

Implementation of Post-occupancy Evaluation: A Potential Tool for Building Asset Management and Creating More Productive, Cost- Effective and Sustainable Buildings at MSU White Paper

Introduction

Post-occupancy evaluation (POE) refers to the evaluation of a completed constructed facility during its occupancy. A structured systematic POE process can answer several significant questions including: is the constructed building facility functioning as planned? If not, what corrective measures are necessary? And, how can buildings be better constructed in the future?

This paper provides background on POE, including its origin, its processes and also helps to identify possible benefits of implementing a POE protocol at Michigan State University. POE measures can have application in new buildings and renovations as well in the evaluation of existing facilities.

Post-occupancy Evaluation

POE can be defined as “the 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 (2001), it 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”. The RIBA 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”. In 1997, Preiser defined POE from the perspective of a facility manager. This is relevant to large owners such as MSU. He defined POE as “a diagnostic tool and system which allows facility managers to identify and evaluate critical aspects of building performance systematically”. POE can be used by a variety of industry professionals and owners, as well as for a number of building types.

Origins of POE

According to Preiser and Schramm (2002), Building Performance Evaluation can be traced back to the early work by Manning (1965), Pilkington Research Unit, England, and Markus et al. (1972), Building Performance Research Unit (BPRU) at the University of Strathclyde, Scotland. The latter had varying emphases on cost or value received by the client/provider or the occupant/end user.

Over the past 30 years, the most sustained of these processes is “Post-occupancy Evaluation” (POE). In 1997, Preiser and Schramm created an integrative framework for building performance evaluation, and proposed an evaluative and review stance in all six major phases of the building delivery and life cycle. The history and evolution of POE was described in the book “Post-Occupancy Evaluation” (Preiser et al., 1988), and was recently updated in “Improving Building Performance” (Preiser, 2002). The frameworks below show where POE fits in the context of an overall building performance evaluation (Figure 1), and three levels within a POE framework.

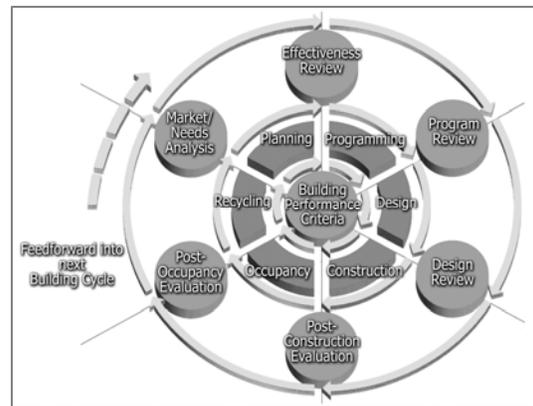


Figure 1 Building Performance Evaluation Model
(Preiser 2002 and Jay Yocis, University of Cincinnati)

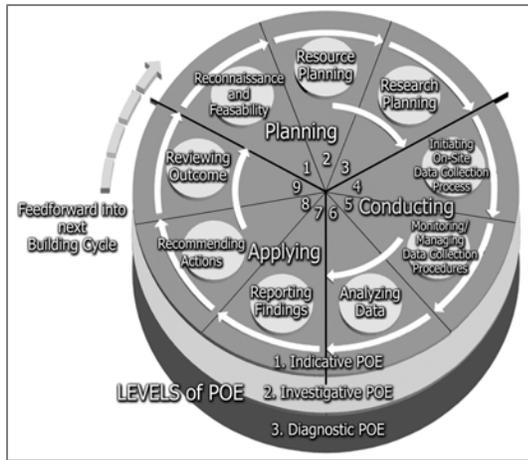


Figure 2 Post-occupancy Evaluation Framework (Preiser 2002)

Objectives of POE

One of the primary objectives of POE is to feed forward 'lessons learned' from the review of completed capital projects into a process that would ensure that best practices are applied in future projects. More specifically POE tests generic and specific aspects of the planning and detailed design of facility buildings. It also tests their impact on building users with respect to several parameters such as: health and safety, security, indoor environment quality and functions. According to Zimmerman and Martin (2001),

"The over-arching benefit from conducting POE is the provision of valuable information to support the goal of continuous improvement". POEs have been used to evaluate the degree to which buildings enable users to fulfill their intended goals. A comprehensive POE method, one that includes assessments of occupant well-being and productivity, along with the evaluation of the building functions and operations, completes the feedback loop that is essential for the successful future development and improvement of building design and practices (Huizenga, et al. 2006).

