FACTORS INFLUENCING THE CHOICE OF AUTOMATING SYSTEMS USED IN HIGH-RISE BUILDINGS IN LAGOS, NIGERIA

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Abstract
The consistent change and functions of building systems coupled with the level of sophistication of users of high-rise buildings require that facility managers find innovative ways to control and manage facilities. In this while, the use of automation systems presents facility managers innovative ways of ensuring functionality of the built environment through the integration of people, place, process and technology. These systems must however be selected with care and operated with dedication to achieve desired results. This study examined factors influencing the choice of automating systems in high-rise buildings in Lagos, Nigeria with a view to providing information that could enhance facility management practice. The study selected 53 high-rise commercial buildings based on their high occupancy ratio. Total enumeration of the identified 53 resident facility managers of these high-rise buildings was carried out. Information collected included types of automating system used by facility managers, time of acquisition of automating systems used among others. Descriptive and inferential statistics such as frequency tables, mean ranking and factor analysis were used to analyse the result.

Findings of the study revealed that the choice of automating systems used by facility managers was significantly influenced by the cost of acquisition of the automating system, while the need to protect buildings against failure was considered as the most significant factor influencing the adoption of automation in the management of facilities in high-rise buildings. The study concluded that cost of acquiring automating system is the most influencing factor when considering the choice of automation, while the need to protect buildings against failure was considered as the most significant factor influencing the adoption of automation.

Keywords: *automation, automating system, facility management, high-rise buildings, resident facility managers.*

1.0 Introduction

The realities that buildings-built decades ago are aging and that they need more upkeep, recurrent repairs and upgrades pose serious challenge to building operators (owners and facility managers). Also, the nature and function of building facilities continues to evolve in the face of technological innovation and overall digitalization of our modern space. This evolution is constantly changing the roles of facility managers and making building operators (buildings owners/facility managers) to continuously find innovative ways of controlling and managing facilities. These roles could get more complex for facility managers of high-rise building. This is because high-rise buildings are special type of construction based on their height, structural stability and various mechanical and electrical systems needed to make occupation conducive. Hence, facility mangers are increasingly striving for better control over resource utilization rates of their facilities for a more economic, environment-friendly and optimized facility management experience through the use of information technology herein referred to as facility management automation (East, Bogen, and Rashid, 2012; Parasanazhad and Tarandi, 2012).

Facility management automation provides the facility manager with the tools and methods that aid control over facility management process which can be said to be complex in nature. It spurs facility management implementation and also serves as an integrating factor for people, place and facilities (Lunn and Stephenson, 2000; Madritsch and May, 2009). Studies have revealed that data repository technology (BIM), interoperability software (IFC), work flow system (CAFM), facility intelligence software (BMS) sensor mobile (augmented reality AR) and field capture technology (drone) are the common automating systems used in facility management practice (Wang, Wang, Yung and Jun, 2013; Coenen and Felten, 2014; Scupola, 2014; Ebbesen 2015; Lok and Baldry, 2015). Automation is not a new term in facility management because the term “facility management” originated from the hi-tech world and it was adapted into the built environment by space planners and office manufacturers (Owen 1995). It has since evolved in the last four decades from pneumatic and mechanical devices into direct digital controls and then later into electronic devices with microprocessors and communication capabilities (Lunn and Stephenson, 2000; Ebbesen 2015; Golabachi and Kamat, 2016).

According to Azarh (2011), the introduction and adoption of new technology usually require factors which may affect the use of such technology for its successful take off and subsequent benefits to be derived thereof. Hewawasam, *et al* (2016) identified high initial cost, lack of knowledge and competencies, technical faults and design failures, staff attitude and resistance to change as factors affecting adoption of automating system in the construction industry. Hassainain, *et al.* (2017) also identified inappropriate selection of facility management personnel, inadequate training of facility personnel and poor operation and maintenance activities as factors affecting the adoption of automation in the construction industry. Studies on automation have been broadly discussed in relation to construction industry. This study attempts to narrow it down to facility management and to examine it in the context of a developing control so as to provoke advancement in facility management practice in Nigeria.

The major research question that will be addressed by this paper is; what are the factors influencing the choice of automating systems used in high-rise buildings? With a view to identifying factors that are peculiar to developing countries like Nigeria and providing information that could enhance advancement in facility management practice.

