ASID FOUNDATION RESEARCH GRANT PROGRAM

Pre- & Post-Occupancy Evaluations: A Means for Contributing to Positive Outcomes

RESEARCH TEAM:
Debra Harris, PhD, RAD Consultants / Baylor University
Jane Rohde, Principal, JSR Associates, Inc.
Lauren Erickson, Project Coordinator, JSR Associates, Inc.
Shernise Richardson, NCIDQ, Assoc. AIA, JSR Associates, Inc.

INSTITUTION:
Baylor University
RAD Consultants
JSR Associates, Inc.

AMERICAN SOCIETY OF INTERIOR DESIGNERS FOUNDATION

EXECUTIVE SUMMARY

PURPOSE OF STUDY

The purpose of this research was to address the gaps in consistent methodology utilized by the design profession for the collection, evaluation, and interpretation of data when completing Pre- and Post-Occupancy evaluations. This research established an evidence-based methodology for completion of Pre- and Post-Occupancy Evaluation and a related assessment tool that compares ***desired*** outcomes with ***actual performance*** outcomes.

RESEARCH SUMMARY

One of the current issues within the design industry is the lack of consistent criteria being set up at the beginning of a project's design process for decision-making. This same criteria can also be utilized to evaluate success of measurable operational and design outcomes at the conclusion of construction and occupancy, including the return on investment (ROI) aspects. The research project includes an evaluation of existing evidence-based tools and best practices to develop a consistent approach to completing programming and planning information (i.e., Pre-Occupancy Evaluation) that is updated throughout the design process as a framework for decision-making. Part of the planning process includes the establishment of criteria at the front end of a project by incorporating operational inputs and physical space requirements in conjunction with desired measurable outcomes. When completing the Post-Occupancy Evaluation (POE), the information, criteria, and measurable outcomes are used as a benchmark to verify compliance with the intended outcomes established at the beginning of a project.

One of the most important factors is that a POE is a reflection or answer to the Pre-occupancy Evaluation. Changes during the design process requires reevaluation and adjustments to expected final outcomes. Pre-evaluation and preliminary design documentation are imperative to the POE. The outcome from this work is a proposed process for evaluating design in a consistent manner, allowing for critical evaluation on occupant experience, organizational health, and building outcomes that support health, safety, and wellness grounded in evidence-based design.

- This tool (spreadsheet) is comprehensive and allows for consistency across Workplace projects for aggregated comparisons and for continuous improvement in design strategies and solutions for the design team.

- The tool is to be utilized for two purposes: 1) provide a consistent listing of the questions to request client responses – gleaned through surveys, interviews, and/or focus groups, and 2) provide a selection guide for materials (as influenced by performance and durability, as well as cleaning and disinfection of surfaces related to the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2).
- The tool can be expandable, scalable, and adaptable based upon type of project, project end-users, operational flows required, supportive design interventions, and physical setting elements.

Download the Workplace POE Template and the **Senior Living POE Template**

DESIGN IMPLICATION HIGHLIGHTS

- A process for Pre-Occupancy Evaluation through operational responses to specific questions creates a framework for assessment of the success of a designed solution.
- Through identified design strategies for meeting the goals of the project, the Workplace template provides a strategy for Post Occupancy Evaluation (POE) that:
  1) addresses occupant needs;
  2) satisfies building and operational needs; and
  3) includes return on investment (ROI) and life-cycle cost analysis to use in comprehensive evaluation in understanding the benefits to the occupant and the organization.
- The results of the POE (completed a minimum one year after occupancy) provides an opportunity to complete comparisons and build the evidence base for future decision-making, both operationally and for the design of the physical environment.
- The process is based on the use of a multi-disciplinary team approach that utilizes the documentation of the Pre-Occupancy Evaluation desired outcomes to benchmark the success of a project and its assumptions with the actual outcomes of the Post Occupancy Evaluation (POE).

PRE- & POST-OCCUPANCY EVALUATIONS: A MEANS FOR CONTRIBUTING TO POSITIVE OUTCOMES

BACKGROUND

The first attempts to assess building performance from the occupant point of view occurred through case study evaluation in the 1960s. Since then, systematic approaches have developed through post occupancy evaluation. To improve a systematic evaluation process, pre-occupancy assessment used during the preliminary design process provides a structure for orderly assessment. **Pre- and post-occupancy evaluation (PPOE) are processes of systematic evaluation of performance of design criteria and buildings prior to and after they have been built and occupied**. PPOEs are different from other evaluations of building performance because they focus on the requirements of the occupants, including health, safety, security, functionality and efficiency, psychological comfort, aesthetic quality, and satisfaction.[1, 2] The objective is to understand the design criteria, predict the effectiveness of emerging designs, review completed designs, support operations and facilities management, and connect the occupant response to building performance.[1] This process influences decisions during preliminary design and provides a mechanism for continuous improvement post occupancy for that design to inform future design.

