75.0%) followed by those in the range of 101-250million Naira (60.0%). In terms of those that said they have not been involved in a BIM project, the parentage was highest (71.4%) for organizations with turnover <1 million Naira followed by those whose turnover ranged between 11-50million Naira (69.0%). Again, the Chi- Square test show that significant differences exist among the different groupings on BIM utilization ($X^2 = 34.340^a$, $p<0.05$).

Table 10 Cross –Tabulation (Turnover and BIM utilization)

		Involvement in a project that utilize BIM		Total
		Yes	No	
Turnover of organization	< N1M	4	10	14
		28.6%	71.4%	100.0%
	N1-10M	18	6	24
		75.0%	25.0%	100.0%
	N11-50M	18	40	58
		31.0%	69.0%	100.0%
	N51-100M	14	14	28
		50.0%	50.0%	100.0%
	N101-250M	15	10	25
		60.0%	40.0%	100.0%
	>250M	1	1	2
		50.0%	50.0%	100.0%
Total		70	81	151
		43.4%	53.6%	100.0%
		Chi-Square	($X^2 = 34.340^a$)	Sig = .000

4.2 BIM Awareness and Understanding

The level of awareness and understanding respondents have on BIM was examined in this section. BIM awareness was rated on a 5 point Likert Scale ranging from Very high =5, High =4, Average =3, Low=2, Very Low=1 in the questionnaire. The descriptive statistics in Table 11 shows that mean value obtained for the professional groups on BIM awareness ranged from 2.5 to 3.3. This is further illustrated in Figure 1, as could be seen from the results, Architects and Engineers have mean score of 3.3 and 3.0 respectively while Builders and Quantity Surveyors have 2.5 and 2.8 respectively. Based on the mean score obtained, it could be stated that the level of BIM awareness among Architects and Engineers is a bit higher than that of Builders and Quantity Surveyors. However, looking at the ANOVA results through the F and Significant value obtained (0.05 level of significance), the differences that exist in the mean value among the different professional groups is not significant at 0.05.

What this result means is that no significant difference exists in the level of BIM awareness and understanding among the professionals at 0.05 level of significance ($F = 1.732$, $P>0.05$). This result suggests two things, first that slight differences exist in mean scores obtained for the professional groupings. Second, this difference is not statistically significant at 0.05. Thus, no sweeping assumptions should be made that Architects and Engineers have more awareness on BIM than Quantity Surveyors and Builders, although slight differences exist in their mean score as shown by the results, it is not significant or substantial enough to make such sweeping assumption.

Table 11Awareness and Understanding of BIM

Profession	Mean	Std. Deviation	F	Sig
Architect	3.3043	.70290		
Engineer	3.0244	.85111		
Quantity Surveyor	2.8718	1.13228	1.732	.163
Builders	2.5556	.52705		
Total	2.9603	.98577		

