A Case Study in Support of Multiple Post Mortem Assessments

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ABSTRACT

Creative projects in various fields are often subjected to after-the- fact 'post-mortem' assessments to better understand their successes and failures. Names for these include project retrospectives or post occupancy evaluations (POEs) depending on their field of origin. This case study from the architecture field will show the utility of engaging in multiple rounds of post-mortem activities in order to assess the solution from multiple stakeholder perspectives and in doing so, more fully recognize its strengths and weaknesses.

The design of a homeless shelter bedroom was subjected to two POE analyses: a 'demand side' focused study that analyzed user accommodation, and a 'supply side' study that addressed issues including budget and funding. The two POEs yielded both corroborative and contrasting findings that sometimes worked at cross purposes. Three evaluation tactics emerged that could be extended to other fields' post mortem assessment activities: 1) conduct two or more POEs; 2) vary the POE criteria so that one is deep and focused 'demand side' user analysis and the other is 'supply side' operational and installation issues; and 3) conduct the POEs over a broad time period.

1. INTRODUCTION

Many fields hold in common the need to engage in creative projects intended to solve problems or in some other way accommodate their intended users. Software development, business initiatives and scholarly research studies are only some of these endeavors. Post-mortem techniques are similarly common that review these completed projects to better understand their successes and failures. Reflecting the unique nature of these varying fields, these a posteriori assessments are called post mortem reviews in business [1], project retrospectives in software development [2] and post occupancy evaluations in architecture and interior design [3].

This case study examines the utility of a post occupancy evaluation review for an architectural project. Specifically, the case study demonstrates that the multidimensional nature of project solution 'fit' to the problem suggests there are benefits of applying more than one post-mortem evaluation to a given project. This tactic could be applied to these other types of projects in other fields as well, and that assessing success from different perspectives may well yield insights that a single post mortem assessment may miss.

It is generally accepted that a design solution for an architectural building project is most successful when a comprehensive set of criteria for both the user and the project's context are considered [4]. It follows that post-occupancy analyses (POE) evaluating project success should similarly address diverse aspects including emotional and physical user needs, and also building operational and budget issues [5] [6] [3].

The utility of post-occupancy evaluations is well established in research literature [7]. POEs encourage accountability and facilitate the discovery of challenges that can plague later construction projects. Evaluation has also become necessary due to the increasing specialization of trades, which makes holistic assessment more elusive. Indeed, the increasing numbers of people that contribute to a design, its construction and maintenance means that no one person controls the entire project from its birth through its lifetime [6]. In this context, it is easy to lose sight of original goals. If buildings are to serve those that inhabit them, then an on-going attendance to the project's fitness to its users and context is necessary by those that designed and/or constructed it [3].

This essay will suggest that a built environment project may require more than one post-occupancy evaluation to fully evaluate its success. This may be so because the range of needs that a project must accommodate is typically complex, requiring examination of multiple issues from a variety of points in time.

For the authors of this essay, the need for more than one post-occupancy assessment became clear through their efforts to determine the success of a project they designed and installed at a homeless shelter. The goal was to identify aspects of the design that needed adjustment so design changes could be implemented and the project replicated in an improved form.

The authors subscribe to the increasingly held notion that a holistic approach to assessment is optimal to better acknowledge the diversity of forces that act on a building project (such as budget and schedule) but also the plethora of user needs the design must facilitate (including physical needs, psychological considerations, and social issues). Viewing building assessment in this fashion mirrors the realization by many researchers and designers that the world operates in a more complex, integrated fashion than previously acknowledged. This paradigm shift is identified as systemism [8] or a systematic approach [7]. In the words of one research team, research methodology needs to adopt what others have already discovered: "Arguably, in the business world a fundamental paradigm shift has already taken place: from a mechanical model of linear thinking of 100 years ago to a natural model of open and living systems. In a natural 'systems view' the world is looked at in terms of integration. In short,

everything is connected" [5, p.14]. In contrast to current thinking, this natural systems view prioritizes consumers, not producers. It also identifies adaptation, not consistency, as the goal, and that unity of purpose, not economies of scale, is a worthy objective. The natural systems view further acknowledges that continuous improvement, not consistency of operation, is the proper approach [5]. Others suggest that such a systematic approach to building post-occupancy assessment may be a logical path to examining the overall habitability of a built environment [9]. Such feedback could also conceivably permit a project to continually improve over the course of its life, or its replication.