The programming and planning of a project is based upon the need for a consistent, adaptable assessment that demonstrates a sequential process for requesting operational and physical setting information. This information provides a framework for comparing after occupancy to verify established goals and needs are met. The identification of items that differ from initial expectation can subsequently be evaluated to verify what can be adapted operationally or within the physical environment to address issues, differences, and changes of operational practice that may occur after occupancy. The Post Occupancy Evaluation is intended to occur, at a minimum, one year after occupancy for adequate data collection to occur without the halo effect, which is the tendency for positive impressions to influence one's opinion.

The **benefits of PPOE** are 1) the transference of operations knowledge accrued to inform future building designs;[3] 2) iterative improvement of an existing facility's performance;[4] and 3) the ability to benchmark building performance between facilities.[5, 6] Benchmarking requires a systematic approach whereby facilities are evaluated using the same criteria, building evidence for evaluating differences across design strategies. Initiating a pre-occupancy assessment during the preliminary design process provides a framework for systematically developing the post-occupancy evaluation to measure building performance, operational processes, and occupant outcomes.

Methods for assessment include evaluation of the program and plan, site verification, and operational processes. **Indoor environmental quality (IEQ) factors** such as material selection and composition, indoor air quality, lighting and views, acoustics, thermal comfort, and occupant control should be evaluated during pre- and post-occupancy. **Environmental, behavioral, and operational conflicts** should be identified and addressed within the design process. Data collection can include **observational studies or behavior mapping, interviews, and surveys**. **Building and environmental data** can be collected from sources like power and water companies. Analysis may be qualitative or quantitative and may vary depending on the data collected. **The results should connect building, operational, and occupant outcomes to each dimension**, which varies by project based upon priorities established with stakeholders.

PPOEs are good opportunities for evaluation of the return on investment (ROI). ROI is a performance measure used to evaluate the efficiency of an investment or comparative assessment of several different investments.[1] In design, the ROI is compounded by the complexity of the built environment and occupant needs. ROI outcomes are expressed in monetary value. A **ROI evaluation** is a process that requires information that supports a clear understanding of the goals of the project, a review of existing documentation, identification of factors of measurement, behavioral and physical outcomes, and information provided by the occupants through surveys or behavior mapping. The following list describes the information required to assess a design project for ROI:

- **occupant survey data** may focus on satisfaction with the environment, preferences of the individual, and engagement with their job
- **human resource data** may include employee turnover, injuries, and illnesses to compare design interventions for improved outcomes
- **programs** may be assessed as well – for example, if an employer initiates a program targeted on health and wellness, the programs can be evaluated for effectiveness
- the **building assessment** would include indoor environmental quality for improving health and wellness
- decisions such as selecting tunable lighting, providing access to views and daylight, designing monumental stairs, and other design decisions may all impact the quality of the environment, leading to improved health outcomes[2]

Employee engagement is connected to satisfaction with the environment and the employees' jobs. The cost of replacing an employee due to attrition or a temporary loss due to injury or illness can be substantial. Improving **physical fitness and nutrition** by designing to encourage occupants to engage in activities and choices to meet those goals can improve health outcomes, such as blood pressure, blood sugar levels, and fatigue. **Indoor environmental quality features**, such as access to natural light or tunable lighting, can improve circadian rhythm entrainment. All these factors can collectively improve health and wellness of the occupants or staff of an office, which could improve cost of insurance premiums and other factors that may increase overall health of the organization.

When focusing on building specific outcomes, it may be beneficial to conduct an **analysis of life-cycle cost (LCC)**. LCC analysis is a method that evaluates the total cost of ownership of an asset throughout its expected life.[3,4] This evaluation of life-cycle cost of a building or a building system can be used to compare functionally equivalent alternatives.[5] For ROI, the LCC analysis can be critical information to understanding the building cost and the ROI outcome, but it can also help to estimate the ROI for a given set of assumptions in reducing or improving outcomes.

The process for conducting a LCC analysis is defined by the National Institute of Standards and Technology (NIST) and includes parameters for defining the problem, identifying feasible alternatives, establishing common assumptions, and acquiring financial information.[6] To conduct an LCC analysis, the following list of information must be available:

1) Assumptions
   a. study period (how many years for the ROI projected valued)
   b. discount rate
2) The formula for LCCA: LCC = I + Repl – Res + E + W + OM&R + O, where:
   a. LCC - the total life cycle cost present value (PV) dollars
   b. I - the PV investment costs (cost of system, installed or first costs)
   c. Repl - the PV capital replacement costs
   d. Res - the PV residual value (resale or salvage value less disposal costs)
   e. E - PV energy costs
   f. W - PV water costs (water consumed and sewer)
   g. OM&R - PV maintenance and repair costs
   h. O - PV of other costs
3) Identify the systems included in the LCC analysis (i.e., building envelope, interior finishes, lighting, mechanical systems, flooring systems, etc.)
4) Justification for all data used in the LCC analysis, including source of data

The results of the LCC analysis provide projected costs of the selected building systems, from initial costs through the end of the study period, and the presumed life-cycle (for individual products – this would be the desired service life, or anticipated replacement service life vs. the reference service life). This information can be used for final projections of investment but can also be used to test various design solutions or products to determine the best cost outcome that meets the other project criteria that leads to designing for health and wellness.