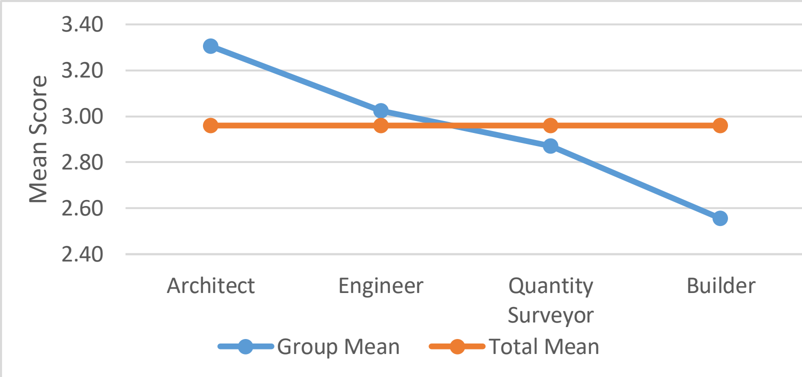

Figure 1: Awareness and Understanding of by profession

We went further to test how organization size could affect BIM awareness and understanding. The descriptive statistics shows that mean values ranged from 2.2 to 3.3 as illustrated in Figure 2. The breakdown of results shows a kind of consistent pattern as the mean scores tended to increase with the size of organization. The least mean score of 2.2 was obtained for those organizations with < 10 employees while those with 11 to 30 and >250 employees recorded the highest (3.3). The ANOVA results show that a significant difference exists in the level of awareness and understanding of BIM among respondents based on the size of their organization ($F= 6.626$, $p<0.05$). Going by this result, it could be said that size of organization influences level of awareness and understanding of BIM in the building and construction industry in Nigeria. Those organizations with <10 employees (small scale) have low awareness level on BIM compared to medium and high scale organizations which have more level of awareness (average).

Furthermore, awareness on BIM was examined with respect to turnover of the organizations where the respondents work. Results (Figure 3) show that mean score obtained ranged between 2.7 and 3.2, which is an indication that their awareness level is on the average. However, a closer look at the different groups based on rate of turnover showed some slight variations in mean score. Respondents from organizations whose turnover ranged between 51-100 million Naira recorded highest mean score of 3.2

followed by those within the range of 11-50 million (3.1), >101million (3.0) and <1 million (2.7).

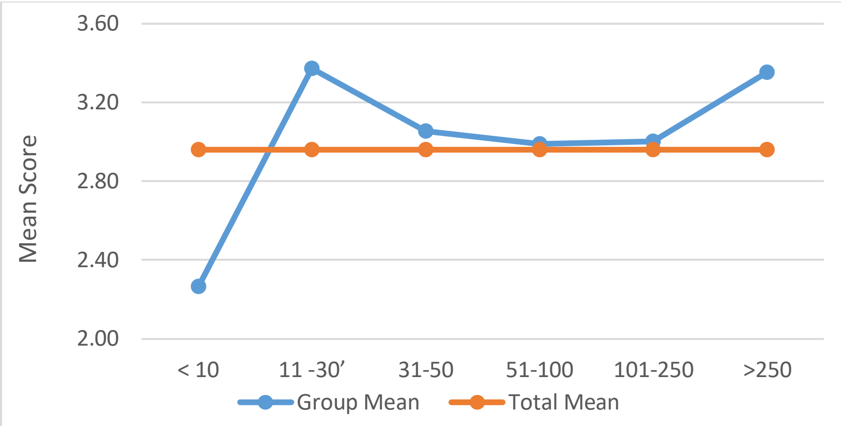

Figure 2. Awareness and Understanding of by size of organisation

However, ANOVA results showed that no significant difference exists among the groups (organization turnover) on BIM awareness and understanding at 0.05 level of significance ($F= 1.196$, $p>0.05$). What this result suggests therefore, is that though slight variations exist in mean score for the different turnover groupings, as earlier stated this is not significant enough to make sweeping assumptions that turnover affects awareness and understanding of BIM.

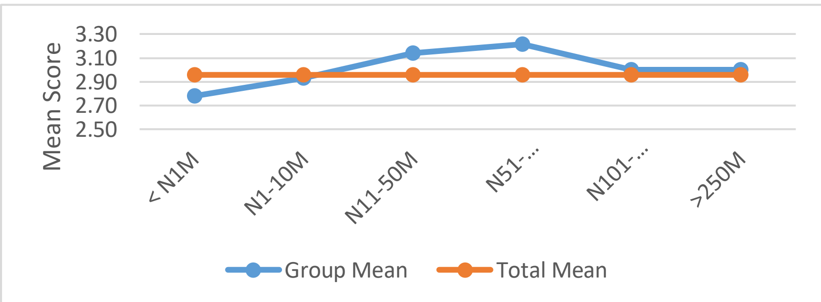

Figure 3: Awareness and Understanding of by turnover of organization

5. Conclusions

The study was conducted to determine the level of awareness and understanding of Building Information Modelling among construction industry professionals engaged in various organisations. The data for the study was collected through questionnaire survey to Architects, Quantity Surveyors, Structural and Services Engineers. The questionnaire was administered to the target respondents through online survey. A descriptive and inferential approach was adopted for the data analysis.