In the context of post-occupancy evaluation, a systematic approach might consider the simple but important question of "If a design serves its users but cannot be built, what good is it?" or conversely, "If a design is easily built but fails its users, why pursue it?" This dichotomy brings to mind the need to address both 'sides' of those requirements necessary for a building project: the 'demand' side of occupants' requirements, and the 'supply' side of a building or project's budget, schedule, and installation requirements [5, p. 29]. In the literature review below, other authors' reflections on how to classify the diversity and complexity of user needs in a POE are further considered.

In the opinion of the authors, the need to consider both 'sides' particularly comes into play in the case of interior environments for socio-economically compromised users, whose need for physically, psychologically and emotionally appropriate surroundings may be keen. One such environment is homeless shelters, as residents often must seek to live there as a last resort, or to escape living on the streets, and may enter the shelter in a state of emotional and/or physical crisis. It is reasonable to conclude that built environments thoughtfully designed to promote well-being may be particularly helpful for those who experience this trauma. Compounding the problems of shelter construction are limited budgets through uneven or insufficient funding, which can constrict or entirely eliminate helpful interior features.

2. REVIEW OF LITERATURE

The evaluation of building projects after installation is not a new process, but is one that only recently has received extended attention leading to new approaches and tools [3] [6]. Zimring and Reizenstein offer a full historical retrospective of the development of post-occupancy evaluation strategies [7], summarized in part below.

One of the earliest systems for POE was Vitruvius' 'test of fitness' expressed in his book De architectural [10]. The 1960's onward saw a time of increasing development of POE tactics and theory. Among the many processes that emerged were the ASTM International organization's Standards on Whole Building Functionality and Serviceability [11] and the Building Performance Report by the New Buildings Institute [12].

The recent work of Wolfgang Preiser with various co-authors is one current evolution of these many earlier ideas. With their development of the 'Building Performance Evaluation' method (BPE), these authors seek to "holistically link diverse phenomena that influence relationships between people, processes and their surroundings, including the physical, social and cultural environments." [3, p.5]. The BPE system further aspires to recognize that external organizational, political, economic, and social systems can impact building projects and should be considered in evaluation measures [3].

The Building Performance Evaluation system in fact sees post-occupancy evaluation as one of its processes in an overarching procedure that starts before construction commences. Hence, BPE is both multidisciplinary in its approach and also comprehensive in its application to a building project. Notably, the BPE system defines user needs in a series of 'performance levels' [3]:

- health, safety and security performance concern
- functional, efficiency and work flow performance
- psychological, social, cultural and aesthetic performance

With regard to this hierarchy of priorities for users, Preiser and Vischer observe that the list moves from 'lower to higher levels of abstraction" [3, p. 6]. While this essay's authors would agree that all these performance levels deserve consideration, this raises the issue of seeing user psychological, cultural, social and aesthetic not only as more individual and difficult to assess, but also as less important (which Preiser and Vischer do not promote, and instead describing these factors as "less codified, but nevertheless equally important to designers" [3, p. 6]). In the end, these factors proved to be among the most important in the POE studies reported in this essay.

Also central to this discussion, Preiser and Vischer's system acknowledges that these performance levels interact and may come into conflict. Indeed, they state that it is in these sometimes unforeseen interactions where challenges may arise: "Many of the building problems identified after occupancy have been found to be systemic: information the engineer did not have about building use; changes that were made after occupancy that the architect did not design for; or facilities staff's failure to understand how to operate building systems" [3, p. 8]. Other researchers have undertaken comprehensive-style assessment studies and have similarly witnessed how various issues of the project's performance can interact. For example, Wener and Olsen [13] evaluated pre-trial detention centers through staff and inmate questionnaires, observation, and other measures. Their conclusions reported interactions between social structures and the physical facilities. In a 1980 study of low income housing, Kantrowitz and Nordaus discovered connections between territoriality and site security [14].

