



# Post-occupancy Evaluation of Higher Educational Buildings: Purpose, Obstacles and Benefits

Željka Jurković<sup>(✉)</sup> and Danijela Lovoković

Faculty of Civil Engineering and Architecture Osijek, Josip Juraj Strossmayer  
University of Osijek, Ulica Vladimira Preloga 3, 31000 Osijek, Croatia  
zjurkovic@gfos.hr

**Abstract.** The post-occupancy evaluation (POE) is an overview of the architectural and technical performance of the building during its use. The purpose of POE is to improve future construction, based on previous experiences in the use of the building by immediate users. We primarily explored the architectural aspect of buildings (site, function, interior design) and the methods in which it should be valorized by users, primarily by a questionnaire. The article gives an overview of the benefits that investors and architects can have from POE and highlights obstacles to more POE procedure. We are focused on the long-term benefits that POE can provide if adopted as a standard method of valuing higher education buildings by users. POE focus in higher educational buildings is whether the physically constructed structure of the building with its architectural elements results in quality use by end-users. We found that the implementation of POEs procedures is the most necessary in educational buildings.

**Keywords:** Post-occupancy evaluation · Higher educational buildings · Architecture · Benefits · Questionnaire

## 1 Introduction

History of modern-day POE methods dates back to the late 1960s. The first publication with the term “POE” dates back to the 1975 but the terminology became more accepted after the textbook was written in 1988 [1] and after Technical report for US Federal Facilities Council was written in 2001 [2]. POE starts from the assumption that the performance of the building should be evaluated by the end-users at least one year after moving in. POE is defined procedure or process of systematically evaluating the characteristic of the buildings after they have been built and occupied after some time [3].

POE implies two basics aspects of buildings: technical performance and functional performance [4]. Technical performance includes: site performances, lighting, heating, cooling, ventilation, acoustics, indoor air quality, energy and water consumption, CO<sub>2</sub> output, use of green energy sources, fire safety. Functional performance includes:

space arrangement, aesthetic value, amenity, life-cycle cost, maintenance [4, 5]. Consequently, there are two types of methods applied in POEs: objective methods (physical measurements) and subjective methods (questionnaires, interviews), measurable and non-measurable methods, i.e. qualitative and quantitative data.

The article primarily explores the functional parts of POE, those related to the architecture of the buildings. POE process can evaluate any purpose of building: commercial buildings, offices, residential buildings, educational buildings, medical buildings, transport buildings, etc. We chose higher education buildings because they are mostly built with public finances, they have significant building and maintenance costs, they have an area of several thousand m<sup>2</sup> and premises for various purposes (lecture halls, cabinets, laboratories, offices) and they must be nearly zero energy buildings (nZEB). Higher education buildings have a large number of different users (students, teachers, non-teaching employees) who spend majority of their time indoors. Spatially, because of their purpose and size, higher education buildings are important for the city in terms of urban position and they are often located in prominent city locations or on university campuses.

The purpose of POE is to improve future construction, based on previous experiences, actual performance of the building, feedback of the building, rather than project and calculations predicted performance. The goal is to learn from the experience of the building's users, determine has the building's performance met the expectations, how satisfied building users are with the environment that has been created [2]. The aim of POE is to correct possible mistakes and reduce maintenance costs, all in order to improve the next project. In this article, the focus is on the long-term benefits that POE can provide if adopted as a standard method of valuing higher education buildings by users.

## 2 POE Methods for Evaluating Architectural Elements

The general methodology of the POE process includes several phases that can be summarized in three: the preparatory phase (selection of POE team, what is to be inspected and evaluated, review of building documentation), implementation phase (total building observation tour, conducting interviews or questionnaires, data collection) and the POE reporting phase [5]. POE is an interdisciplinary process that involves the participation of architects and other engineers, together those who were involved in the designing, supervision, or construction of the building and those who were not involved. The participation of independent experts ensures the objectivity of the overall approach, objective analysis of information and obtained results. Royal Institute of British Architects (RIBA) defined POE as a systematic study of buildings 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 [6]. RIBA also gave to the public Post Occupancy Evaluation Guidance to ensure that the profession and the public have access to POE-related methods and procedures [7]. Different characteristics of the building are examined by different methods. The functional characteristics of the building are examined mainly by subjective methods (surveys, questionnaires, interviews, building tour observation). POEs of functional performances of higher educational buildings often

focuses on occupants’ experience and use of the facilities and almost every POE procedure would use a questionnaire or an interview as the most common research method [8].

Basic architectural elements for POE of functional building performance are presented in Table 1 [5, 7, 9–12]. They include evaluation of site, architecture, functionality, environmental protection, security, interior and comfort of use. Table 1 displays the elements of the higher education building that need to be evaluated and the proposed established evaluation methods or POE feedback techniques.