To achieve the aim of this study, literature was reviewed along topical issues, while method of data analysis was explicitly stated, analysis and findings of the study were well articulated giving conclusion and recommendation that stem from the research findings.

2.0 Review of Literature

2.1 The Concept of High-Rise Buildings

The Council of Tall Buildings and Urban Habitat (2004) defined high-rise buildings as building that create distinct conditions in terms of design and construction when compared to other buildings in a certain region and specific period as a result of its height. The definitions of high-rise buildings have been on the basis of height and number of floors. These definitions differ based on time, region and technological innovation. For instance, Nigeria had no high-rise building when the western world decided on vertical transformation of horizontal expansion in the 1870's ((Ajayi and Awosode, 2019). This is obvious in the definition given by Awotona (1987) which defined high-rise building as any building that is higher than a three storey walk up. Lagos state planning regulation considers any building with minimum of five floors as high-rise buildings (Ezema and Olutayo, 2014). This is quite different from the definition of National Fire Protection Association in United States (NFPPA, 2016) which identified high-rise building as a building that has a minimum overall height of 28 meters from the ground level to the highest floor. High-rise buildings were firstly built in the United States of America in the 1870s, while tall buildings began to surface in cities of Shangai, Hong Kong, Sao Paulo and other important Asian and Latin American cities in the 1930s, Europe and Australia decided to go vertical in the middle of twentieth century. According to High-Rise Security and Fire Safety (2009), three key inventions that gave birth to the construction of high-rise buildings are: the invention of the world's first safety elevator in 1853; the replacement of the fragile combination of cast iron and wood with steel frame in 1870s and the invention of air conditioning in 1902.

It is worthy of note to state that high-rise buildings were firstly built as a response to continuous industrialization and swift population growth of the late nineteenth century which led to a large demand of office space. Early high-rise buildings were targeted to meet the increasing demand for office space, while the first residential high-rise building (Ritz Tower) with 41 stories and 165 meters height was built in 1926. The cost of developing high-rise building is often high when compared to low line buildings. To ensure long term sustainability of investment made in these structures, there is need to protect such investment through maintenance of the building fabrics, building systems and building services which will make occupation conducive for users.

2.2 Concept of Facility Management Automation

Maintenance of building fabric and its services (which is an aspect of facility management) during the operation phase of the building contributes immensely to the sustainable performance of the building (Ding *et al.*, 2009). Good maintenance culture is needed for a nation to maintain the value and amenity of its building stock; however the consistent change in the nature and function of building systems coupled with the level of sophistication of users of high-rise buildings require that facility managers find innovative ways to control and manage facilities. More so, facility management requires in-depth knowledge of skills and tools for building operations, maintenance, engineering, forecasting, budgeting, health, safety and security, however, the use of information and communication technology tools herein referred to as automation has influenced facility management in recent years (Thompson, 2000). Facility management automation which is defined as the use of computerized system to perform or supplement facility management functions spurs facility management implementation. It also serves as an integrating factor for people, place and facilities (Lunn and Stephenson, 2000; Madritsch and May 2009).

Roles of automation in service industry have been discussed under three broad headings (Broadbent and Weill, 1997; Mele, Spena and Colurico, 2010). The first role describes information communication and technology (ICT) as an enabler of a service innovation. New inventions in service industry are usually rooted in hi-tech; this may take the form of introducing new technology entirely or changing the way an existing technology is being used (Barras, 1986). The role of e-banking and various e-government services is a typical example. The second role refers to ICT as a support infrastructure for a service innovation. Examples of this can be an online help desk or the use of the internet to collect ideas about new service offerings (Prandelli, Sawhney and Verona 2008). The third role relates to ICT as a utility for a service innovation. This implies the use of ICT mainly to reduce costs, such as the adoption of many facility management systems at the operational level to increase the coordination of activities which are either internal or external to the organization. Service innovation is thus often based on investments in ICT, the adoption of new ICT platforms and their subsequent adaptation to produce new products and services or improve business processes (Potts and Mandeville, 2007). It has been established that facility management is a service industry and it can be said that automation has played the above discussed roles in facility management practice (Scupola, 2014; Coenen and Felten, 2014; Lok and Baldry, 2015). As an ICT enabler, different automating systems (data containers and workflow systems such as: BIM, CMMS, CAFM and IWMS) has been developed to enhance facility management practice (Lunn and Stephenson, 2000). As a support infrastructure for a service innovation; facility management automation supplements facility management functions. While as a utility for service innovation facility management automation has positive impact on cost and time savings, minimizing errors, omissions and rework (Carbonari *et al*, 2014; Bryde *et al* 2103; Barlish and Sullivan, 2012).