Due to the complex and diverse types of user criteria for built environments, multiple researchers examining and strategizing POE methods have at times sought to categorize these criteria into groups that make them easier to consider. Table 1 compares these approaches across three author groups.

Preiser and Schramm identify that Building Performance Evaluation must address both the 'demand side' of things, which identifies the occupants' requirements of the space, as well as the 'supply side' of the project's requirements, which include realities of budget, schedule, building codes, energy concerns, and other matters that lie beyond the immediate users' concern [6; p. 29]. Similarly, Watkins, Peavey and Clarke describe a 'focused POE' that "look(s) beneath the surface to understand the impact of the built environment on users" [15, p. 28]. In their way of thinking, the focused POE offers a rigorous assessment, possibly using statistical methods, to discover the

Table 1. A comparison of approaches to using multiple post occupancy evaluations [6] [15] [7].

POE Type	Preiser & Schramm (2012)	Watkins, Peavey and Clarke (2012)	Zimring & Reizenstein (1980)
User POE	Demand side/occupants' requirements	Research level: looks beneath the surface to understand impact on users	
Operational POE	Supply side/building's capabilities	Surface level: the space's satisfaction of its specification and performance metrics	Systematic approach study that captures interrelated elements but is not focused on a particular issue

true effect on users in such matters as safety, health and well-being. Watkins, Peavey and Clarke also describe the need for a 'surface level POE', which implies "looking at a space and assessing whether it meets the specification and performance metrics for which it was designed following a facility's occupation"[15, p. 28]. This surface level POE would likely be less rigorous, statistically speaking, but no less important. Zimring and Reizenstein offer further potential support of this notion in their description of a 'systematic approach' POE study that addresses the relationships of diverse issues, but is not focused on a single attribute [7].

Multiple authors, then, have described that it is potentially desirable to examine the success of a building through various lenses of issue and also orientation—toward the user, or alternately, toward the mechanics of the building process and other extended aspects of the project's context. With this brief overview of various POE systems established, this essay will now turn to the authors' application of multiple POE's that take 'demand side' and 'supply side' forms in their quest to determine the success of a prototype design.

3. METHODS

In 2010, the authors completed the renovation of a very small project-- a prototype homeless shelter bedroom for four family member residents. With plans to seek funding that would permit more bedrooms to be improved, two separate post occupancy assessments were conducted to determine the design's appropriateness to its objectives. The authors sought assurance that the POE's offered a holistic assessment of the design; especially they suspected that issues would be inter-related. That is, they anticipated that physical, psychological, and socially-oriented 'demand side' user needs would be in agreement or possibly at cross purposes with, budget, construction and similar 'supply side' issues. The authors surmised this tension due to a number of observations:

1. Features that may support residents' well-being may be difficult for shelters to supply due to restricted budgets. Less expensive alternatives offer reduced support for residents. For example, a single ceiling lighting fixture provides bedroom ambient light, but may not help a resident trying to read in the lower bunk at night while others sleep.
2. Shelters are high-use spaces that have great demands on their durability. Easy-to-clean surfaces are attractive to shelter operators. For example, high-gloss floors are simple to maintain and buff, but have an irritating, sterile effect on the interior atmosphere of the space for someone living there.
3. To minimize taking a room out of rotation, it is desirable that construction down time is minimized. However, this desire can serve to over simplify the design to its most basic bed-and-dresser configuration, depriving residents of helpful features.

The small nature of the project permitted the authors to investigate the 'fit' of the design deeply and over time that might not have been possible with a larger, more complex project scope. The purpose and methodology of both POE studies are described in Figure 1.