State of the Art

The American Institute of Architects (AIA) 'Best Practices' examined the importance of POE and its benefits to industry in North America. AIA identified a variety of groups who have conducted POE studies and summarized the state of the art in an article-

"Green Building Post-occupancy Evaluations: Learning from Experience". The Center for the Built Environment (CBE) at the University of California, Berkeley, has been conducting surveys that assess the indoor environmental quality in office and commercial buildings. There are three surveys: Measuring Indoor Environmental Quality: A Web-based Occupant Satisfaction Survey; A Web-based Occupant Satisfaction Survey for Benchmarking Building Quality; and, Listening to the Occupants: A Web-based Occupant Satisfaction Survey. Surveys are used to record the responses of building occupants and measure occupant satisfaction and self-reported productivity with respect to the nine IEQ categories (Zagreus et al. 2004). During the POE, all three surveys are conducted to determine the level of building performance for occupants and operators and; how the design team felt about the construction process.

In 2005, a team of Usable Buildings Trust (UBT) members conducted POE of Buildings and Their Engineering (PROBE, 2005) in order to ascertain the value addition towards creation of better buildings. UBT and the Royal Institute of British Architects (RIBA) in U.K. are the most prominent organizations that are associated with the research and development in order to further enhance the scope of POE.

The University of Minnesota Center for Sustainable Building Research (CSBR) extensively conducts POEs to assess the impact of economy, environment, human, and community on buildings over time based on the various strategies implemented during the building delivery process.

Types of POEs

POE may be classified in three levels including: Indicative (wide ranging application), Investigative (more detailed approach), Diagnostic (extremely detailed and focused study). Jacqueline Vischer identifies four separate types of POE and illustrates each with a case study. These are (Vischer, 2001, p.32): Building-behavior research or the accumulation of knowledge, Information for pre-design programming for buildings for which design guides or prototypes may be useful, Strategic space planning –

i.e. building assessment as part of 'workspace change to bring space use more in line with strategic business goals and, Capital asset management where POE is considered a tool in developing performance measures for built space.

Importance of POE to facility owners

POE is a powerful tool to enable owners to determine the true value of a facility in terms of economic, environmental, human and community outcomes. Through evaluation, researchers and professionals have found the occupant satisfaction survey to be useful as it provides valuable information and results in the context of the Indoor Environment Quality (IEQ) performance of a built space. This helps to evaluate the effectiveness of design and operation of facilities, provide information for the formulation of design and construction guidelines and, benchmark facility performance. An evaluation renders the identification of environmental factors that need improvement, diagnosis of causes for occupant dissatisfaction and supervision of occupant perception of building, and contractors' performance (Huizenga et. al, 2002).

The LEED rating system has been widely adopted in the US by federal agencies, state and local governments, and private companies as the standard for sustainable building. While it has brought green design and construction practices into the mainstream, systematic assessments of how these buildings affect occupants are rarely done. Hence, POE studies of green buildings have focused on more easily quantifiable criteria such as energy use and physical measurements of environmental conditions, which at best give an indirect assessment of how the building is affecting it's occupants (Proceedings of Healthy Buildings 2006). In accordance with the ASHRAE 55 standard, it is now imperative for POE to be conducted by an owner in order to check if the constructed facility meets minimum IEQ performance requirements.

POE may be conducted for various categories that will result in individual outcomes. For example, POE may be conducted in: behavior research, feedback to the pre-design program, strategic space planning and capital asset management, etc (Preiser and Vischer, 2002). "POE expertise and data gathering methods

can be applied to various situations which would benefit facility performance in the continuous quest for quality improvement. Thus POE techniques become an important asset in the "toolkit" facility managers can use for TQM (Total Quality Management)"(Preiser, 1995.)