**Table 1.** Basic architectural elements for POE of functional building performance.

Basic architectural elements for POE	Performance indicators	POE methods
Site, location context, zoning, surroundings	Urban presence and visibility, street frontage, access (pedestrian, bicycles, vehicles), walking distance to public transport, parking	Building tour, interviews, questionnaires
Overall architecture	Building form, building size, building volumes, number of stores, Flexibility and external envelope, fenestration, building phasing, potential for future expansion	Building tour, interviews, questionnaires
Functionality	Spatial configuration, spatial layout, grouping of spaces, spatial relationships, dimensions, proportions, heights of lecture halls, heights of laboratories, circulation, vertical and horizontal communications, accessibility	Building tour, interviews, questionnaires
Environmental protection	Flooding, earthquakes, wind and sun, erosion	Building tour, questionnaires
Interior	Furnishings, walls, doors, ceilings, materials, colors, finishes	Building tour, questionnaires
Safe and secure	Alarms, cameras, detectors, safety in use	Building tour, questionnaires
General occupant satisfaction	Space quality, Privacy and comfort, occupant’s health and wellbeing response	Questionnaires

In addition to the listed standard evaluation elements (Table 1), higher education buildings, due to their specifics, require the evaluation of additional building characteristics as presented in Table 2. The tabular overview is systematized on the basis of research from the available literature [4–7] and research by the authors. Specific evaluation elements relate to the purpose of the building (higher education building), to different users (students, teachers, non-teaching employees) and the specific requirements that the building should have as a public building in which a large number of people gather, reside and work.

**Table 2.** Specific architectural elements for POE of functional building performance.

Specific architectural elements for POE	Performance indicators	POE methods
Aesthetics, image	Unique form, design innovations, inspiring architecture	Questionnaires
Creativity, innovations	Efficiency in teaching and student activities, choice of learning and teaching environment, workplace productivity, interactivity, collaborative work environments	Questionnaires, interviews
Occupancy	Capacity of lecture halls and laboratories	Schedules, interviews
Interior	Equipment	Building tour, questionnaires
Signability	Signposting, wayfinding, visible and clear visual communications	Building tour, questionnaires

It is evident that POEs are flexible procedures, which can be upgraded, depending on the specific requirements or new elements in the behavior of the buildings to be evaluated. Emergency issues that should be incorporated into POEs, for example, are the threat of terrorism or evaluating the buildings to prevent the spread of coronavirus or future pandemics, as presented in Table 3 [10].

**Table 3.** Emergency architectural elements for POE of functional building performance.

Emergency architectural elements for POE	Performance indicators	POE methods
Anti-terrorism protection	Barriers, alarms, detectors security equipment	Building tour, questionnaires
COVID-19 building response	Maintaining social distance, capacity of outdoor and indoor spaces, capacity of covered spaces, capacity of lecture halls and laboratories, natural ventilation, separate communications, adjustments for distance learning	Building tour, questionnaires

### 3 Benefits and Beneficiaries of POE for Higher Educational Buildings

POE is a diagnostic tool which allows investors and facility managers to identify and evaluate critical aspects of building performance systematically. POE projects are conducted for numerous purposes: to identify problem areas in existing buildings, to test new building prototypes and to develop design guidance and criteria for future buildings [8, 13]. POE provides the ability to compare projected building performance and actual building behavior in use. The most important benefit of POE is feedback, “lesson learned”, valuable information how the building actually behaves in use, whether and how satisfied users are with the building.

There are three main beneficiaries of POE: investors (facility or building managers), architect (and other engineers) and users, as presented in Table 4.

We can also conclude that the general public or society as a whole is the most important beneficiary of POE because POE procedures lead to saving public money, ensure rise of architectural and building quality and provide knowledge for regulatory processes. Public buildings are particularly important in this context and thus buildings for higher education. Universities invest in more new buildings over the years and continuously renovate existing buildings, higher education sector is involved in numerous and often significant construction projects, sector must promote value for the money [11]. Higher education buildings are the ones that often guide construction standards and the sustainability of construction and influence national policy in regard to buildings and the environment [11, 12].

POE is a management aid, feed-back method for measuring building performance (technical performance) and functional performance (users interaction with built environment), POE leads towards more sustainable production and consumption of built environment [20].

