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POST-OCCUPANCY EVALUATION TOOLS FOR EFFECTIVE MAINTENANCE MANAGEMENT OF PUBLIC SCHOOLS

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ABSTRACT: *Post Occupancy Evaluation (POE) involves the systematic assessment of buildings, facilities and surroundings occupied by end-users.This paper examines the POE tools for effective maintenance management of Public School Buildings. In this study, questionnaires were administered and retrieved from the 331 end-users that is staff and Parents of pupils of the Rivers State Model Primary Schools from 12 selected schools in 6 Local Government Areas out of the 138 completed functional schools. Purposive sampling technique was adopted to select the 12 schools. The descriptive statistical tools such as table, frequency, percentage and relative importance index (RII) were employed in analyzing the data collected. The findings showed that POE tools for effective maintenance management are both quantitative and qualitative methods and the tools include questionnaire, walkthrough observation, photographs, interviews, focus group and survey as the most valuable tools. POE tools are vital effective maintenance management tools employed as feedbacks from end-users for effective integration towards sustainable maintenance. The study therefore recommends POE tools for effective maintenance management of Public Schools in Nigeria.*

KEYWORDS: Post Occupancy Evaluation, Methods and Tools, Maintenance Management, Building Performance, End-users

INTRODUCTION

Post Occupancy Evaluation (POE) refers to the evaluation of a completed building and its facilities following occupancy. A structured systematic POE process can answer several questions such as, is the constructed building and facilities functioning as planned? If not, what corrective measures are necessary? And how can buildings be better maintained and managed in the future? Post occupancy evaluation has evolved in some form since people began occupying buildings. Its association with relatively systematic assessment of how well a building performs on explicit criteria is more recent, but has existed over the past 30 years, a technique by which design Practitioners could learn from their past mistakes and successes alike (Preiser and Schramm, 2002). The intent simply was to avoid continually reinventing the wheel, by doing so, presumably the cost of maintenance could be lessened, occupant satisfaction, comfort and performance could be enhanced, and organizations could get better value for the money from their facilities (Becker, 1974).

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In examining the actual functioning of and end-users satisfaction with buildings which are very rarely revisited and assessed once they are handed over to the users, POE tools is required for evaluation and verification. This lack of evaluation and verification tools stems from numerous reasons leading to a situation in which every single building remains a unique specimen, design mistakes are repeated and when some re-evaluation of the building as an end product is undertaken, it is often based on non-systematic trouble shooting. It is hard in many cases to compare the results of such tools due to lack of uniformity in building and the exercise, standard procedures and protocols (Roof et al, 2004). It has been claimed that unless a systematic approach or tool is taken for the buildings improvement, the current practices remain haphazard that does not necessarily promote sustainability (Meir et al, 2009).

POE as a evaluating and verifying tool for effective maintenance management has consists of a set of methods and techniques used for the purpose to evaluate building performance from the professionals perspective and to verify satisfaction from end-users perspective to draw a systematic diagnosis of the positive and negative functional aspects, as well as the construction system, environmental comfort, cost benefit relationship related to maintenance and human behavior (Ornstein, 2005). Thus POE tools will serve as feedback for managing the quality of the construction process, as well as built environment, especially initial planning, programming and design and in maintenance programs of the public buildings when in use (Ornstein, 2005). The methods and tools used in POEs need to be extended and modified to suit the requirements of evaluating buildings and its facilities (Cooper et al, 1991). Interestingly, POE technique developed by social scientist with shared interest in human behavior and the physical environment have often been regarded with suspicions and even hostility that may cause friction between different stake holders (Meir et al, 2009). It is against this back ground that this paper examined the POE evaluating and verifying tools for effective maintenance management of public schools highlighting their potential benefits to buildings in Nigeria.

LITERATURE REVIEW

POE measures can have application in new buildings and renovation as well in the evaluating of existing facilities. Despite the lack of an industry-accepted definition of POE, nor is there a standardized method for conducting a POE exercise, the effort to reflect the objectives and goals of POEs as they are practiced depends on different professionals and their terms been used. POE is a process of evaluating buildings in a systematic and rigorous manner after they have been built and occupied for some time (Preiser et al, 1988). According to Vischer (2002) POE is any and all activities that originate out of an interest in learning how a building performs once it is built, including if and how well it has met expectations. Zimring (2014) stated that POE is a continuous process of systematically evaluating the performance and or effectiveness of one or more aspects of buildings in relation to issues such as accessibility, productivity, safety and security and sustainability. The Royal Institute of British Architect Research Steering Group (RIBA, 1991) defined POE as a systematic study of building in use to provide architects with information about the performance of their designs and building owners and users with guidelines to achieve the best out of what they already have. Preiser (1997) defined POE from facility management perspective as a diagnostic tool and system which allows facility managers to identify and evaluate critical aspects of buildings performance systematically.

