STAKEHOLDERS' PERCEPTION OF SIGNIFICANT CHALLENGES TO THE IMPLEMENTATION OF BUILDING MANAGEMENT SYSTEM IN NIGERIA

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ABSTRACT

*Building Management Systems (BMS) has evolved over the years and **it** is having positive impact on the users of buildings. This research assessed the challenges to the implementation of Building Management System in Nigeria. The population consists of architects, builders, quantity surveyors, electrical and mechanical engineers who are actively involved in BMS projects. Random sampling technique was used in selecting the experts for the study. A total of 64 copies of questionnaire were administered using the Google form, but 44 was filled which amounted to 69% success. Descriptive statistics was used in analyzing the data gotten. The results obtained from this study showed that the level of awareness and the rate of implementation of the Building Management System in Nigeria is very low. The factors affecting choice of BMS include the ease of procuring the system, the cash flow associated with it, the level of demand of the property after implementation amongst others. It concludes by proposing a number of measures that would facilitate the wide spread adoption and implementation which includes giving tax waivers on BMS systems, provision of laws to guide and regulate the process of building automation system and most importantly creation of public awareness on the need and benefits of the system. Furthermore, power must be stabilized and alternative means made available to ensure continuous operation of the system. Also, security in the country must be improved and allowances made for the upgrade and regular maintenance of the BMS. Finally, there should be training of BMS operatives to effectively maximize every given benefit the BMS offers.*

KEYWORDS: ***Building Management System, Implementation Challenges, Construction, Procurement, Maintenance***

1.0 INTRODUCTION

The construction industry has witnessed substantial progress in the adoption of new technologies in the development of buildings. The adoption of these technologies led to the creation of a new concept in construction industry called ' Intelligent buildings' or "smart buildings". These buildings combine innovation and systems with skillful management to maximize the return on investment (Clements-Crome, 2011). It was redefined as any building that is responsive to the requirements of occupants, any society, or organization. In the light of this, a smart building or a city at large is defined by the following important elements: intelligent energy, intelligent safety, intelligent buildings, smart water, intelligent transport, smart healthcare etc. It can balance its social needs, environmental needs, and commercial needs - by optimizing resources at its disposal. These services must be controlled by some means to ensure that their functions are conforming to the necessities (DVI, 2017).

In order to achieve this, a BMS (Building management system), whose purpose is to automate and take control of all facilities operation in the most optimal and efficient way, within the constraints of the installed device within a building is established. Intelligent building systems are mainly managed and controlled through one single system – the Building Management System (BMS). Building management systems (also known as Buildings Automation Systems, (BAS) are one of the vital intelligent building systems (Wang & Xie, 2010). A building management system comprises of various subsystems which are connected in several ways to form an integrated system. With the development of the modern computer in the 1940s, BMS witnessed its beginning in the late 1960s. Due to their ability in increasing efficiency in buildings management, building management systems would seem to be an optimal choice for effective management for all types of buildings (Wang & Xie, 2010). The BMS is basically a solution which is integrated into a facility to ensure an environment that is safe, secure, and comfortable and energy efficient.

In Europe, there is technological advancement in the energy efficiency market and increasing use of technology like Artificial Intelligent (AI), and Internet of things (IoT) in the energy efficiency software especially in the residential sector in Europe. This creates wide spread opportunities for BMS as the number of households equipped with energy management system has increased. There is urgency to bring down emission level coupled with intensifying use of renewable energy and development together with upgrading the buildings to make them energy efficient. All of these has made the implementation of the system gain more ground.

In Asia, integrated systems are changing how buildings are managed and delivering improved tenant experience. In a large part of Asia, new technology is being taken advantage such as the (IoT) which works with the BMS to monitor and enhance the experience in buildings and installation. Moreover, Asia has not achieved the same level as Europe and North America, where both building construction and performance are highly and strictly regulated by specific standards (Omorogiuwa & Folorunso, 2019.)

However, most private and public buildings in Nigeria are faced with lots of problems which sum up as challenges to the implementation of this building management system leading to a slow and sluggish adoption of high technology in the country. One of the major challenges facing its implementation as stated by Hassanain *et.al* (2017) is “inadequate or insufficient knowledge of how this system works and the benefit derived from the installation of a BMS in one’s facility. Building clients also considers the “enormous” cost involved in setting up a BMS. Another constant barrier to the implementation of a BMS in Nigerian construction industry is unavailability and inadequate supply of materials needed. Other challenges will be discussed later in the research work.