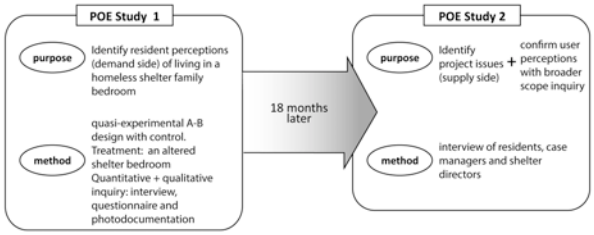

Figure 1. The purpose and methodologies of POE studies 1 and 2.

The authors designed a solution for a bedroom in a homeless shelter, and then, with the assistance of University grant funds, had the project constructed and installed. The authors then subjected the design solution to two POE analyses separated in time by 18 months. While the POE studies focused on two very different project aspects—user needs (demand side) and operational issues (supply side)—both POEs shared the use of observations and interviews. The first POE exclusively examined the demand side by concentrating on resident perceptions of the space, and the second, later POE examined operational 'supply side' issues questions, and also re-addressed demand side by asking others their perceptions of the space.

The First POE

The purpose of the first POE study was to explore potential connections between the physical design of homeless shelter bedrooms and residents' sense of personal control, sense of helplessness and crowding. The first author of this essay undertook the redesign of a single four-person family bedroom within a transitional homeless shelter in the southern United States in 2010 and the second author served as the designer of record for the project's installation. The original purpose of this grant-funded design was to install a 'treatment'—an altered bedroom environment- that would be subjected to analysis for its attendance to the needs of the resident family. At that time, only this single, user-oriented 'demand side' POE assessment was envisioned in order to provide data for a research study with an outcome of qualitative and quantitative findings. Figure 2 describes the first POE study's method.

The participants for the first POE were two parents of unrelated families living in the shelter at the same time. Using a case study pattern-matching methodology, the first parent occupied an unaltered room at the shelter for 4 weeks, then moved into the

altered room for the study's remaining 8 weeks. The second family who did not inhabit the treatment room provided information about the use of the unimproved room, as did observation of the first family during the first four weeks of the study before they moved into the altered room.

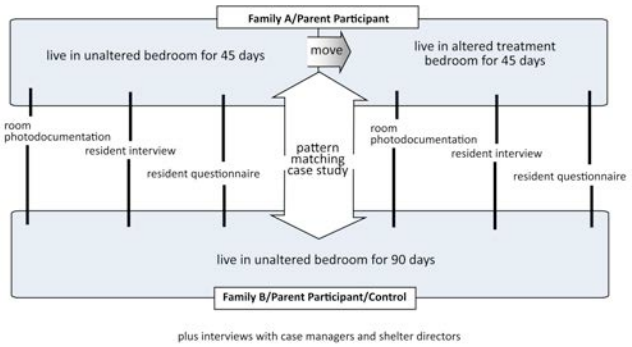

Figure 2. Detailed methodology of POE study 1.

Efforts were taken to select participants with similar demographic characteristics. The two participants were both single mothers with two children living with them in the shelter. Neither family shared their room with other, unrelated family members, and both shared a bathroom with another family. Both intended to stay for the maximum six months per the shelter's policy, and both had resided at the shelter for approximately three months before the study commenced and anticipated they would be there another three months. Observation, resident interview and case manager interviews identify that both parents had generally positive relationships with their children.

The treatment bedroom was altered and a series of 18 features were installed that were anticipated to engage with the family's sense of personal control and crowding (see Table 2). Figures 3 and 4 show the study's altered bedroom and unaltered bedroom that was 20 feet down the hall at the shelter along a double-loaded corridor.

Because it was anticipated prior to design and construction that a POE would be the focus of the study, this first study generated objective performance criteria using strategies suggested by POE experts [6]:

1. Access published literature to inform the research: The author accessed psychological findings on crowding, sense of internal control, and sense of helplessness to determine positive benchmarks for study outcomes.

