ASSESSMENT OF FUNCTIONAL AND ENVIRONMENTAL INDICATORS IN THE PERFORMANCE OF BUILDINGS IN FEDERAL UNIVERSITIES OF SOUTH EAST NIGERIA

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ABSTRACT: *The purpose of this paper was to evaluate the extent to which functional and environmental measures/indicators are expressed in the performance of Educational buildings in Universities of South East Nigeria and recommend measures for improved understanding and practice. Literature review was used to provide a clear understanding of the constructs of functionality and environmental performance in buildings. A questionnaire relating to the diverse contents of these constructs was developed and administered to a convenient sample of staff and students of some Federal universities under investigation. Data generated from the questionnaire were analysed using Excel and statistica; Version 9.0. The study suggests that majority of the respondents (staff and students) were generally dissatisfied with the functional and environmental performance of their building facilities. Information about the design and use of specific buildings were imprecise and therefore not usually identified in the institutions studied. The functionality and environmental concerns of most of the building spaces such as classrooms, offices and residential accommodations were found to be poor. Hence, the interaction between users and building spaces did not add value to learning and working experiences. The findings point to the conclusion that functional efficiency and environmental performance goals seem not have been explicitly expressed in the design of most buildings investigated. The study points to the need for designers and facilities managers in these institutions to acquire skills on critical aspects of building performance evaluation, particularly, the recognition of environmental and functional concerns/indicators as means of meeting the increasing demand for higher quality by stakeholders in the education sector.*

KEYWORDS: Assessment, Buildings, Environmental, Functional, Nigeria, Performance, Universities,

INTRODUCTION

Buildings form a significant part of infrastructural facilities in higher education system in Nigeria. They therefore constitute an expensive long-tem resource which must be designed to reflect the institutions' vision and strategy for learning. Over the past decade, Universities in Nigeria have recorded an unprecedented increase in students' population (Okorie, 2009). This increase poses a tremendous challenge to the universities in terms of building facilities, funding and environmental concerns. To cope with this challenge, the universities must not only rely on the procurement of new buildings, they must also be concerned with improving the functional

and environmental performance of existing buildings to maximize the return on investment in both facilities and people (Amaratunga, 2000).

Higher educational institutions are in the business of knowledge transmission and promotion of learning capacity (El-Khawas, 2003). This is facilitated through the use of space provided by buildings as an educational tool. The physical condition and functional effectiveness of the buildings are therefore critical for educational effectiveness. The performance evaluation of educational buildings ensures that buildings meet the infrastructural challenges of educational institutions by supporting it as an enabler. It further ensures that the effectiveness of buildings is maximized not just in terms of occupancy costs but also with respect to user satisfaction. A successful educational building is determined by evaluating how the building is functioning, how the learners and teachers are utilizing the spaces and how the design has promoted the educational process (Heitor, 2005). Therefore, the ability of the building to successfully accomplish the purpose for which it is designed measures its success.

The recent expansion in higher education participation in Nigeria has exposed the functional inadequacies of buildings in the university system. The building environment is poor and inadequate for effective learning and teaching. Thus, the need for an evaluation of the extent to which functional and environmental aspects of building performance affect educational effectiveness is imperative in the present climate of education in Nigeria.

Purpose/objectives of study
The purpose of this paper is to raise the awareness and understanding of the need for strategic planning, decision making and development of a building facilities management solution among those who can influence design and funding decisions in the higher education system in Nigeria. To this end, the specific objectives of the study include to**:**
  • Provide a greater understanding of key issues/indicators of functional and environmental performance of buildings;
  • Appraise the nature and type of building facilities in the targeted higher institutions;
  • Determine the suitability of the buildings and establish the extent to which they enhance both educational and operational effectiveness; and
  • Identify the functional/environmental problems in the existing buildings and proffer appropriate building facilities management solution in the targeted institutions.