**Table 4.** Benefits and beneficiaries of POE

Beneficiaries of POE	Benefits from POE	References
Investors building managements	Improve the commissioning of subsequent buildings, improve management procedures, provides data for future buildings, provide procedures for quality monitoring, mclient gets more from their investment, cost and time savings, it supports fine-tuning of the building, it supports renovation of existing building and prioritize renovations, allow to build on success, not no repeat failures, POE Database	[2, 7, 15, 18–20]
Architects other engineers	Applying design skills more effectively, improve the design of subsequent buildings, learning from occupant response, access their work on a deeper level, allow to build on success, not to repeat failures, provide knowledge for design guides and regulatory processes, better understanding of the psychosocial aspects of buildings, POE Database	[2, 14–16, 18, 20]
Users	Improved fit between occupants and their buildings, evaluation of human (user) response, connect building with occupants' habits, occupant survey database	[2, 17, 20]

#### 4 Obstacles or Why There is not Much POE in Practice?

POE has not become a norm in building industry, number of literary sources documented why POE is not carried out with regularity [8, 11, 14, 16, 20]. Although, POE has developed in last decade and continuing to rise. Many POEs protocols are in use in UK, USA, Canada, Australia and other countries [5, 7, 8, 11]. In the UK there are two formal schemes underway which have been applied to the Higher Education sector. One (external) is PROBE (Post-occupancy Review of Buildings and their Engineering, from 1995) and the other (internal) to the higher education sector itself, is HEDQF (led by the Higher Education Design Quality Forum, from 1994) [11]. The PROBE project has demonstrated that a process of feedback from the original project team and the building users on key indicators can radically help improve building design [11]. More information about PROBE, the process, studies and conclusions, including downloadable reports may be found on the PROBE website [11, 21]. Multi-disciplinary HEDQF was set up to promote design quality and value for money in higher education, bringing

together professionals involved in design, construction, occupation and management of buildings. More information about HEDQF may be found on the HEDQF website [11, 22].

The question arises: why do we not see much of the POE in practice? The answer is somewhat paradoxical: those who should be beneficiaries of POE (see Table 4) are at the same time obstacles to the wider applications of POEs procedures.

POE takes time and resources and, above all, feedback culture. Investors, architect and other engineers have the realistic possibility to be harmed by POE [14]. Investors do not want to spend additional money for evaluating something that they had already procured and paid to professionals (architects, engineers). Who is certified to practice POE? And what if POE brings out some serious flaw in design? Who will pay for corrections? Who will pay for users' satisfactions? Architects and whole project team often think that they will be blamed for any problem, that their reputation will be ruined. POE is not part of regular or usual architect's service to their clients nor is it part of public procurement. Will only users have the power to determine the success of building? The notion of professional liability is the most significant contribution to the lack of POE, especially in a litigious society without feedback culture [11, 14].

POE is user-centered, but there is the absence of POE in the curriculum, we do not teach our students about user-centered design and POE methods [14, 19].

## 5 Discussion and Findings

Although many real and justified questions are asked about POEs, the longtime benefits of conducting POEs procedures (see Table 1,2,3) outweigh the concerns and fears of investors, architects, other engineers and construction industry.

Education is of the utmost importance to society as a whole, and so are education buildings. We found that higher education sector has the potential to be a leader in conducting POE procedures. Which sector is more scientifically prepared, more committed to constant learning and improving? Which sector, if not higher education, is more used to practice self-assessment methods and is committed to feedback culture?

POE is a tool for evaluating actual performance not just predicted performance. Considering the multiple advantages of POE, we found that the implementation of POE procedures is the most appropriate and necessary in educational buildings. Higher education buildings have a large number of different users, buildings are mostly built with public finances and have significant building and maintenance costs because they often have an area of several thousand m<sup>2</sup>. Universities invest in more buildings over the years, continuously building new or renovating existing buildings. The implementation of POEs for educational building can be organized in cooperation with the academic community (faculties), within the framework of scientific research, so not to burden the architects and other design companies financially and in time.

## 6 Conclusion

POE ask questions and provide answers on how buildings actually work in architectural, technical, social and management terms for the users [23]. POE is a diagnostic tool

which allows architects, investors and facility managers to identify and evaluate critical aspects of building performance systematically. POE provide lessons and feedback for the architect, investors and construction industry. There are numerous benefits of POE, including improved building design, improved procurement and cost savings. Various certificates, including awards in architectural competitions come before, in the design phase of construction, POE as a method of quality evaluation comes after moving into the building. We can conclude that POE bridge that gap between construction phase and the use of the building. POE is user-friendly method of evaluation. One of the common and most effective method of evaluating architectural elements is the questionnaire.

In the article, we were focused on the assessment of functional performance, i.e. the architectural elements of buildings, especially higher education buildings. Considering advantages of POE, we found that the implementation of POE procedures is the most appropriate and necessary in educational buildings and that higher education sector has the potential to be a leader in conducting POE. The implementation of POEs for educational building can be organized in cooperation with the faculties, within the framework of scientific research.

Further research of POE procedures should focus on linking POE and BIM technology in construction, with the aim of increasing quality and reducing construction and maintenance costs.

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