As the scope of BMS gradually expands, there is need to sufficiently study the challenges to its implementation and how well it can best be solved to enjoy its envisaged benefits which include increasing the occupants’ level of comfort and ensuring their safety to a certain level, resolving operational problems quickly and more efficiently, improving the performance of the building and reducing energy and water consumption (Daniel *et al.*, 2017).

There is dire need for the buildings industry in Nigeria to integrate the intelligent building technology in commercial and multifunctional buildings. Therefore, this study seeks to assess the perception of stakeholders on the challenges to implementation of building management systems in the Nigerian construction industry.

2.0 LITERATURE REVIEW

2.1 Building Management System

Building Management Systems (BMS) is one of the most important intelligent building systems because it comprises of various subsystems which are connected in several ways to create an integrated system. A lot of definitions have been given on Building Management System, some of which are stated below:

Andrew (2018) defined Building management systems as "intelligent microprocessor-based controller networks installed to monitor and control a buildings technical systems and services such as air conditioning, ventilation, lighting and hydraulics". More specifically they link the functionality of individual pieces of building equipment so that they operate as one complete integrated system. BMS are also referred to as "smart building technology" which encompasses services listed earlier which are essential for managing industrial operations. BMS and centralized building management systems enhances the management of industrial infrastructures and a building's mechanical and electrical equipment (BMS, 2021).

Ambika (2017) defined a "Building Management System (BMS) or a more recent terminology, Building Automation System (BAS) as a computer-based control system installed in buildings that controls and monitors the building's mechanical and electrical equipment such as ventilation, lighting power systems and security systems". A BMS is often defined as a control system, consisting of software, hardware and quite obviously communication protocols to control and monitor a vast range of building systems and controls (i-Scoop, 2018).

Building Management Systems (BMS) (also called Automation or BAS) as defined by Mustafa *et al.* (2002), are used in buildings for automatic monitoring and control of services such as lighting, plumbing, fire services, heating and air conditioning systems. The term refers to a system that uses sensors, controls and activators. All these use an electronic digital processor to implement control algorithms and have the capability of communicating with other controls. The BMS term covers all control elements, including hardware, controllers, any linking network and central controllers. Allen and Remke (2008) further stated that building automation or management system is used to control different functions including; ventilation and Air-Condition (HVAC) heating, system and also temperature not forgetting scheduling of equipment. Building automation systems (BAS) is an umbrella terms (and is also Known as building management system, BMS). Wang & Xie (2010) referred to it as a wide range of computerized buildings control systems, from special-purpose controllers, to standalone remote stations, to large systems including central computer stations and printers. Current generation BMS systems are now based on open communications protocols and are WEB enabled allowing integration of systems from multiple system vendors and access from anywhere in the world.

2.2 The Development and Rise of Building Management Systems

The BMS started in the 1940s with a stage (known as the pre-BMS stage) in which a central control and monitoring panel was used to operate basic tasks. The number of switches and sensors that were connected at the central monitoring and control units are lesser than the improved BMS to which a large number of inputs and outputs are connected.

The BMS witnessed another stage in the 1960s with the emergence of the first computerized building automation control system. This was the first BMS generation. It was as a result of the development of the modern computer. The first building automation protocols were proprietary or closed. A proprietary protocol is like an exclusive language: in order for the devices and systems within a BMS to communicate and understand one another, same protocol must be used. Coaxial cable or two wire digital transmissions were used to connect remote multiplexers and control panels to a computer which allows all messages, sensors and devices to communicate easily. Other functions carried out by this system at that time include: high and low alarm limits and reports, automatic reset of analog outputs, scheduled programming of controllable devices. Due to the restrictive nature of proprietary protocols, building owners were held captive to a single protocol which limits their choice of building automation equipment: hence, the integration of individual subsystems that operate using different protocols was grossly limited. Each protocol has its own advantages and proper adherence is an effective way to optimize building system and meet the particular needs and budget of building owners (BTL, 2018). The main constraint that characterized this generation was its high cost and complexity in its usage.

The second BMS generation came up which was referred to as “BMS with data gathering panel based on microcomputer”. This was to improve on the shortcoming of the first generation BMS. Software packages for energy management was designed and incorporated into the BMS. The software packages include demand control, day/night control, duty cycle, optimum start/stop etc. its improvement brought about rapid increases in the use of minicomputer, central processing units in building management systems. BTL (2018) further asserted that another improvement that reflected in this generation as against the former was that data gathering units were introduced which helped to reduce the number of wires used to transmit data within points. This was majorly as a result of the decline in the cost of hard ware during the 1970s. This stage brought about ease of use of computer and programs interface with no need for specialist users.