Design Functionality and environmental performance of educational buildings
Functionality is a property given to an artefact in order to create a practical effect (Douglas, 1996; Warell, 2001). An important effect can be described as space use. It therefore reflects the user's demands and needs in order to gain good productivity. For existing buildings, there is the need to answer the question "How well is the building suited for the activities of the user"? This can be described as fit for purpose relating to the building's operational layout or functional elements. The functional elements according to OECD (2006), deals with the fit between the building and its activities. It relates to how well the building directly supports activities within it while being responsive to the specific needs of the organization and its occupants both qualitatively and quantitatively. Functionality of educational buildings pertains to space needs

and requirements, system performance as well as durability and efficient maintenance of building elements. The key issues in the evaluation are space design and internal logistics. This implies that the critical indicators in the evaluation process include effective and holistic space management/operations, initial investments in capital, maintenance and repairs, provision of feedback loops between the building brief and completed building, learning spaces, support facilities to accommodate at least 95% of the student enrolment and workspace for staff and school administration(OECD, 2006).

In his research on challenges of defining international design principles for educational buildings, Heitor (2005) identifies key factors that must be considered when addressing design quality in educational buildings. These factors are grouped into pragmatic concepts and design principles. The pragmatic concepts range from the functional ideas to the design solutions which addresses issues such as planning/schematic design and development. Heitor (2005) states that the success of this complex process implies a careful preparation phase involving those concerned with the project so that educational strategies, curriculum, targets and priorities of users will be reflected. Heitor (2005) further states that the initial phase (the schematic design) anticipates a definition of the design brief based on functional ideas. The functional ideas address how a variety of activities should be executed differently by everyday users (students, lecturers, teaching assistants, visitors and guests) in the institution as a whole. Heitor (2005) therefore refers to the functional ideas as pragmatic concepts defined according to educational goals.

Environmental performance refers to the environmental sustainability of building elements and strategies. It is concerned with the role of buildings and their impact on the users, the community and the ecological environment. Indicators in this category include monitoring against prescribed sustainability targets at national, state, and project levels (Then and Tan, 2002). Other issues to be considered include environmental impact, health, safety and security.

A major consideration in today's energy conscious world is the design of buildings that are environmentally responsible. Robinson and Robinson (2009) state that sustainable building designs should demonstrate a commitment to innovation, use of passive design elements and active systems, materials, finishes and selections with the ultimate goal of eliminating any foot print on the environment.

Design decisions on educational buildings should consider issues relating to optimization of energy use, site potential, protection and conservation of water, enhancement of indoor environmental quality and optimal maintenance practices. This agrees with the report of the Organization for Economic Co-operation and Development (OECD) (2006) which outlines sustainable building design factors as site planning, sustainable systems and sustainable methods and materials. OECD (2006) explains that in site planning, the building must demonstrate an environmentally responsible site planning by maximizing the site potential. In the area of sustainable systems, the building must demonstrate effective and efficient use of water, energy, recycling, waste management and day lighting. Sustainable methods and materials entail an effective demonstration of the use of sustainable construction methods and building materials.
The underlying question in the concept of educational building design is how the school's physical space (design product) should work to support educational goals (task) and at the same

time ensure long term optimal use of the facility. Issues addressed in this stage include academic activities, schedule of spaces and fittings, required relationships of spaces and people within the physical and psychological environment, quality of space and construction as well as operating and life cycle cost considerations. Heitor's (2005) study adequately addresses the issue of functionality and environmental concerns based on the reflective practice of educators and design professionals.

METHODOLOGY

A questionnaire was developed from both primary and secondary data and administered to a convenient sample of staff and students of some selected universities in South East Nigeria. The questionnaire was designed to obtain representative views of the respondents on the levels of performance and relative impact of each attribute of functional and environmental aspects of buildings within a set of attributes being rated. Likert scales were provided on a rating continuum (1-5) to measure the varying degrees of respondents' opinions about the relative worth of the attributes in the subsets. However, the questions were structured to explore the respondents' reactions to the buildings on campus and further reveal insights about the respondents' well being in the universities' environment

Out of 170 questionnaires distributed to the respondents, 86 were completed and returned which corresponds to a response rate of about 51 percent. Data obtained from the questionnaires were analysed using MS Excel and statistica (version 9.0) in the form of frequencies and measures of central tendency. The results and interpretations shown in tables and charts are presented as findings in section 4.0. Based on the response rate and findings of the study, the conclusion drawn may be deemed indicative of the level of functional performance and environmental quality of buildings in the study context.

FINDINGS AND DISCUSSIONS

The findings and discussions in this study are shown in Tables 1 to 6 and Figures 1 and 2 respectively.