METHODOLOGY

The research method used was based on best practices, peer-reviewed research, and other credible sources. Practical application was foremost the priority. Developing a POE tool begins to provide a standardized process for assessing success in meeting the goals of a design project. The process for return on investment and life-cycle cost analysis are described to provide a vehicle for collecting the necessary data for a full assessment of a design project. This goes beyond that of a traditional Pre- and Post-Occupancy evaluation which focuses on occupant outcomes because all factors included are important to consider to be sustainable.

NEXT STEPS

The research project is being utilized to expand the Phase II work for *SBIR Healthy Behaviors through Active Design: An Evidence-based Web Application to Inform Design & Public Policy.* The goal is to take the template developed in Excel and platform the tool as a **Web-based and BIM-based tool that supports design professionals in the programming and planning phase, as well as the post occupancy evaluation phase to verify outcomes**. The Workplace Template shall be used as another dataset for incorporation into the Web and BIM Applications.

RESEARCH BIO

DR. DEBRA HARRIS, the principal investigator of this study, is an evidence-based design researcher, product developer, and designer. She is an associate professor in the Family and Consumer Sciences Department in the College of Health and Human Sciences at Baylor University and a Fellow of the Center for Health Systems & Design at Texas A&M University. Current and recent research involves chemical exposure risks of materials and surface material influence on the spread of healthcare associated infection. Her body of work is focused on factors affecting user experience and outcomes, especially related to health, productivity, safety, and cost implications of the physical environment.

JANE ROHDE, AIA, ASID, FIIDA, ACHA, CHID, LEED AP BD+C, GGA-EB is the founder and principal of JSR Associates, Inc. She is a certified interior designer and registered architect. Her firm focuses on research, advocacy, codes and standards, and design, specifically in the healthcare, senior living, and sustainability sectors. Recent research includes being Pproject manager for Phase I and Phase II of SBIR Healthy Behaviors through Active Design: An Evidence-based Web Application to Inform Design & Public Policy completed in conjunction with Baylor University. She has recently completed an updated color study based on the CHER study completed in 2004 with Dr. Harris.

SHERNISE RICHARDSON, NCIDQ, ASSOC. AIA is a certified interior designer and has worked at JSR Associates, Inc. for six years as a project designer for various types of healthcare and senior living projects. Recent research includes being the BIM Leader for Phase I and Phase II of SBIR Healthy Behaviors through Active Design: An Evidence-based Web Application to Inform Design & Public Policy completed in conjunction with Baylor University.

LAUREN ERICKSON is the coordinator of the project and has worked at JSR Associates, Inc. for fifteen years as an interior design consultant, project coordinator, and office manager. Lauren is also participating in the SBIR Healthy Behaviors through Active Design: An Evidence-based Web Application to Inform Design & Public Policy research project.

REFERENCES

1. Preiser, W.F.E., *Continuous quality improvement through post-occupancy evaluation feedback*. Journal of Corporate Real Estate, 2003. 5(1): p. 42-56.
2. Shepley, M.M., *Research Methods for Design Practitioners to Evaluate Facilities*. HERD, 2011. 4(3): p. 7-13.
3. Cooper, I., *Post-occupancy evaluation - where are you?* Building research and information : the international journal of research, development and demonstration, 2001. 29(2): p. 158-163.
4. Göçer, Ö., Y. Hua, and K. Göçer, *Completing the missing link in building design process: Enhancing post-occupancy evaluation method for effective feedback for building performance.* Building and environment, 2015. 89: p. 14-27.
5. Preiser, W. and J.L. Nasar, *Assessing building performance: its evolution from post-occupancy evaluation.* ArchNet-IJAR, 2008. 2(1): p. 84-99.
6. Roberts, C.J., et al., *Post-occupancy evaluation: a review of literature.* Engineering, construction, and architectural management, 2019. 26(9): p. 2084-2106.
7. Harris, D., *Return on investment of a LEED platinum hospital: the influence of healthcare facility environments on healthcare employees and organizational effectiveness.* Journal of Hospital Administration, 2014. 3(6): p. p37.
8. Funderburk, L., et al., *Healthy Behaviors through Behavioral Design–Obesity Prevention.* International journal of environmental research and public health, 2020. 17(14): p. 5049.
9. Kirkham, R.J. and A.H. Boussabaine, *Forecasting the residual service life of NHS hospital buildings: a stochastic approach.* Construction Management & Economics, 2005. 23(5): p. 521-529.
10. Kirk, S.J. and A. Dell'Isola, *Life Cycle Costing for Facilities.* 2003, Norwell, MA: RSMeans.
11. Fuller, S. and S. Peterson, *Life-Cycle Costing Manual,* B.a.F.R. Laboratory, Editor. 1995, U.S. Department of Energy: Gaithersburg, MD.
12. Fuller, S. *Life-Cycle Cost Analysis (LCCA).* 2012 [cited 2012 February 6]; Available from: **http://www.wbdg.org/resources/lcca.php**.