2.3 Empirical Studies

Wang *et a.l* (2013) classified information technological tools used in facility management into two: data containers or ata repository technology (FTP servers, BIM and GIS etc) and workflow systems (CMMS, CAFM and IWMS). While Ebbesen (2015) gave an elaborate list of the commonly used automating systems in facility management: data repository technology (BIM), interoperability software (IFC), workflow system (CAFM), facility intelligence software (BMS) sensor mobile (augmented reality AR) and field capture technology (drone).

Ebbesen (2015) reviewed literature on information technology in facility management. The study considered the current state of research on the use of information technology in facility management. The study revealed that data repository technology (BIM), interoperability software (IFC), workflow system (CAFM), facility intelligence software (BMS) sensor mobile (augmented reality AR) and field capture technology (drone) are the common automating systems used in facility management practice. It further stated that BIM is the most researched technology while CAFM is the most used technology. The study is not empirical and thus based on the author’s opinion rather than replicable data also the study focused on facility management practice in Europe. This study however focused on Nigeria where facility management automation is relatively new and also make use of empirical data.

According to Azhar (2011), introduction and adoption of new technology usually requires factors which may affect the adoption of such technology for its successful take off and subsequent benefits to be derived thereof. Factors affecting facility management automation in high-rise buildings can be grouped into: those specific to the nature and level of sophistication of high-rise buildings; those specific to different models and software adopted in facility management automation while others are general to the diffusion of information technology into facility management practice. Hewawasam, *et al.* (2016) identified high initial cost, lack of knowledge and competencies, technical faults and design failures, staff attitude and resistance to change as factors affecting adoption of automating system in the construction industry. Hassainain, *et al.* (2017) also identified inappropriate selection of facility management personnel, inadequate training of facility personnel and poor operation and maintenance activities as factors affecting the adoption of automation in the construction industry. All these studies were carried out in developed countries, although these factors can be ubiquitous there is the need to identify those that are peculiar to developing countries like Nigeria where this study is domiciled.

3.0 Research METHOD

In a bit to provide answers to factors influencing the choice of automating system adopted in facility management of high-rise buildings in Lagos, the study adopted survey research where 53 high-rise commercial buildings were identified in Ikoyi, Lagos Island and Victoria Island; all in Lagos State Nigeria. Primary data sourced from questionnaire which was administered on facility managers of high-rise buildings was used for the study. A total number of 53 questionnaire were administered while 41 copies of the questionnaire were returned and found useful for analysis. Information collected included types of automating system used in high-rise buildings, time of acquisition of the system, factors that influenced the choice of the systems used and the factors influencing the adoption of automation in facility management automation. For appropriate data analysis of the information gathered from respondents, both descriptive and inferential statistical techniques were employed.

3.1 Data Validity Test

Table 3.1 illustrates the test of assumptions on the adequacy of the matrix and the significance of the factors influencing the adoption of automation in the management of high- rise buildings in the study area. With a determinant level .001, the assumption that the listed factors affect the adoption of automation in the management of high-rise buildings in the study area. More so, with KMO of .770 which is greater than 0.70, this indicates that enough items were predicted by each (principal factor component). And since the Bartlett's test has a significant value of .000 which is less than .05; this implies that the variables (factors affecting the adoption of automation in high-rise buildings in Nigeria are correlated highly enough to provide a reasonable basis for factor analysis.

Table 3.1: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		
Bartlett's Test of Sphericity	.Chi-Square	3

4.0 Analysis and Results

This section presents findings from field survey, and they were presented in line with objective of the research while inferences were drawn from the data gathered.