Table 1 Population distribution of questionnaires and percentage response for each institution

Case organisation	Number of questionnaires distributed	Number questionnaires received (No of respondents/responses)	Percentage contribution to total responses
University A	50	30	35
University B	45	20	23
University C	45	20	23
University D	30	16	19
Total	**170**	**86**	**100**

Table1 reveals that the highest proportion of respondents came from university A. This can be explained by the relatively high students and staff population of the university compared to other universities in the study. However, there is no doubt that the differences and apathy observed could have resulted from geographical variations in the opinion of respondents about poor and inadequate infrastructural facilities in these institutions. The researcher observed that stakeholders, particularly staff and students show widespread discontent about inadequate building spaces with most complaints coming from university D. The low response rate from this University (19 Percent) attests to this assertion.
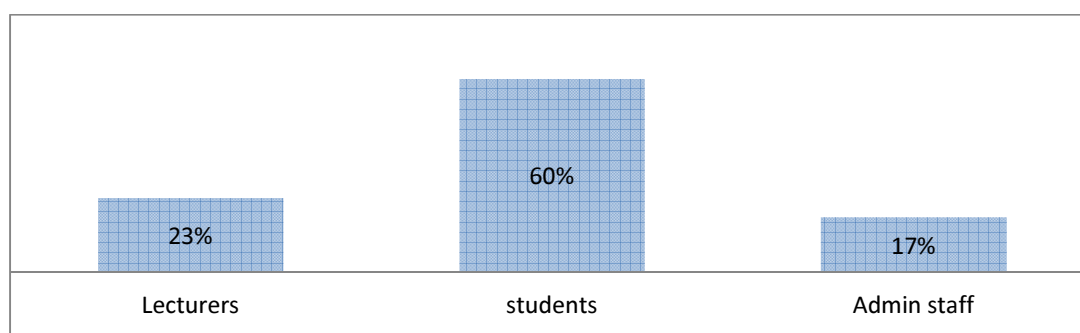

Figure 1 Status of Respondents

Figure 1 reveals that majority of the respondents are students (60 percent). This adequately captures the highest group of users of building spaces in the universities. However, all the staff (both administrative and academic staff) constitutes about 40 percent (23 + 17) of the respondents. This gives a fair representation of the staff and students proportion in the Nigerian university system.

Table 2 Rating of building spaces for respondents' work/ studies (in percentages)

Type of space	More difficult………………………………………………………………………………...........................Easier				
	1	2	3	4	5
	Ratings (in percent)				
Office	14	23	48	8	6
Classrooms	18	24	34	17	7
Lab/Workshops	22	33	21	14	10
Library	20	26	27	17	10
Hostel/Residence	8	7	30	28	27
Spats/Gym	17	19	61	1	2

Table 2 shows that the respondents feel that it is difficult or more difficult to work or study in laboratories/workshops (33+22=55 percent); libraries (46 percent); classrooms (42 percent) and offices (37 percent) respectively. It is also difficult to work/study in spats/gyms (36 percent).

This implies that it is virtually difficult to work or study in all the building spaces studied. According to the respondents, it is more difficult to work in laboratories/workshops (highest rating of 22 percent) than other spaces. The respondents also believe that it is easy to work or study in hostels/residences and this was rated highly (55 percent). The respondents' opinion can be explained by inadequate and poor space efficiency of buildings in the universities under investigation as revealed by the line graph in Figure 2.
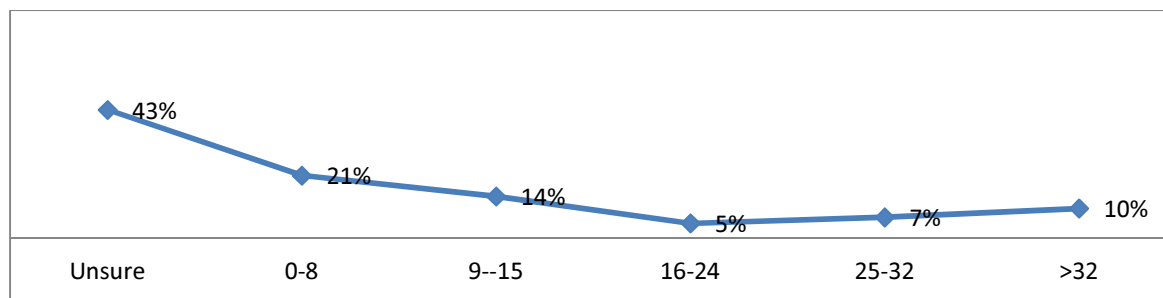