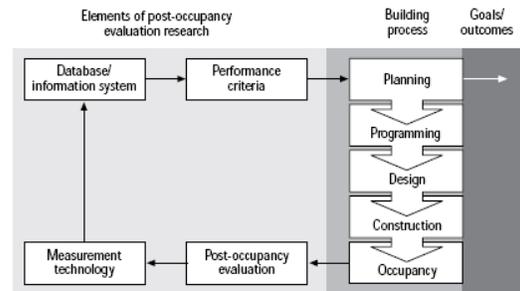


Figure 3 POE as a Facility Management Tool (Preiser, 1995)

Figure 3 illustrates that "facility managers may become the keepers of expertise and databases/information systems on facility performance of common facility types, as opposed to architects, or independent clearing-houses. Being on-site and familiar with everyday problems and issues of building performance, facility managers may also be aided by so-called building user manuals which should be developed for facilities independently of who happens to operate them at a given point in time" (Preiser, 1995). Figures 4 and 5 illustrate that if a well maintained knowledge base information system is combined with a POE database system, this could assist facility designers for future projects. These models were developed by Wolfgang Preiser for the University of Cincinnati, Ohio.

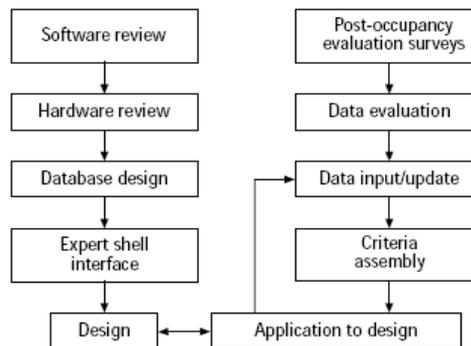


Figure 4 POE Project Overview (Preiser, 1995)

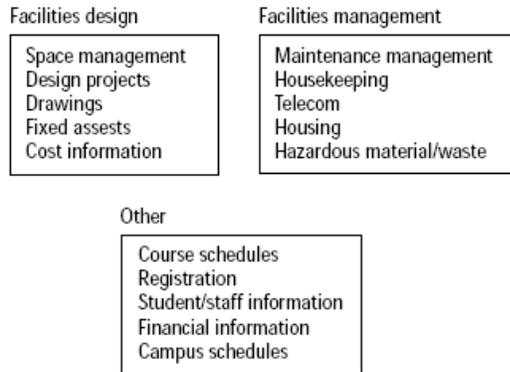


Figure 5 Typical University FM Database (Preiser, 1995)

Benefits of POE

The short term, medium term and long term benefits of POE have been laid out in "Learning from Our Buildings: A State-of-the-Practice Summary of Post-occupancy Evaluation", (2002) and are outlined below.

Short-term benefits

- Identification of and solutions to problems in facilities
- Proactive facility management responsive to building user values
- Improved space utilization and feedback on building performance
- Improved attitude of building occupants through active involvement in the evaluation process
- Understanding of the performance implications of changes dictated by budget cuts
- Better-informed design decision-making and understanding of the consequences of design.

Medium-term benefits

- Built-in capacity for facility adaptation to organizational change and growth over time, including recycling of facilities into new uses
- Significant cost savings in the building process and throughout the life cycle of a building
- Accountability for building performance by design professionals and owners.

Long-term benefits

- Long-term improvements in building performance
- Improvement of design databases, standards, criteria, and guidance literature
- Improved measurement of building performance through quantification.

Existing Methodologies

In 1995, taking into consideration the various methods of conducting POE, Wolfgang Preiser developed a process model as shown below in figure 6. The model represents the three phases and nine steps of his POE process.