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Watson (2003) stated that POE serves as a tool to account for building which is essential when organizations are require to demonstrate that building programmes are responsibly managed. POE is a useful tool for building asset and facilities management as long as the approach employed to collect feedback from end-users is effectively integrated towards sustainability of the building (Olatunji, 2013), while Meir et al (2009) opine that POE is a vital step towards buildings sustainability. According to Wener (1989), POEs in architecture are concerned with social and behavioural issues as opposed to aesthetic issue by comparing building performance with explicitly stated human performance needs. Preiser, Rabinowitz and White (1988) stated that variable such as task performance, communication, safety and thermal comfort may be considered for evaluations conducted with specified format, which ranged from a simple to complex investigation of concerns whereby performance is typically measured on three dimensions: technical, functional and behavioural.

Meir et al (2009) identified the methods and tools employed as both quantitative and qualitative approaches based on the information analyzed and assessed from POE to include measurement, monitoring, sampling, surveys, questionnaires, cohorts studies, observations, task performance test, document analysis, on-site observations. All these are scientific or social science research methods and tools used in POE exercise making it a tool for built environment research. Ornstein and Ono (2010) aver that in experimenting with new tool, the use of different tools to guarantee the precision of the qualitative and quantitative data collected is necessary. Also important is the constant refinement of the visual quality of the diagnoses and recommendations drawn up by the experts, in order to make the presentation easy to read, watch and interpret by users and decision-makers as it affect building end-users.

In evaluating the end-users' satisfaction most common qualitative tools used to evaluate the built environment, making use of the opinions of the building end-users are focus group discussion, cognitive map, interviews and physical and electronic models of internal environment (Villa, 2008). Beside the quantitative tool most frequently used in POE is the application of objectives questionnaires with scale of values showing the representativeness of the sample always been proven, as well as the level of confidence and their margin of error of the findings for data validation are all scientific research methods (Villa, 2008). Ornstein and Ono (2010) asserted that other evaluation tools employed by experts (evaluators) include checklists, walkthrough, photograph, behaviors maps of pedestrian, traffic-flow and physical (environment) measurement not excluding questionnaires and the schematic representation of the hierarchy of spaces.

Despite many research that have been undertaken, the aspects of POE as an evaluating and verifying tool for effective maintenance management have not been widely emphasized from the above literature reviewed. In order for public school buildings to remain competitive in the built environment, a tool that respond to end-users' needs, concerns, expectations and opinions and must use this information to quantify performance and compare with best practices. POE tools seek to improve the quality of maintenance of buildings and by extension promotes sustainable built environment where maintenance issues were not looked into.

RESEARCH METHODOLOGY

This study utilized questionnaire and semi-structured interview with key stakeholders ie staff and parents) of Rivers State Government Model Primary School Buildings, in Nigeria.

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Questionnaire survey and semi-structured interviews are part of the strategies employed in carrying out POE globally. The records in the Rivers State Ministry of Education showed that there are 138 completed functional school buildings across the 23 Local Government Areas of the State that constitute the population of the study.The population of the survey research is the staff and parents of pupils of the schools. Non-probability purposive sampling technique was used to select a sample size of 12 schools from 6 Local Government Areas, and 2 schools from each Local Government Area of the state. A total of 331 questionnaires were administered and retrieved from the 12 schools and the frequency distribution of respondents from the 12 schools that participated in the study are shown in Figure 1. Descriptive statistical tools such as frequency and percentages, relative importance index (RII) were used. Relative importance index was used to measure and arrive at a reasonably reliable actual position of the respondents(s) on the attitude continuum. Under relative importance index (RII) measure, variables are rated using a 5-point likert scale in order to assess the significance of each factors. The relative importance index (RII) was evaluated using the following equation:

$$RII = \frac{\Sigma ajni}{\Sigma xj}$$

Where I = response category index

xi = the sum of j factors 1, 2, 3, …….N

ai = constant expressing the weight given to the I response

nj = the variable expressing the frequency of the i^{th}.

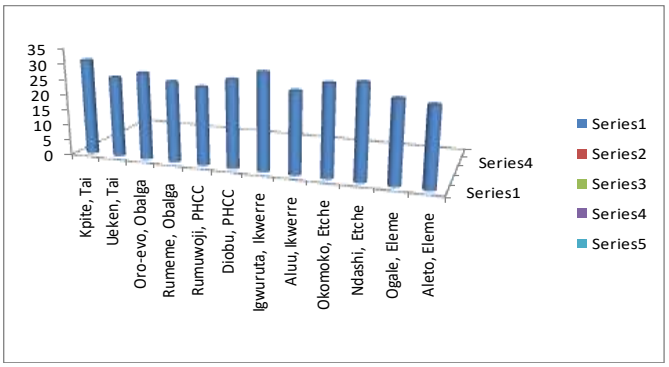

Figure 1: Distribution of Respondents in Various schools

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RESULTS AND DISCUSSION

In this section, the data were collated, analyzed and the results are presented in Tables 1 and 2 followed by the discussions. Table 1 showed that 50% of the respondents agreed that both qualitative and quantitative (mixed methods) are used for POE, while 30% of the respondents agreed that quantitative method used and the remaining 20% agreed that qualitative methods are used. This implies that half of the respondents admitted that POE evaluating and verify methods are quantitative and qualitative (mixed) methods and are reliable.