Figure 2 Average time spent in office building spaces by the respondents on weekly bases

Figure 2 indicates that a relatively higher percentage (21 percent) of respondents spend between 0 to 8 hours in their offices on weekly bases. This is followed by 14 percent (9 to 15 hours) and 10 percent (>32 hours) respectively. The respondents in these categories are mostly staff members who use office spaces to perform their duties and if the offices are not conducive, the lecturers prefer to be more in the classrooms than their offices. The relatively low percentage of respondents who spent more hours in their offices indicate that staff members do not spend quality time in their offices and this reveals an appreciable loss of productivity in the university system. It also points to the conclusion that space efficiency is poor and this partly accounts for the high level of absenteeism from offices observed by the researcher.

Table 3 Rating of building accessibility by the respondents

Aspects of building	Not accessible……………………………………..............Very accessible				
	1	2	3	4	5
	Ratings (in percent)				
Accessibility into and around the building (lifts, maps, way finding, lighting etc)	40	35	14	6	5

In **Table 3,** the respondents feel that most of the buildings are not accessible. This means that accessibility into and around the buildings is poor. Accessibility is an important aspect of building performance and buildings that are not accessible to all users cannot be said to be performing well. The implication of the responses in Table 3 is that people with disabilities or the physically challenged were not considered in the design of the buildings and therefore excluded from effectively using or operating in them. The respondents/users in this regard need more functional and accessible buildings in the university system.

Table 4 Rating of the indoor building environment by the respondents (in percent).

Aspects of indoor building environment	Uncomfortable……………………………………………… …..........................Comfortable				
	1	2	3	4	5
	Ratings (in percent)				
Temperature comfort	36	27	18	14	5
Ventilation comfort	34	30	14	13	9
Discussion privacy and distraction from noise	33	28	29	8	2
Visual privacy	21	27	27	16	9
Artificial lighting comfort	13	12	28	31	16
Natural lighting comfort	8	9	25	37	21

Table 4 indicates that the most uncomfortable aspect of the indoor building environment is temperature (36 percent). This is followed by ventilation (34 percent), discussion privacy and distraction from noise (33 percent). Most of the respondents view natural lighting to be almost comfortable with the highest rating of 37 percent. According to Sanoff (2003), design for ventilation must support day lighting features but this is not reflected in the above situation. The temperature discomfort can be understood because of the tropical weather in the study area. Artificial lighting was rated highly as almost comfortable (31 percent) while visual privacy was rated badly (27 percent) as almost uncomfortable. The general conclusion that can be drawn from Table 4 is that none of the aspects of indoor building environment is actually comfortable. This does not encourage effective teaching and learning in the university system.

Table 5 Assessment of room acoustics and colour by the respondents (in percent)

Aspects of indoor building environment	Poor……………………………………………………….............................. ....Very good				
	1	2	3	4	5
	Ratings (in percent)				
Room acoustics	22	23	40	14	1
Colour	17	22	34	22	5

Table 5 reveals that most of the respondents feel that room acoustics is almost poor (23 percent). This means that the sound-carrying ability of the rooms is not acceptable and therefore needs improvement. The respondents' opinion explains why discussion privacy and distraction from noise were rated high and uncomfortable in Table 4. Concerning the question on colour, it can be

seen from the same table that the respondents' opinion about colour is split between almost poor (22 percent) and good (22 percent). Modern universities must design buildings and create spaces that attract students; similar to the way supermarkets attract customers. One of the physical characteristics of a teaching and learning environment is the use of colour. The best use or choice of colours is dependent on age and gender. The youths which constitute a larger proportion of the university community, admire bright and soft colours, particularly the females (Lackney, 2003; Buys, 2009). It is obvious from the respondents' responses that the building colours in the universities should be made more attractive.