Table 4.1 shows that 19(46.3%) of the sampled commercial high-rise buildings had property maintenance or management department that performs the traditional role of property managers, while 17(41.5%) had structured facility management department or unit. This corroborates the findings of Aliyu *et al* (2015) that operators of public and private corporations consider facility management as an effective tool for the management of their buildings. Although the application of facility management in the management of high rise buildings in Lagos is still below average. However, owners/operators of high-rise buildings hold them as an investment, hence the need for proper maintenance. Also, one can infer that there is no significant relationship between ownership of high-rise buildings and the presence of facility management department. The Table also indicated that 21(51.2%) of the sampled buildings had in house facility management department while 10(24.4%) adopted outsourced facility management strategy and the remaining 10(24.4%) adopted hybrid facility management strategy. A keen look at the facility management strategy and ownership of the buildings shows that a larger percentage of the public buildings 13(76.5%) adopted in house facility management strategy as against outsourcing management. This indicates that public building operators prefer employing staff that will be treated as civil servants in the facility management department than contracting their services out to experts who are constantly kept abreast with development in facility management industry. This could explain the reason why majority of our public buildings were in state of disrepairs (Iyagba 2005).

Table 4.1: Facility management strategies adopted in high-rise buildings

:ility Management Department	Frequency		rcentage (%)
y/Maintenance department	19		46.3
Management Department	17		41.5
	5		12.2
	41		**100.0**
Management Strategies			
e facility management	21		51.2
rced management	10		24.4
facility management	10		24.4
	41		**100.0**
Management Strategy* Ownership of Buildings	**Ownership**		**Total**
	blic	/ate	
e facility management	3	.3	21
rced management	7	3	10
facility management	9	1	10
	.4	.7	41

Table 4.2 indicates that facility managers were more familiar with computer aided facility management (CFAM) with 26(19.8%) followed by computer maintenance management system (CMMS) 23(17.6%) and building information model (BIM) 20(15.3%). Industry foundation class (IFC) and integrated workspace management system (IWMS) has the lowest frequency 8(6.1%). Computer aided facility management (CFAM) has been around for a while and its ease of use makes it more popular while building information model (BIM) is the latest technology in the built environment that every facility manager wants to have an idea of what the model is all about.

Table 4.3: Types of Automating Systems That Facility Manager Are Familiar With

ating System	luency	entage (%)
Building Automating (BAS)	19	14.5
Building Information Model (BIM)	20	15.3
Building Maintenance System (BMS)	16	12.2
Computer Aided Facility Management (CAFM)	26	19.8
Computer Maintenance and Management System (CMMS)	23	17.6

Construction Operation Building Information Exchange (COBie)	11	8.4
Industry Foundation Class (IFC)	8	6.1
Integrated Work Space Management System (IWMS)	8	6.1
	1* **	**100.0**

A Note: * ** this figure exceeded the number of respondents because of multiple responses was allowed

As indicated in Table 4.3, 19(48.7%) of the facility managers use computer aided facility management (CAFM) in the management of their facilities while 9(23.10%) 7(18.0), 3(7.7%) and 1(2.5%) used computer maintenance and management system, building automating system, building maintenance system and building information model respectively. Automating systems such as Construction operation building information exchange (COBie), industry foundation class (IFC) and integrated workspace management system (IWMS) are not being used by facility managers in the study area. Integrated workspace management (IWMS) performs similar functions with CAFM. Most facility managers choose CAFM because it aids the capturing, usage and electronic analysis of all data that is applicable to the life cycle of facilities. According to (GEFMA, 2007) CAFM provides numerous key functions to meet required standard expected by its users (building owners and facility managers) satisfactorily and these functions include lease administration, project management, space management and maintenance management processing and resource planning. Hence making CAFM interesting for real estate and facility management companies. And this could be the reason why most facility managers chose CAFM over other computerized system. This corroborates the view of Ebbesen (2015) that CAFM is the only technology that was actually being used in facility management organizations and implementation of BIM technology in facility management industry is at the initial stage. Building information Model is a data repository technology which is relatively new to Nigerian construction industry. It is being used traditionally right from the design stage of the construction considering the huge amount of information needed to manage the life cycle of a building. However, 29(76.3%) of the sampled high-rise buildings were constructed between 11 and 50 years ago. This makes it difficult for facility managers to use BIM for facility management and this explains why only 1(2.5%) of the facility managers adopted BIM and this could be because building (Heritage Place

Building) is relatively new and also considered as the only fully automated building in Nigeria. The ratio of response on the awareness facility managers about different automating systems to the use of these systems is 3:1 (0.3). This means that other factors aside the level of awareness of facility managers about these systems affects the choice of computerized systems used by facility managers.

