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 is having positive impact on the users of such buildings. This research is aimed at assessing 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 techniques was used in selecting the experts for the study. A total of 64 questionnaires 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, construction, procurement, maintenance

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, 2004). 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, 2002). 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, 2010). The BMS is basically a solution which is integrated into a facility to ensure an environment that is safe, secure, 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 "in adequate 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. At present, the major implementation of this technology is mostly reflected in large scale and high budgeted projects. During the life cycle of the buildings projects, there have been a set of issues that must be considered for achieving the optimal level of the BMS. Such issues include: the involvement of the client and end users in briefing process to determine the BMS performance requirement, proper selection of the supplier and the subcontractor to install the BMS and ensure appropriate initial and continued training for the BMS personnel (Ehrlich & Goldschmidt, 2011; Lowry, 2002). Achieving optimal level of such issues will often lead to decreased BMS investment costs, more significantly appropriate design, installation and operation and maintenance.

Although the building management system has gained much ground and has being fully embraced in developed countries such as Japan, France, UK, USA, etc, it has not yet being fully implemented in African countries. In Nigeria, the highest levels of automation in buildings that one can easily identify are sensors-controlled glass doors which are available in most public buildings. The inadequacy or failure in the power generation sector has resulted in the unavailability of power to over 60% of its population. Together with other factors, one can deduce that the overall adoption of BMS in Nigeria has been terribly poor as highlighted by Ben & Margaret (2014).

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	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).

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.

1 Methodology

This study essentially employed the use of descriptive survey techniques and quantitative research design using the questionnaire method. The population of the study comprises of professionals in the building industry 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 system firms within Lagos State, Nigeria. The sample size was 64. This is due to the fact that those involved in the subject matter of this research are relatively new 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 and mean were used in presenting the data collected.

3. RESULTS

3.1 Demographic Information 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.

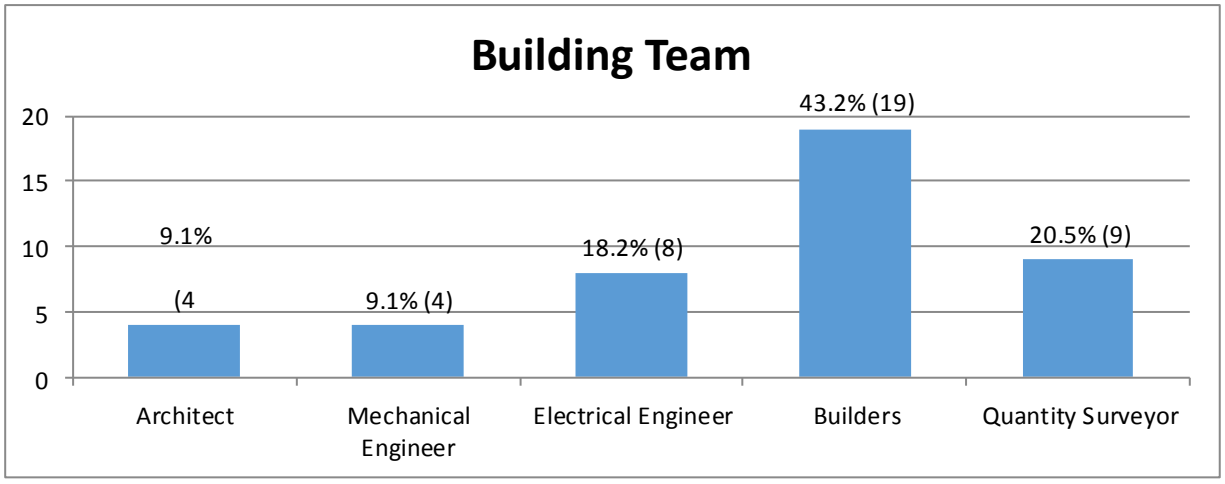


Figure 1: Distribution of respondents

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.