Table 6 Overall rating of performance measures by respondents

Performance aspects of the building	Adequate…………………………………………………………….... ....Inadequate				
	1	2	3	4	5
	Ratings (in percent)				
Fitness for purpose	2	2	9	29	58
Maintenance	1	7	10	23	59
Space needs met	1	1	23	35	40
Access to day light	8	13	26	40	13
Sanitary spaces	8	17	21	25	29
General accessibility	1	7	30	37	25
Fire safety	13	15	18	33	21
Furnishings	5	19	31	23	22

Table 6 indicates that all the performance aspects were rated inadequate or almost inadequate by the respondents. It is notable from the table that the most inadequate aspect of building performance is maintenance rated 59 percent. This is followed by fitness for purpose and space needs (58 percent and 40 percent respectively). It must be noted that access to daylight was rated highly (40 percent) and so considered almost inadequate by the respondents. According to the respondents, general accessibility, fire safety, and furnishings were almost inadequate with 37 percent; 33 percent and 23 percent ratings respectively. Most of the respondents' views about sanitary spaces were inadequate. This implies that the performance levels of all building facilities in the universities need to be improved

SUMMARY AND DISCUSSION

This study captures the opinions, feelings and experiences of respondents (staff and students) about the performance of existing buildings in the institutions and therefore reveals the functional and environmental inadequacies of building performance in the universities under investigation. Generally, the respondents' experiences and feelings show that interaction between them and building facilities in the universities do not add value to their learning and working experiences. The responses indicate concerns regarding such building performance issues as poor space conditions and management, poor accessibility, poor environmental quality in terms of

comfort, uncomfortable noise levels, lack of privacy, and poor safety, health and security conditions in the buildings studied.

This study forms the mirror image of the extent to which educational buildings meet the needs of the user and building performance evaluation practices in the chosen context. The poor performance of building facilities in this study compares with the findings in earlier studies by Buys (2009) which reveals that the performance levels of physical facilities in South African and United Kingdom tertiary institutions were all below bench mark ratings identified in the study. This state of affairs throws up a great challenge to facilities and construction management professionals and re-enforces the need for improved performance of buildings in higher education built asset management.

The key contribution of this paper is the identification of functional and environmental measures as a missing link in the performance of educational buildings; a lacuna that has hitherto created gaps between building users and design practices in Universities of South East Nigeria. The implication here is that facilities managers in these institutions should maintain and implement an effective feedback mechanism from the user to the designer. This will enable the design and building teams address inadequate performance aspects in the future.

CONCLUSION AND RECOMMENDATIONS

Building performance evaluation has been analysed in terms of the functional and environmental concerns in the case organisations. The literature scan in the study has revealed key functional and environmental issues that must be considered for the effective performance of educational buildings. These include space efficiency/adequate spaces and fittings, adequate day lighting, sustainable methods and materials, enhancement of indoor environmental quality and optimal maintenance practices, protection, conservation of water and energy use.

However, analyses of data in this study showed that building performance in the case organisations did not meet most of the above criteria. Space efficiency in most of the buildings such as classrooms, offices and residential accommodations were found to be poor and from the findings, it was apparent that the interaction between users and building facilities in the universities did not add value to learning and working experiences. Apparent lack of a performance evaluation database and standards for building performance evaluation was observed in the institutions studied. The authors also observed that the level of perception and awareness of evaluation is low and building performance generally seems to be unpredictable in terms of quality standards and user expectations. Furthermore, building performance evaluation constructs and related concepts are not well established in the case organisations. The lack of adequate and functional building facilities in the University system constitutes enormous threats to educational effectiveness and system performance. Consequently, the standards and quality of education, to some extent may be compromised.

It is therefore recommended that performance evaluation of building facilities in Nigerian universities be given substantial attention to address the issue of low perception and awareness of the importance of this tool for organisational effectiveness. Facilities managers and other

building service consultants should create the awareness by informing top management of the importance of building performance evaluation as a facilities management function, particularly, its role in supporting the core business of the university system and achievement of educational goals.

Building performance evaluation should be part of the procurement process. This would enable the design and construction teams to investigate or evaluate the extent to which completed buildings meet the performance objectives. It is further recommended that a performance evaluation database for buildings in educational institutions be developed in Nigeria. This would provide information on performance standards and cost of performance evaluation activities thereby helping to improve the effectiveness of design and evaluation process. This study will help to determine the design and performance directions in building service delivery. Nevertheless, the user- need phenomenon identified in the study forms the starting point for further study in this field of knowledge.

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