The study reveals that the traditional design-bid-build remains the most common practice in the Nigerian construction industry. On the CAD data exchange format used, the drawing exchange format is still popular among practitioners and the often-complete designs before passing to other practitioners for their input. Similarly, the CAD data utilized by respondents varied, the chi-square test shows that significant differences exists in the level of BIM utilization for project execution among various respondents based on the size of organizations. Significant difference also exists in the information exchange format used and the turn-over of organisations. The medium and large organisations uses more than one Data format. On the level of involvement in projects that utilize BIM. The results here varied in accordance with the size of organizations. The ANOVA results revealed a significant difference in the level of awareness and understanding of BIM among respondents based on the size of organizations'. These findings have allowed conclusion to be made that the size of organizations' influences level of awareness and understanding of BIM in the construction industry. An examination of the level of awareness with respect to turnover of firms shows a slight variation in the perception of respondents, hence, a sweeping assumption that turnover affects awareness and understanding of BIM cannot be made.

References

Abubakar, M., Ibrahim, Y. M., Kado, D., and Bala, K. (2014). Contractors Perception of the Factors Affecting Building Information Modeling (BIM) Adoption in the Nigerian Construction Industry. Computing in Civil and Building Engineering, 167-178.

Amuda-Yusuf, G., Adebiyi, R. T., Olowa, T. O. O. and Oladapo, I. B. (2017). Barriers to Building Information Modelling Adoption in Nigeria. Journal of Research Information in Civil Engineering, 14(2), 1478-1495.

Bui, N., Merschbrock, C. and Munkvold, B. E. (2016). A review of Building Information Modelling for Construction in Developing Countries. Paper presented at the Creative Construction Conference, 26-28 June, 2016, Budapest,Hungary.

.Collaborative Building Information Modelling (BIM): Insights from Behavioural Economics and Incentive Theory. Report for Royal Institution of Chartered Surveyors. (2015). London: Royal Institution of Chatered Surveyors.

Eadie, R., Browne, M., Odeyinka, H. and Mckeown, C. (2014). A Survey of Current Status of and Perceived Changes Required for BIM Adoption in the UK. Built Environment Project and Asset Management Volpp 5 (1), 4-21.
Eadie, R., Odeyinka, H., Browne, M., Mckeown, C., & Yohanis, M. (2013). An Analysis of the Drivers for Adopting Building Information Modeling. ITCON, 18, 338-352.

Fung, W. P., Salleh, H. and Rahim, F. A. M. (2014). Capability of Building Information Modeling Application in Quantity Surveying Practice. Journal of Surveying, Construction and Property (JSCP), 5(1).

How can Building Iformation Modelling (BIM) Support the New Rules of Measurement (NRM) Report for Royal Institution of Chattered Surveyors. (2014). London: RICS.

Kori, S. A. and Kiviniemi, A. (2015). Towards Adoption of BIM in the Nigerian AEC Industry: Context Framing, Data Collecting and Paradiggm for Interpretation. Paper presented at the 9th BIM Academic Symposium And Job Task Analysis Review, 7-8 April,2015, Washinton DC, USA.

Olatunji, O. A., Sher, W. D., Gu, N. and Ogunsemi, D. R. (2010). Building Information Modelling Processes: Benefits for Construction Industry. Paper presented at the 18th CIB World Building Congress, Salford.

Rogers, J., Chong, H.-Y. and Preece, C. (2015). Adoprion of Building Information Modeling Technology (BIM): Perspectives from Malaysian Engineering Consulting Services Firms. Engineering, Construction, and Architectural management 22(4), 424-445.

Succar, B. and Sher, W. (2013). A Competency knowledge-base for BIM learning',. Paper presented at the in Australasian Universities Building Education (AUBEA2013), , November 20-22, , Auckland, New Zealand.

Tahir, M., Haron, N., Alias, A., Harun, A., Muhammad, I., & Baba, D. (2018). Improving Cost and Time Control in Construction Using Building Information Model (BIM): A Review. Pertanika Journal of Science & Technology, 26(1).