Table 1: POE Evaluating and Verifying Methods

Methods	**Frequency**	**Percentage**
Qualitative	67	20.0
Quantitative	100	30.0
Both	154	50.0
Total	**331**	**100**

Source: Authors Field survey, 2016

Table 2 revealed that questionnaire ranked first as POE verifying tool with a relative importance index (RII) of 0.7498, walkthrough observation ranked second with RII of 0.7148, photographic records ranked third with RII of 0.6972 and interviews ranked fourth with RII of 0.6749. Table 2 further showed that focus group discussions ranked fifth with RII of 0.6652, survey ranked sixth with RII of 0.6495. It implies that the most likely preferred POE tools found to be more useful in the context of Rivers State Government Model Primary School Buildings are questionnaire, walkthrough observation, photographs, interviews, focus group discussion and survey.

Table 2 also showed that document analysis ranked seventh with a relative importance index (RII) of 0.6374, workshops ranked eighth with RII of 0.6326, measurement/physical monitoring ranked ninth with RII of 0.6313, cohort studies ranked tenth with RII of 0.6042. Also with the same method of ranking, bench marking ranked eleventh with RII of 0.6030, while task performance ranked 12th with RII of 0.5758 and visual selection and perception ranked thirteenth with RII of 0.551. It implies that all other POE tools including document analysis, workshop, measurement/physical monitoring cohort studies, benchmarking, task performance and visual selection and perceptions used in the evaluation of buildings and verification of end-users satisfaction are less important. The study found that questionnaire is the most important tool while visual selection and perception are lest important.

Table 2: Relative Importance Index (RII) of POE Evaluating and Verifying Tools

POE Innovative Tools	**N**	**TWN**	**RII**	**Rank**
Walkthrough/observation	331	1,183	0.7148	2nd
Interviews with individuals	331	1,117	0.6749	4th
Focus Group Discussion	331	1,101	0.6652	5th
Workshop	331	1047	0.6326	8th
Questionnaires	331	1241	0.7498	1st
Measurement/Physical Monitoring	331	1045	0.6314	9th
Benchmarking	331	998	0.6030	11th
Visual Selection and Perception	331	912	0.5511	13th
Task Performance	331	953	0.5758	12th

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Document Analysis	331	1055	0.6374	7th
Surveys	331	1075	0.6495	6th
Cohort Studies	331	1000	0.6042	10th
Photographic Records	331	1154	0.6972	3rd

Source: Authors' Field Survey, 2016.

Summary of Opinions of key Informants on the Preferred POE Tools

Key informants indicated that elicited Information is feed forward into the feedback loop basically with issues concerning maintenance management having the occupants in mind. And it includes the following:

- Questionnaires are a valuable way of collecting data from large group of people and being able to gather consistent data across the facilities assessed with multiple choice questions with scales of values measured.
- Walkthrough observation reflects on how the space perform by the evaluator with end-users walking around the building identifying are of conflict based on checklists to observe the condition of construction, functional aspects, environmental comfort and behavior, and activities in the environment.
- Photographs which shows the poor state of facilities defects appearance with its technique of graphic representation as to understand the flows and dynamics of the activities involved in regular application, visualization, description and quantification of activities.
- Interviews with individuals as useful way of getting very specific information as to develop a deeper understanding of a particular problems based on few specific questions inducing participants in certain directions recorded for later transcription.
- Focus group discussion involving drawing out information on a range of topics consists of group meetings with limited number (6-8) of participants including the moderator with questions prepared to stimulate discussion and the debate as recorded are later transcribed.
- Survey as a tool used in combination of questionnaire and interview supplementing each other, and use primarily to gauge end-users' satisfaction that may provide as much as 80% of all the needed indicators for the assessment of building performance.

CONCLUSION AND RECOMMENDATIONS

The study examined Post Occupancy Evaluation as an evaluating and verifying tool for effective maintenance management of public school in Nigeria. The study found that POE provides a valuable approach for evaluating and verifying end-users satisfaction level as well providing recommendations to improve building performance through effective and efficient maintenance management to ensure satisfaction. The approach has a potential in collecting data and analyzing building performance as it uses strategic methods and tools in evaluating and verifying to achieve the best quality of building services, whereby the assessment integrates the building end-users' behavior, perception and opinion.

POE is a useful tool for building asset maintenance and management, as long as the methods and tools employed collects feedback from end-users which is used effectively integrated towards sustaining public buildings. The study also found that POE evaluating and verifying tools for effective maintenance are both quantitative and qualitative methods and the tools include questionnaire, walkthrough observation, photographs, interviews, focus group discussion, survey, document analysis, workshop, measurement/physical monitoring, cohort studies, bench marking, task performance, and visual selection and perceptions.

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The study concludes that POE evaluating and verifying tools are effective and efficient for maintenance management as tools employed to collect feedback from end-users used for effective integration towards sustainable maintenance. The study therefore recommended POE evaluating and verifying tool should be used for effective maintenance management of public school buildings. Additionally, there should be effective POE tool and maintenance management practices for the public buildings to improve the end-users' satisfaction, comfort and performance.

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