After these, BMS was improved to a Microprocessor based system using Local area network (LAN). Microprocessors and chips were gradually declining in price which was the major reason for the development of new technology in BMS. These control stations started using Local Area Network represented in the typical system architecture of BMS (BTL, 2018). As technology kept increasing and several researches were being carried out to proffer solution to the incompatible problems of BMS, a lot of standards were developed and promoted. Some of the technologies that were adopted in the BMS industry ran from open protocols, standard technologies, communication and software technologies commonly used by Internet or Intranet or within the computing network area. BMS users were increasingly adopting wireless technology since going wireless translate to less cables, less wires, and less conduits (BTL, 2018). Wireless communication protocols mitigate the limitations of traditional hardwired circuits, particularly in the realms of infrastructure challenges.

Michael (2020) stated that the use of building management system is growing at approximately 15% to 34% annually. He further posited that by 2022, the building management system industry is expected to be worth around $104 billion. Building management systems are being implemented for an increasingly wide range of application. While the initial BMS systems were for heating and cooling and primarily used to reduce cost, today, a huge range of smart devices is being leveraged to increase workers' productivity, reduce operational costs, and secure businesses. BMS systems are also used to monitor and secure hospitals, data centers, airports, and hotels.

The BMS is supplied and procured as a complete system that includes engineering, supply, installation, programming and commissioning. They are supplied by specialist integrators that are either directly associated with the manufacturer or are approved re-sellers. All integrators should have full factory technical support and are required to work closely with Mechanical and Electrical services and other contractors.

2.3 The Development and Rise of Building Management Systems

As beautiful as this feature might seem, there are lots of challenges in the adoption and implementation of the BMS in Nigeria. A few of them are summarized below as listed by other researchers:

Table 1: Challenges to the Adoption of BMS

Challenges	**Authors**
Awareness	Omorogiuwa & Folorunsho (2019)
Economy	Michael (2020)
Technical know-how	Omorogiuwa & Folorunsho (2019), Hassanain *et.al* (2017)
Power supply failure	Omorogiuwa & Folorunsho (2019), Daniel *et al*. (2021), Ben & Margaret (2014)
Maintenance and upgrade	(BS3811:1984)
Training	Piper (2004), Horwitz and Bennett (2009)
Limited value	Walter (2021)
Scalability	Omorogiuwa & Folorunsho (2019)
Security issues	Hayden (2019), Michael (2020).
Access to data to implement and sustain the process	Allen and Remke (2008), (Michael, 2020).
Lack of useful visualization techniques or tools that consolidate operational data that is suitable for human interpretation	Daniel *et al*. (2021), Ben & Margaret (2014)
Coordination of different tasks among the professionals	Ben & Margaret (2014), (Michael, 2020).

Source: Author, 2022.

However, the level of satisfaction with the performance of these systems is influenced by a number of challenges that could take place during the life cycle of building projects. Therefore, there is a need to identify and investigate these important challenges that influence the successful implementation of the BMS. A major reason for carrying out this research is because there is basically no clearly defined system for the installation of this technology in Nigeria. The study seeks to achieve the following objectives: to determine the level of adoption and factors that determines the choice of Building Management System in Nigeria; to investigate and evaluate the challenges that influences the successful implementation of the BMS, and to develop a plan of action sufficient enough to solve the identified challenges.