Table 4.3: Types of Automating System used by Facility Managers

Types of automating system used by facility managers	**cy**	**age (%)**
Computer Aided Facility Management (CAFM)	19	48.7
Computer Maintenance and Management System (CMMS)	9	23.1
Building Automating (BAS)	7	18.0
Building Maintenance System (BMS)	3	7.7
Building Information Model (BIM)	1	2.5
Construction Operation Building Information Exchange (COBie)	-	-
Industry Foundation Class (IFC)	-	-
Integrated Work Space Management System (IWMS)	-	-
	)***	**100**

As presented in Table 4.4, a total number of 22 (53.7%) high-rise buildings are being managed with the use of computerized system, majority of which were acquired between 5 and 9 years ago. The result indicates that the use of computerized system in the study area became popular in the last decade. And that automation is still in its early stage in Nigeria. More so, 6(27.3%) of the sampled facility managers stated that the computerized system were acquired at the construction stage of the building and those high rise buildings were built in the last five years. Computerized systems were installed at the operation stage of 16(72.7%) high-rise buildings. Based on these findings one can infer that professionals in the built environment in Nigeria are gradually catching up with the happenings in the global built environment in the last decade.

Table 4.4: Acquisition of Automating System

Time of Acquisition of Computerized System		
	Frequency	**rcentage (%)**
	1	4.5
	9	41.0
	8	36.4
	3	13.6
	1	4.5
	22	**100.0**
Stage of Acquisition of Computerized System		
Design and Construction Stage	6	27.3
Operation and Management Stage	16	72.3
	22	**100.0**

Table 4.5 shows factors that influence facility management departments' choice of computerized systems. Cost of acquisition/maintenance ranked 1st with a mean of 4.04. It shows the cost of acquiring computerized system is significant in the choice of computerized system acquired by organization. Technical capability of personnel, organization strategy, and availability of the system, organizational need and ease of use ranked 2nd, 3rd, 4th, 5th and 6th. Organizations prioritized the cost spent in the acquisition of automating systems and often than not preferred systems that are cost effective in terms acquisition, installation, use and maintenance. This could explain why the latest technology (Building information Model) did not have general acceptance among facility managers because it's not only expensive but also in levels. Since 69.2% (18) of the users of automating systems had stationed staff that controlled or managed the automating systems, this implies that the technical capability of the personnel in the facility management department is often put into consideration before the acquisition of automating system. This is further explained in Table 4.19 where users of computerized systems considered technical capability as being significant. Ease of use of automating system ranked 6th, when organizations are considering the type of automating systems to be acquired. The perception of the organization on the ease of use of the computerized system was neutral with a mean of 3.58. This could mean that board of directors of organization seldom consults users of automating system (facility/maintenance department) whenever they want to acquire these systems. Considering the fact that each of the factor had a mean

greater than 3.0, one can conclude that cost of acquisition, technical capability of personnel, organization strategy, availability of the system , organization need and ease of use were all significant factors that determined the choice of computerized systems.

Table 4.5: Factors Influencing the Choice of Computerized Systems

	1)	2)	3)	4)	5)	an	l	k
Cost	2	1	-	14	9	4.04	0.81	1st
Technical capability of personnel	2	-	1	18	5	3.92	0.78	2nd
Organization strategy	2	2	1	14	7	3.85	0.77	3rd
Availability of the system	2	1	5	11	7	3.77	0.75	4th
Organizational need	2	2	2	14	6	3.77	0.75	5th
Ease of use	5		3	11	7	3.58	0.72	6th

Note:* Variables in each of the seven factors influencing the choice of computerized system was rated by facility managers of high-rise buildings using Five point Likert's scale of 'Very insignificant', 'insignificant', 'Neutral', 'Significant' and 'Very Significant' and denoted as VI, I, N, S and VS respectively. To arrive at the facility managers' aggregated view on each item. Each of the rating above was respectively assigned a value of 1, 2, 3, 4 and 5.