2. Consult analogs and precedents: The author examined other previous solutions in homeless shelters, but found little that took an academic approach that centered on application of its psychological issues. Some literature from college dormitory studies was relevant. The second author of this essay acted as the interior designer of record for the project, and brought her experience of past works to bear on the design.

Table 2. Environmental features added or changed within the altered bedroom.

	Alteration
1	Bedroom entrance door: change out to lockable lockset with master (staff) and child (resident) keys
2	Increase storage in the room, including hanging clothes storage, dresser units, wall shelves, bedside table and wall hooks
3	Create double-lock system for medications storage in room
4	Lighting/fan/headboard system
5	(4) laptop desks
6	(4) alarm clock/radios with headphones
7	Magnetized wall paint on both bed side walls. Marker boards on these walls by each bed.
8	Cubicle-style curtains for (4) beds with tiebacks
9	Dutch-style main door with horizontal shelf surface
10	Television with DVD player, rabbit ears. 19" screen.
11	Floor area rug(s)
12	(4) wall-attached bed bolster cushions
13	Blackout roller shade window treatment
14	Full length mirror
15	Family-customizable door signage
16	Seating cubes (2)
17	(4) bed elasticized covers (place over blankets and sheets for day use)
18	Marker board surface on door

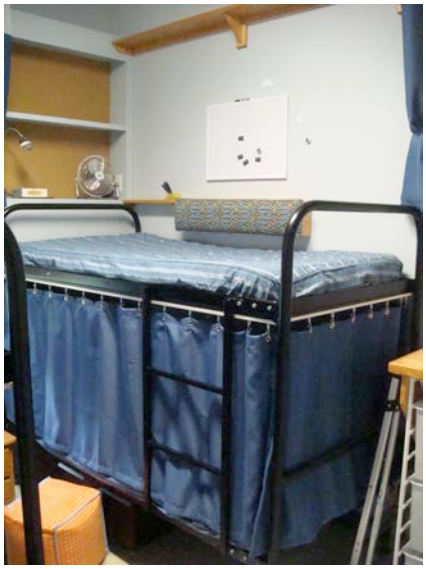

Figure 3. The altered bedroom shows increased storage and personal control features such as privacy curtains and lighting for reading in bed, ventilation fans and bulletin boards for personal displays of objects.

Assesses actual operations to determine building performance evaluators: The author conducted site visits, gathered photographs of the existing conditions, and interviewed on-site case managers and the shelter director. Findings influenced the design with regard to its visual presence along the hallway and security considerations.

3. Consults resident experts: A focus group of residents was assembled and queried prior to design of the space to determine their priorities and preferences

Figure 4. An unaltered bedroom in the same family dormitory of the transitional homeless shelter.

The first study's primary research question was "how is a family bedroom environment that provides personal controls in a transitional homeless shelter perceived and used by a resident family?" A portion of the study's sub-questions addressed the nature and effects of the family's use of the controls with regard to their perceptions of crowding, sense of internal control (or sense they can control their own destiny), and sense of helplessness. These factors were deemed important to a homeless resident's state of mind because they are linked to heightened state of stress and powerlessness that can negatively affect these persons' ability to secure a job and stable housing. The subquestions were as follows.

1. Does the presence of local interior environment lessen the perceived sense of crowding in adult family members?
2. What are the effects of perceived crowding on the family?
3. Are the local environmental features in the altered bedroom associated with a different sense of internal control for family members in the altered room than for family members in an unaltered room?
4. Are the local environmental features associated with a different sense of helplessness for family members in the altered room than for family members in an unaltered room?