3.0 METHODOLOGY

This study essentially employed descriptive survey techniques and quantitative research design using the questionnaire method. The population of the study comprises of professionals (Architects, Services Engineers, Builders and Quantity Surveyors) who are involved in construction activities. The sample size was obtained using the Krejcie Morgan formulae, having obtained the population from the Federation of Construction Industry (FOCI) and respective professional institutes of the professionals. This study population is made up of professionals in the construction industry including Building Management **s**ystem firms within Lagos State, Nigeria. The sample size was 44. This due to the fact that those involved in the subject matter of this research are relatively few in Nigeria. Random sampling techniques was used in selecting the experts for the study. The questionnaires were generated using the responses obtained from the group of professionals in the construction industry for the purpose of data collections. The respondents to the questionnaire are the practitioners in the construction industry within Lagos State. This method of data collection is significant as it helps in the collection of firsthand information from the direct personnel involved in the implementation of a building management system. The questionnaire contains two sections: the first which contains questions that helps to identify the respondents and their relevance to the study together with their level of experience; and the second section which consists of questions about the implementation of the BMS and challenges that would affect its success to generate responses needed for the purpose of the research study. Using five-point Likert scale questionnaire survey, the respondents were asked to indicate their perceived relative degree of effect for each of the identified challenges by selecting any of the five evaluation scales; "Strongly disagree"(1), "Disagree"(2), "Not sure"(3), "Agree"(4), "Strongly agree"(5) and “Not desired” (1); “Rarely” (2); “Moderately” (3); “Desired” (4); “Most desired” (5). The questionnaire was administered to respondents by the researcher. The purpose of the research was explained to the respondents to gain their consent and assurance was given of the confidentiality of their response and protection of their identities. The data collected was subjected to statistical analysis using Statistical Packages for Social Science (SPSS) and Microsoft Excel. The descriptive statistics of simple percentage, mean and inferential statistics (Kruskal-Wallis Test) were used in presenting the data collected. Kruskal-Wallis test as a non-parametric alternative test for the one-way analysis of variance (ANOVA). Field (2013) asserted that the theory of the Kruskal-Wallis test is very similar to that of Mann-Whitney test. Field and Miles (2012) and Field (2013) posited that Kruskal-Wallis test and Mann-Whitney are based on ranked data. Fellows & Liu (2008) point out that Mann-Whitney test is used when there are two samples.

$$H = \frac{12}{n(n+1)} \sum_{j=1}^{k} \frac{R_j^2}{nj} - 3(n+1) \text{...} (1)$$

Where:

R_j = sum of the ranks for each group
n = total sample size (in this case 4)
n_j = sample size of a particular group (in this case, there are 6 groups: 4; 12; 19; and 9).

4.0 RESULTS

4.1 Demographic details of the respondents

In Figure1, the distribution of respondents based on their profession is described. It can be seen that Architect has 9.1% (4), Mechanical Engineer has 9.1 % (4), Electrical engineer has 18.2% (8), Builder has 43.2% (19) and Quantity surveyors has 20.5% (9).This shows that there is adequate representation of Professionals in the study.

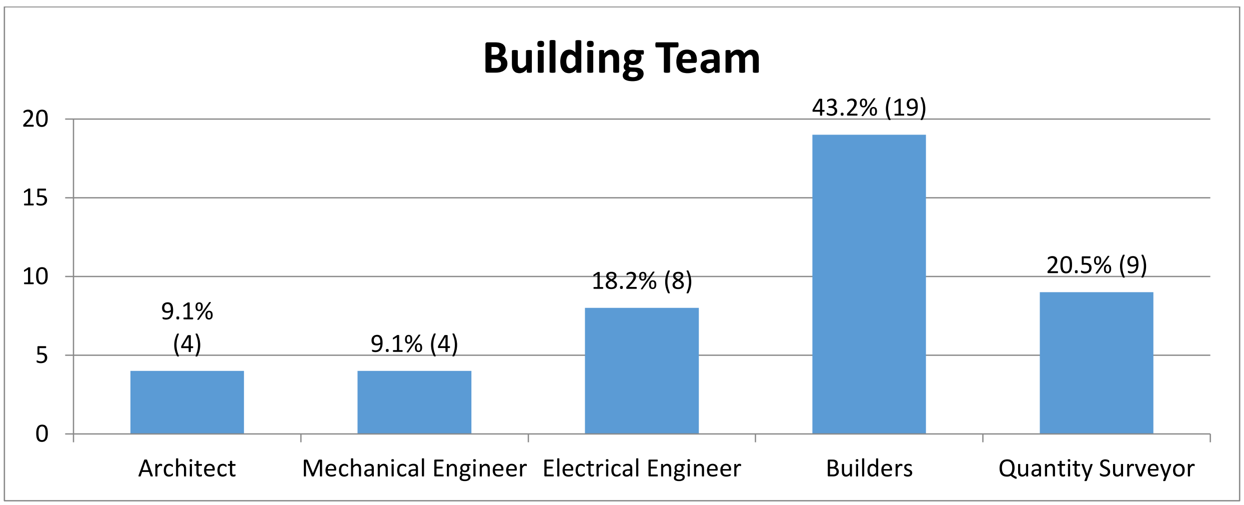

Figure 1: Distribution of Respondents

Figure 2 shows the distribution of respondents based on their years of Professional experience, where 45.5% (20) of the respondents have 1-5years of experience; 25% (11) of the respondents have 6-10 years of experience; 9.1% (4) of the respondents have 11-15 years of experience; 6.8% (3) of the respondents have 16-20 years and 13.6% (6) have the experience of over 20 years respectively. It can be seen that the respondents have vast experiences in the construction industry.