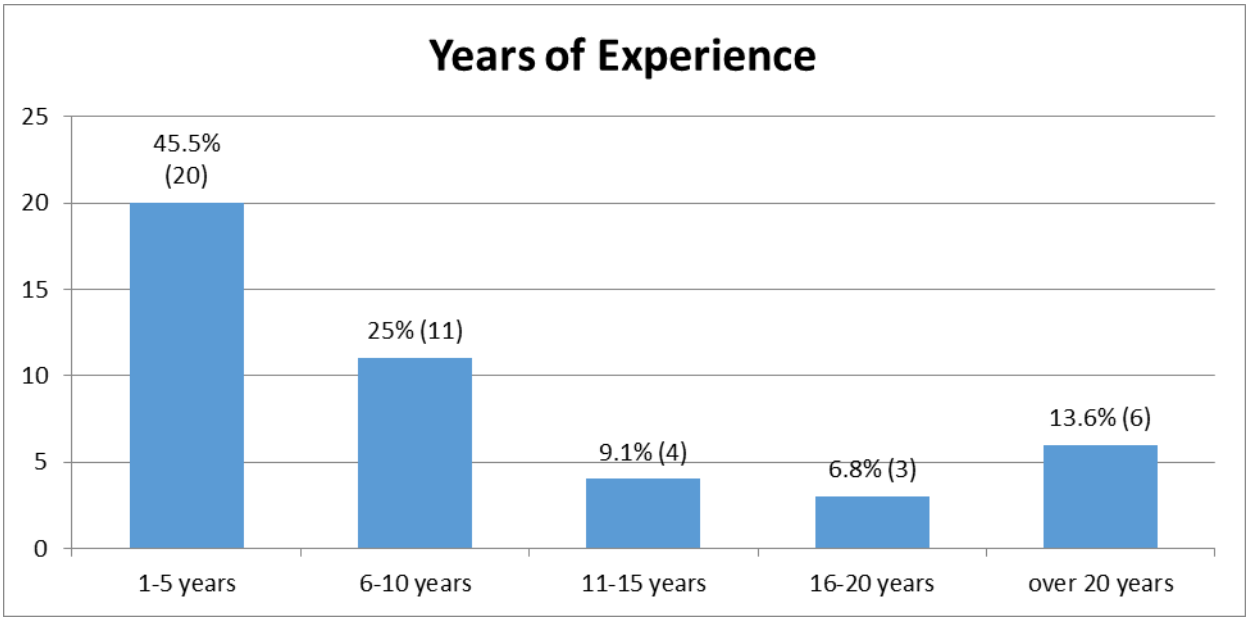


Figure 2: Number of years of experience

3.2 Analysis of the Objectives

Figure 3 describes the rate of level of adoption of BMS in Nigeria according to the respondents' experiences. Low level of adoption had 65.9% (29), moderate had 25% (11) and high 9.1% (4). It can be deduced according to the distribution that the level of adoption of BMS in Nigeria is low.

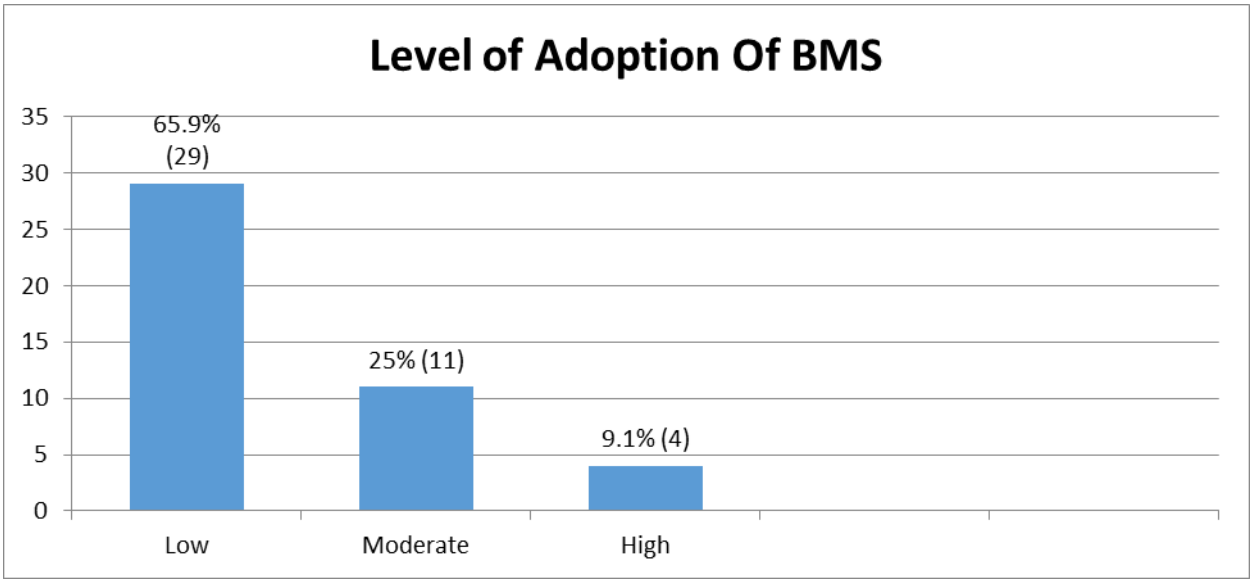


Figure 3: Rate of the level of adoption of BMS in Nigeria (Source: Field Survey)

Table 3.1: Factors that will determine the choice of a BMS

Factors	Mean	Rank
Availability of the BMS locally	3.86	1st
Expected cash flow revenue on the cost of BMS	3.79	2nd
Legal and regulatory requirements	3.66	3rd
End user comfort, security and convenience of occupants	3.64	4th
Level of demand of property after installation of the system	3.57	5th
The impacts of BMS on the environment	3.55	6th

Source: Field survey 2021

Table 3.1 above indicates that availability of the BMS locally would have the highest effect on the choice of a BMS as it ranks first on the list.