Table 4.6 and 4.7 show how the variance was divided among 29 possible factors. It showed four factors with initial eigenvalues of 2.153, 5.683, 7.449 and 12.098. Factor 1 accounted for 31.25% of the total variance explained in the original set of data; Factor 2 accounted for 29.86%; Factor 3 accounted for 24.64%; Factor 4 accounted for 8.67% respectively. Each factor has eigenvalue (i.e. a measure of explained variance) greater than 1.0, which serves as a common criterion for a factor to be useful.

Table 4.6: Total Variance Explained

Component	Initial Eigenvalues			Rotation Sums of Squad Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	12.098	41.717	41.717	9.064	31.254	31.254
2	7.449	25.686	67.403	8.869	29.857	61.11
3	5.683	19.596	87.000	7.146	24.642	85.754
4	2.153	7.424	94.423	2.514	8.670	94.423

Extraction Method: Principal Component Analysis

Table 4.7: Rotation Sums of Squad Loading

Component	Rotation Sums of Squad Loadings		
	Total	% of Variance	Cumulative %
Nature and Management styles of the organization	9.064	31.254	31.254
Diffusion of information technology in facility management	8.869	29.857	61.11
Nature and level of sophistication of the building	7.146	24.642	85.754
Type of software used by facility managers	2.514	8.670	94.423

The Rotated Component Matrix presented in Table 4.8 shows loadings of the variables on each Factor and this is paramount in understanding the results of the analysis. All the 29 variables were sorted into four overlapping groups of factors which are **(**Nature and Management styles of the organization, diffusion of information technology into facility management, nature and level of sophistication of the building and type of software used by facility managers**).** Factor 1 accounted for 31.3% of variance, Factor 2 accounted for 29.9% of variance while Factor 3 and Factor 4 accounted for 24.6% variance and 8.7% variance respectively. Each of these variables has a loading greater than .50 which shows the reliability of the test. Conclusively, principal component factor analysis with varimax rotation was conducted to assess the underlying structure for the twenty-nine items of the factors influencing the adoption of automation in the facility management of high-rise buildings. These items were aggregated into four principal factor components: Nature and Management styles of the organization, diffusion of information technology into facility management, nature and level of sophistication of the building and type of software used by facility managers.

The first factor accounted for 31.3% of the variance, the second factor accounted for 29.9% of the variance while the third and fourth factors accounted for 24.6% and 8.7% of the factors respectively. The first component had nine (9) variables loaded highly on it. These variables were rate of churn (0.977), employee expectation (0.977), lack of skilled personnel (0.977), inappropriate selection of facility management staff (0.982), strategic resource (0.982) ineptitude of decision makers (0.982), age of organization (0.982), management strategies (0.982), staff strength (0.982). This factor was named nature and management style of the organization. The second component factor also had nine (9) variables highly loaded on it. These variables include: high implementation cost (0.952), lack of demand by building owners (0.961), cost of mistakes (0.961), adaptation to change (0.961), global competition (0.964), availability of information technology (0.965), initial cost of installation (0.965), low level of awareness (0.967), demand for information (0.967). This factor was named diffusion of information technology into facility management. The third component factor had eight (8) variables highly loaded on it. These variables are high cost of facilities and space (0.761) design standards and inventory (0.946), need for reduced maintenance and logistics (0.946), poor operation and maintenance activities (0.946), age of building (0.967), management strategies (0.967), number of floors (0.967), protection against failure of buildings (0.978). This factor was named nature and level of sophistication of the building. While the fourth component factor had three (3) variables highly loaded on it. These variables are lack of graphical interface (0.959), interoperability (0.959) and faulty designs and failures. This factor was named type of software used by facility managers. The result presented in the table shows that all these factors have significant effect on the adoption of automation in facility management of high-rise buildings in Lagos, Nigeria.