ISSN: 2736-0814

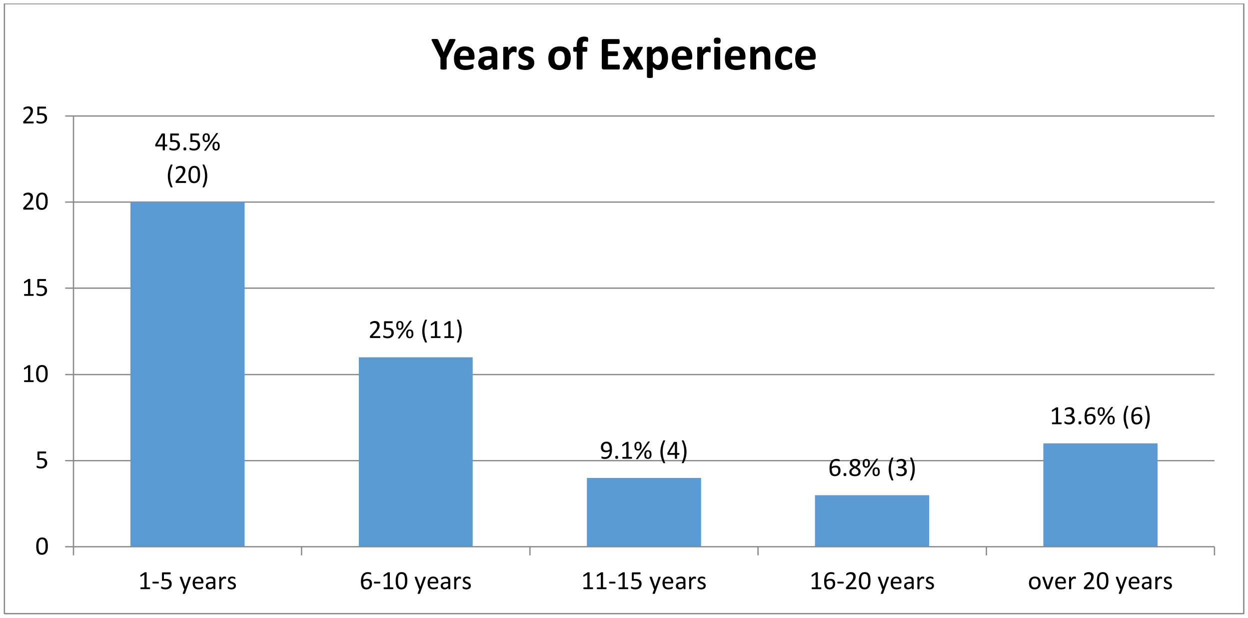

Figure 2: Years of Experience of Respondents

4.2 Analysis of Research Objectives

Table 2 shows that power supply failure in Nigeria (group mean = 4.40) is the greatest challenge to the implementation of BMS in Nigeria, with cost of implementation of the process taking second position (group mean = 4.28). Lack of adequate maintenance and upgrade (group mean = 4.20) is the third most challenging factor to BMS implementation in Nigeria. Other factors are as presented in Table 2.