Table 3.2: Challenges to the implementation of BMS

Challenges	Mean	Rank
Power supply failure in Nigeria	4.07	1st
Cost of implementation of the system	3.86	2nd
Lack of adequate maintenance and upgrade	3.82	3rd
Insecurity in the country	3.75	4th
It is considered as a luxury by developers	3.75	4th
Lack of awareness of the existence and benefits derived from the BMS	3.68	6th

Low cost intelligent building technology is not available	3.68	6th
No accurate documentation of how the system works making it a risky investment	3.66	8th
Lack of competent BMS professionals	3.64	9th
Nigeria is still a struggling developing country	3.59	10th
It is complex and hard to implement	3.18	11th

Source: Field survey 2021

Table 3.2 shows that power supply failure in Nigeria has the highest degree of effect as a challenge to the implementation of BMS in Nigeria with cost taking second position.

Table 3.3 Measures to be taken to facilitate the adoption and 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		
Tax waivers on Building Automation system	3.86	8th
Increased, appropriate and consistent training of BMS personnel	3.64	9th
	3.50	10th

Source: Field survey 2021

Table 3.3 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. DISCUSSION

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

4.1 To examine the level of awareness and effect of some factors on the choice of Building Management System in Nigeria

The level of awareness of BMS is still very low in Nigeria as indicated in the results. This agrees with the findings of Omorogiuwa & Folorunsho (2019). This due to the fact that larger percentage of Nigerians are not familiar with BMS. Before making the choice of implementing a Building Management System, quite a number of factors would play out and must be considered critically to ascertain if it would be viable and feasible to implement such system. The foremost factor that will play out according to the findings is availability of the system locally. The cash flow on the cost of the BMS must be considered. It will also be considered if, after its installation, that property has an increased level of demand or it will experience idleness until the system begins to malfunction and eventually experience obsolescence. The level of comfort it will bring to the user and the impact its installation will have on the environment- if it is environmentally friendly or it would pose a kind of threat and the legal and regulatory requirements or restrictions are all factors that will have effect when making the choice for a BMS. This agrees with Hassanain *et al.* (2017) which stated that inadequate or insufficient knowledge of how this system works and the benefit derived affect the choice of BMS in one's facility.

4.2 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 runs 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 (2004), Horwitz and Bennett (2009), Walter (2021) and Hayden (2019).

4.3 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. 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. The level of adoption of BMS which had a low rate of 65.9% can be worked upon to increase the level to an appreciable percentage. For the features mostly desired by occupants, fire, lighting and security control system had high mean which showed that they are mostly desired. The HVAC, BMS and access control system had low rate on which improvement must be made to push up its relevance. In the case of factors that will determine choice of a BMS, the listed factors all had high mean except the level of demand of property and the impacts of BMS on which steps must be taken to improve them. As regards the challenges to the implementation of BMS, the listed challenges all had high rank 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

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-Croome, D. J. (2004). Intelligent buildings: design, management and operation, Thomas Telford Services Ltd., London .pp 231-234.

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

Ehrlich, P. & Goldschmidt, I. (2011). BAS Usability, *Engineered Systems.* Vol.28, p.28

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

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].

Lowry, G. (2002). Factors affecting the success of the building management system installations, *Building Services Engineering Research and Technology.* Vol. 23 No.1, pp.57-66.

Memoori, G. (2017). The Evolution of the Building Management System: Data and Connectivity. [online] *Available at: https://www.memoori.com/evolution-building-management-system data-connectivity*/[Accessed 10 October, 2021]

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

Okenna, I. (2018). 3 key benefits of using Building Management System for your Lagos Commercial Buildings. www.linkedin.com. Published March 18, 2018 pp 15-23

Swarnalatha, P. (2011). Building Management System Using Windows Communication Foundation and XAML", *International Journal of Engineering and Technology*, 3(2):95-99

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. (2002). Integrating Building Management System and Facilities Management on the internet. Automation in Construction.