Table 4.8: Rotated Component Matrixes

ROTATED COMPONENT MATRIX	COMPONENT			
	1	2	3	4
Rate of churn	.977			
Employee expectation	.977			
Lack of skilled personnel	.977			
Inappropriate selection of facility management staff	.982			
Strategic resource	.982			
Ineptitude of decision makers	.982			
Age of organization	.982			
Management strategies	.982			
Staff strength	.982			
High implementation cost		.952		
Lack of demand by building owners		.961		
Cost of mistakes		.961		
Adaptation to change		.961		
Global competition		.964		
Availability of information technology		.965		
Initial cost installation		.965		
Low level of awareness		.967		
Demand for information		.967		
High cost of facilities and space			.761	
Design standards and inventory			.946	
Need for reduced maintenance and logistics			.946	
Poor operation and maintenance activities			.964	
Age of building			.967	
Management strategies			.967	
Number of floors			.967	
Protection against failure of buildings			.978	
Lack of graphical interface				.959
Interoperability				.959
Faulty designs and failures				.751
Eigen value	**9.064**	**8.869**	**7.146**	**2.514**
% Variance Explained	**31.254**	**29.857**	**24.642**	**8.670**
Cumulative % Variance Explained	**31.254**	**61.11**	**85.754**	**94.423**

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization
a. Rotation converged in 5 iterations

6.0 Conclusion

Factors influencing the choice of automating systems in high-rise buildings were examined with the aim of identifying factors that are peculiar to developing countries and providing information that could enhance advancement in facility management practice. The study revealed that CAFM is the most popular and the most used automating system, while the choice of automating systems was significantly influenced by cost of acquisition, technical capability of personnel, organization strategy, availability of the system, organization need and ease of use. It was also revealed that the need to protect buildings against failure is the most significant factor influencing the adoption of automating system in the management of facilities in high-rise buildings.

The study concluded that cost of acquiring automating system is the most influencing factor when considering the choice of automation, while the need to protect buildings against failure was considered as the most significant factor influencing the adoption of automation. Building operators should ensure that their choice of automating systems is not solely determined by initial cost of acquisition. Staff expertise, level of compatibility of the system among others should be considered.

7.0 References

Atkin, B. and Bildsten, L. (2017). A future for facility management. *Journal* of automation. *Journal of Facilities Management,* 18(7/8), 312 – 323.

Awotona A. (1987). *Nigerian institute of architecture journal*, 3(3) 23-34

Coenen, C., Von Felten, D. (2014). A service-oriented perspective of facility *Construction Innovation*. 17(2), 116-124.

Craighead, G. (2003). *High-rise security and fire life safety* (2nd ed). Butterworth-Heinemann,Woburn, MA.

Delivery in Public and Private High-Rise Residential Buildings in Nigeria: A Case Study of Eko Court Complex and Niger Towers. *Paper Presented at MATEC Web of Conferences on October 15, 2014*

Ding, L., Drogemuller, R., Akhurst, P., Hough, R., Bull, S., and Linning, C. (2009).

Ebbesen, P. (2015). Information technology in facilities management- a literature *eBusiness in Architecture, Engineering and Construction. ISBN 978-0-415-62128-1.*

Elmualim, A., Pelumi-Johnson, A. (2009). Application of computer-aided facilities Management FM for intelligent buildings operation. *Journal of facilities*

Hassanain, M.A. (2009). On the challenges of evacuation and rescue operations in high-rise buildings. *Journal of Structural Survey,* 27(2), 109 – 118.

Madritsch, T. and May, M. (2009). *Successful IT implementation in facility Maintenance.* Elsevier Butterworth-Heinemann, Burlington

McGrail, D.M. (2007). *Firefighting operations in high-rise and standpipe-equipped buildings.* PennWell, Tulsa, UK.

Oladokun, T.T. 2011. An examination of the practice of facilities management in Olanrele, O.O., Ahmed, A., Smith, H.O. (2014). Facilities Management Service

Parsanezhad, P. and Tarandi, V. (2012). Is the age of facility managers' paper boxes over? *people making facilities management.* Retrieved from orbit.dtu.dk on February 01, 2017.

Practice in high-rise commercial properties: Jos in perspective. *Civil and Environmental Research,* 7*(4),* 10-19.

Thompson, B. (2005). Information and communications technologies and industrial Towards sustainable facilities management. *Technology, Design and Process Innovation in the Built Environment,* 6(4), 373-392.

Wang, Y., Wang, X., Wang, J., Yung, P. and Jun, G. (2013). Engagement of facilities

Yau, Y. (2011). Homeowners' participation in management of multi-storey residential buildings. *Journal of Property Management*, 29(4), 345 – 356.