Table 2: Ranking Responds of Challenges to Implementation of BMS in Nigeria

S/N	Ranking responds on Critical Project Success Factors	Architects	Services Engineers	Builders	Quantity Surveyors	Total			RL
		N=4	N=12	N=19		N=94			
		Mean	Mean	Mean		GM	Chi-Square Value	Kruskal-Wallis Asymp. Sig. p	
1.	Power supply failure in Nigeria	4.40	4.45	4.38	4.36	4.40	**1.372**	**.632**	**1st**
2.	Cost of implementation of the system	4.28	4.39	4.26	4.20	4.28	**14.559**	**.0034****	**2nd**
3.	Lack of adequate maintenance and upgrade	4.19	4.26	4.16	4.18	4.20	**4.762**	**.514**	**3rd**
4	Access to data to implement and sustain the process	4.12	4.16	4.17	4.09	4.14	**7.281**	**.241**	**4th**
5	Lack of useful visualization techniques or tools that consolidate operational data that is suitable for human interpretation	3.88	3.89	3.76	3.90	3.86	**4.926**	**.497**	**5th**
6	Coordination of different tasks among the professionals.	3.79	3.86	3.76	3.89	3.82	**3.276**	**.647**	**6th**
7.	Insecurity in the country	3.78	3.72	3.74	3.77	3.75	**2.875**	**.719**	**7th**
8.	It is considered as a luxury by developers	3.72	3.78	3.75	3.76	3.75	**7.162**	**.245**	**8th**
9.	Lack of awareness of the existence and benefits derived from the BMS	3.68	3.65	3.67	3.78	3.69	**6.718**	**.295**	**9th**
10.	Low-cost intelligent building technology is not available	3.67	3.62	3.70	3.73	3.68	**12.092**	**.0041****	**10th**
11.	No accurate documentation of how the system works making it a risky investment	3.60	3.65	3.73	3.65	3.66	**2.612**	**.758**	**11th**
12.	Lack of competent BMS professionals	3.62	3.65	3.71	3.59	3.64	**3.429**	**.627**	**12th**
13.	Nigeria is still a struggling developing country	3.65	3.55	3.62	3.54	3.59	**2.532**	**.779**	**13th**
14.	It is complex and hard to implement	3.09	3.19	3.22	3.21	3.18	**5.174**	**.476**	**14th**

Source: Author's Field Survey, 2022.

Table 3 Measures to be taken to facilitate the implementation of BMS

Measures	Mean	Rank
▪ Ease of Importing BMS materials and equipment	4.27	1st
▪ Concrete laws to guide and regulate the process of building automation	4.25	2nd
▪ Improvement in the security aspect of the country	4.20	3rd
▪ Creation of public awareness on the need and benefits of BMS	4.18	4th
▪ Power stability	4.14	5th
▪ There should be standard maintenance manual and work programs to carry out maintenance work and upgrade on BMS system	4.11	6th
▪ Financial incentives to property developers of automated buildings	3.98	7th
▪ Reduction in the cost of Building management system equipment and materials	3.86	8th
▪ Tax waivers on Building Automation system	3.64	9th
▪ Increased, appropriate and consistent training of BMS personnel	3.50	10th

Source: Author's Field Survey, 2022.

Table 3 shows that procurement of BMS materials and equipment should be made easy and available as it ranks first, laws to guide its process ranks second then security should be addressed, public awareness created with power stabilized.

4.3 Discussion of Results

This study examined the challenges to the implementation of Building Management System in Nigeria. The findings of this study will be discussed under the objectives of the study as stated below:

4.3.1 To investigate and evaluate the challenges to the successful implementation of the BMS

When the choice of implementing a BMS in one's building has been made, its process will face a number challenges that would affect it either at the procurement stage or during its installation or its maintenance period. Power supply failure in Nigeria ranks first as revealed in this research which is in agreement with other researches. Electricity is inadequate and, in a bid, to cover up for this shortage, larger populations generate their power from generators or solar panels. This interrupted power supply makes the installation of this system extremely expensive since a constant uninterrupted power supply would be needed to ensure the seamless operation of the BMS (Omorogiuwa & Folorunsho, 2019). Some other challenges run from the cost of implementation, BMS professionals not competent enough to handle it and the ones who meet up with the standard are scarce and of course increase the cost when you request for their service. These findings agree with Michael (2020), Hassanain *et al.* (2017), Daniel *et al*. (2021), Ben & Margaret (2014), Piper (2002), Walter (2021) and Hydeman, (2004). Though, these studies cut across different countries and climes, the challenges remain the same but at varying degrees and levels. Kruskal-Walli's test was carried out to compare the medians of the samples of the four stakeholders (architects, services engineers, builders and quantity surveyors) that participated in the survey. The result showed that there is no statistically significant difference in the perceptions of respondents on the challenges to the implementation of building management system in Nigeria except for two factors (see Table 2). The two factors are; cost of implementation of the system and low-cost intelligent building technology is not available. The p-values for these 2 factors are less than 0.05 (see Table 3). The reasons for the difference in the results could be attributed to the fact that each of the stakeholders have different and diverse opinion on information related to BMS. The perceptions of these professionals are different because their professional background and individual interests to protect differ.