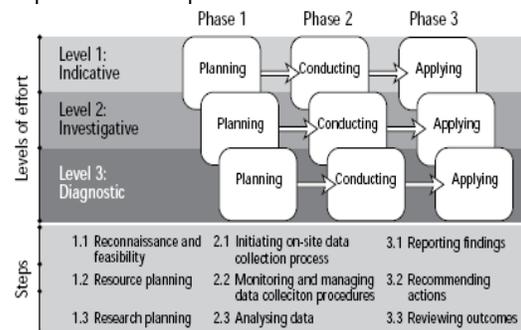


Figure 6 Post-occupancy Evaluation Process Model (Preiser, 1995)

Similarly, Jane Carthey, faculty of the built environment in the Centre for Health Assets Australasia, Sydney developed a standardized methodology as shown in figure 7.

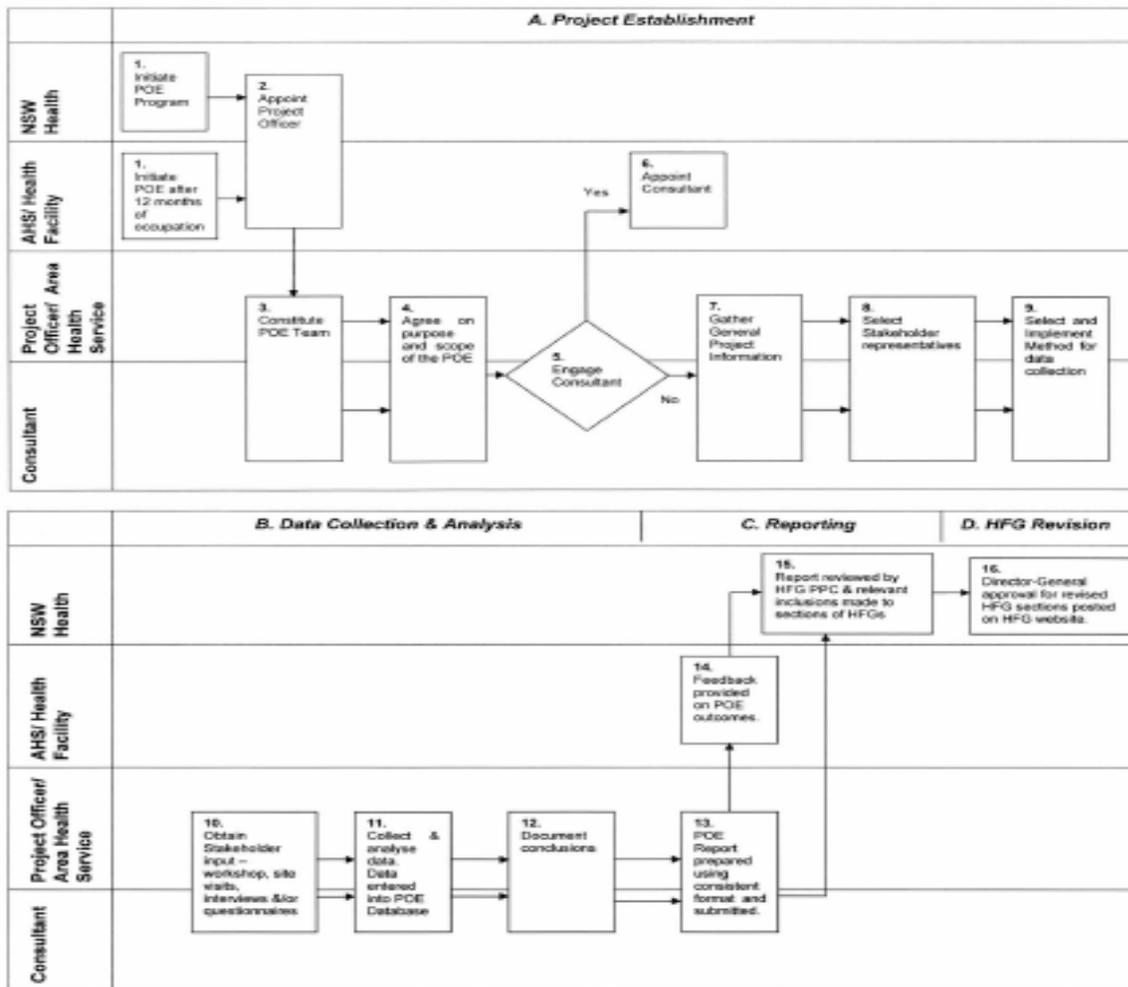


Figure 7 NSW Health Standard POE Methodology (Jane Carthey, 2004)