4.3.2 To develop a plan of action sufficient enough to solve the identified challenges

Having satisfied the first three objectives, it is pertinent to develop concrete plans of actions in form of measures that will facilitate the successful implementation of the Building Management System. Findings from this study show that importation of BMS system should be made easy as it ranks first on the list. Enactment of concrete laws to guide and regulate the process of building automation, ranked second which is in accordance to other researches. When there are laws slated to guide and regulate the process of this System, it eases the installation (Walter, 2021). There is need to create public awareness through every means available to gain the attention and subsequent acquisition of the BMS by the populace.

5.0 CONCLUSION

The study identified various challenges that would affect the implementation of a building management system in Nigeria including some factors that would have effect on the choice of a BMS. As regards the challenges to the implementation of BMS, the listed challenges ranging from poor power supply, cost of implementing BMS down to the last factor, all have high mean score which implied that a lot of work has to be done to reduce these challenges to the barest minimum. The measures to be taken to facilitate the adoption and implementation of BMS all had high to very high ranking but still needs to be improved. In conclusion, all of these are to prevent premature ending of the system before it is implemented and to successfully maintain the system throughout its predicted life span and to ensure proper and consistent upgrade when necessary.

REFERENCES

Allen, P.J. and Remke, R. (2008), "Building automation systems (BAS): direct digital control", *Encyclopedia of Energy Engineering and Technology*, Vol. 2, pp. 104-110, available at: www. tandfonline.com/doi/abs/10.1081/E-EEE-120041701#.V01nCvl97IX

Ambika, P. D. (2017). Know about Building Management System. www.linkedin.com. Accessed 13/08/2022.

Andrew, S. (2018). Leader Building Technologies. A.G. Coombs Advisory. 1200, Building Management Systems (BMS). Seminar 1- The Basics explained, slide4-5, 12-20

Ben, U. I & Magaret, C. I. (2014). Adopting Intelligent Buildings in Nigeria: The Hopes and Fears. *2nd international Conference on Emerging Trends in Engineering and Technology (ICETET)*, May 30-31, 2014 London (UK).

BTL, (2018). The Evolution of the Smart Building: Past, Present and Future [online] Available at :https://btlnz.co.nz/news *the-evolution-of-the-smart-building*/[Accessed 14 October, 2018].

Clements-Crome, D. J. (2011). Sustainable Intelligent Buildings for People: A Review. Intelligent Buildings International, 3(2), 67-86. Doi:10.1080/17508975.2011.582313

Daniel, M., Kazem, S. & Benedict, O. (2017). IoT Considerations, Requirements, and Architectures for Smart Buildings—*Energy Optimization and Next- Generation Building Management Systems. DVI Smart Buildings* Vol 4, No.1, pg.1- 2

Hassanain, M. A., Bin-Mohanna, A., Al-Hammad, A. M. & Sanni-Anibire, M. O. (2017). Challenges to the implementation of building management system in Saudi Arabia, *Built Environment Project and Asset Management,* Vol.7 No.2,pp.130-142. https://doi.org/10.1108/BEPAM-05-2016-0022

Hydeman, M. (2004). Successful DDC system retrofits, *ASHRAE Journal*, Vol.46 No.6. 37-46

I-Scoop (2018).Building Management and Integrated/Intelligent Building Management Systems. [online] *Available at: https://www.i-scoop.eu/building-management-building- management-systems-bms* /[Accessed 05 Oct, 2018].

Michael, Y. (2020). The Challenge of Securing Building Management Systems (BMS) *ASIS International Journal*. Vol 1, pp34-38

Mustafa, H. and Bansal, P. (2002). Building management systems: beyond electronics, *AIRAH Journal*, Vol.18 No.7, pg.22-27

Omorogiuwa, E., & Folorunsho, I. T. (2019). Design Optimization and Implementation of Smart Building Management System in Nigeria. *Journal of Instrumentation and Innovation Sciences* (e-issn: 2456-9860), 4(3), 1–16. http://doi.org/10.5281/zenodo.3465243 Vol. 4, Issue 3, pg3: pg 14-23

Piper, J. (2002). Selecting building management systems – step by step Building Operating Management, Vol 49, pg.100

Walter, O. O. (2021). Application of Building Management System (BMS) in commercial property management in Kenya. Vol. 1, pp 41-50

Wang, S. & Xie, J. (2010). Integrating Building Management System and Facilities Management on the internet. Automation in Construction.