Data Collection and Analysis

Data may be collected for the initiation of the POE with the help of instruments such as: occupant surveys, interviews with the designer, owner and contractor or constructors, physical observation of facility by evaluators, or photographs or video recording (Learning From Our Buildings: A State-of-the-Practice Summary of Post-occupancy Evaluation, 2002). Some organizations such as CBE, Disney Corporation and World Bank have also made use of the upcoming technological advances, thereby implementing the use of web-based surveys and GIS applications.

For example, “the data collected by the CBE survey can be divided up into subjective and objective variables. The objective variables measured include gender, age group, type of work, office type, proximity to windows and exterior walls, and various types of control over workspace environment, such as window blinds. The subjective variables measured include occupant satisfaction and self-reported productivity with the following IEQ categories: office layout, office furnishings, thermal comfort, air quality, lighting, acoustics, cleaning and maintenance, overall

satisfaction with building and overall satisfaction with workspace.” (Proceedings of Healthy Buildings 2006).

Data collected for the purpose of POE may be analyzed using: statistical analysis of the survey responses to derive correlations, content analysis of interview responses to identify a pattern of ideas or trends and, compare physical observations with available literature and photographs checking for consistency of information recorded using other methods.

Case Studies

The UK based PROBE project (Derbyshire, 2001) conducted by the members of UBT was a project that systematically carried out evaluations for several public buildings with carefully developed and documented criteria of building performance and user-satisfaction. The results were analyzed and published in technical journals. Due to limited resources, the initial studies did not address space utilization, costs-in-use or aesthetics although it noted that parameters for assessment of these issues could be developed and implemented in a future evaluation project (Jane Carthey, 2006).

The IEQ survey developed by the CBE has been used to evaluate the performance of 22 buildings in the United States including office buildings, laboratories, banks and courthouses. Findings from several of these studies are highlighted below (Huizenga et al. 2002):

Case one: Office Space, Nebraska, USA

In summer 2001, the CBE survey was used to evaluate the effectiveness of floor air distribution (UFAD) system under a building, which received a response rate of 75%

Case two: Laboratory, California, USA

In November 2001, the survey was used to evaluate the pros and cons of an organization's existing lab space in order to aid the development of design guidelines for a new lab. The survey response rate was 88%

Case three: Office Space, California, Nebraska, Pennsylvania, Florida, USA

Case three shows how the occupant satisfaction survey can be used as a benchmarking tool. One CBE partner organization has used the survey to elicit feedback on how successful each newly constructed building is meeting its design goals. By viewing the survey results for each building side by side, they can gauge the overall performance of their real estate portfolio and identify anomalies within it. The survey was used to measure occupant satisfaction six months after completed construction and occupants had moved into the space. Response rates ranged from 27%-48%.

Similarly, at the University of Minnesota, the CSBR developed and conducted POEs for the Minnesota Department of Natural Resources (MnDNR) for constant up-gradation of the knowledge base for building projects and to create a feedback loop from actual project experience back to decision makers, owners, designers, researchers and the public connected to the MnDNR.

Possible MSU Research

The Center for Construction Project Performance Assessment and Improvement at MSU could work with Engineering and Architectural Services, Construction Management and Interior Design, Office of Facilities and Space Planning, Office of the Vice President of Finance and Operations and, Campus Planning and Administration to develop a step level POE protocol for implementation on newly completed projects. Existing published POE methods would be reviewed by the oversight team for appropriateness and modified in context with MSU. It is expected that a MSU POE protocol could be “cafeteria” style with selection of specific sub-protocols based on the scope, nature, budget and scale of a building project.

Conclusion

POE provides a structured review of the process of delivering a project as well as a review of the operational, functional and strategic performance of the building during occupation. For educational institutions such as MSU, POE must be undertaken for each project in detail to measure the impact of environments on learning, teaching and research, staff and students and property efficiencies.

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