After the project was completed and the family began occupying the new bedroom, the user-focused 'demand side' POE was conducted with the goal of gathering in-depth detailed information concerning the users' perceptions of the space with regard to the research questions listed above. The study's pattern-matching case study format and low participant numbers were a logical choice due to several reasons:

1. Only one bedroom could be altered due to the shelter's high occupancy rate and the study's funding constraints.

2. The study's research questions examined the lived perceptions of residents, which naturally vary. Case study research methods support such narrow and deep-style inquiry in their belief that it is possible "to gain better understanding of the whole by focusing on a key part" [16, p. 1]. This notion also supports the idea of examining a problem at the outset with limited numbers of participants, which in this case are two case study family units, in order to build theory for later wider-scope testing [17].

The primary author conducted an analysis of the resident's perceptions of the modified shelter bedroom through interviews with the mother of the resident family throughout the three month observational period. This time was occupied with interview and response to open-ended questions, completion of quantitative instruments, or both. Photography taken by both the author and the parent to document the family's use of the room. As a measure of control and to permit the pattern-matching study strategy, another mother of a family in the shelter's resident building who did not occupy the modified bedroom was also interviewed and their unmodified room was similarly photo-documented. The author conducted a total of 15 hours of interview of the case study's two parent participants, undertook 12 visits to the two rooms, and photographed the two bedrooms eight times over the course of the three-month data gathering period. The author also administered the following quantitative instruments to both parents at intervals throughout the observation period:

- Locus of control: Duttweiler's Internal Control Index [18];
- Sense of crowdedness: Gove & Hughes' measure [19]; and,
- Sense of helplessness: Burn's measure [20].

Additionally, ancillary interviews with the shelter's case study managers helped triangulate data from the resident observations and interviews.

The user-oriented demand-side POE yielded actionable results (detailed further in the Results section below) and suggested to the authors that it would be helpful to replicate the design within other bedrooms so that more shelter residents could be assisted. At this point the authors also started to believe there might be potential to offer the bedroom solution to other shelters as well, given the positive user assessment findings the study uncovered.

The Second POE

Based on the positive findings from the first POE, the decision was made by the authors to continue to explore the bedroom's design assessment and pursue the possibility of its replication. One important difference at this point in time was the realization that construction funding for altered bedrooms would be paid for by shelters or other sources, not research grant funds. With this change, the project crossed from the realm of the 'theoretical' to the 'real', even though from the start the project's 'treatment' had been an actual, physical room. Suddenly, a host of other issues arose that demanded attention if replication was the new goal. This prompted the authors to develop a series of questions that addressed 'supply side' issues such as feasibility of construction and budget that served as the primary purpose of

the second POE. As this was the case, it became a good idea to broaden the participant base to include not only shelter directors and case managers, but also individuals of these types from various shelters located across the region. This would help ensure that the resulting design would stand an improved chance of supporting a variety of residents and shelters. The second POE study's 'supply side' questions included:

- What design should be replicated (or, what corrections should be made to the first design)?
- What other factors external to user perceptions would affect the design's replication?
- Was this design feasible to build economically?

Conducting a second POE that included broad operational and contextual questions for the project is in keeping with others' recommendations, as discussed in the literature review above. Table 3 reviews these author's language and conclusions, and also places this study's two POEs (in the far right column) in their context.

Table 3. A comparison of author's titles and approaches to using multiple post occupancy evaluations. The column on the right introduces the authors' application of two POEs to their study [6] [15] [7].

POE Type	Preiser & Schramm (2012)	Watkins, Peavey and Clarke (2012)	Zimring & Reizenstein (1980)	Authors' applied POE types for shelter study
User POE	Demand side/occupants' requirements	Research level: looks beneath the surface to understand impact on users		The room residents' perceptions of personal control, crowding, self-esteem, sense of helplessness, overall satisfaction and function.
Operational POE	Supply side/building's capabilities	Surface level: the space's satisfaction of its specification and performance metrics	Systematic approach study that captures interrelated elements but is not focused on a particular issue	Other shelter residents', case managers' and shelter directors' perceptions of budget, installation schedule, feasibility, and potential for project funding

The second 'supply side' POE study was conducted by the authors 18 months after the treatment bedroom's initial installation. The methodology's data gathering took several forms described in Figure 5.

The first POE study's original altered bedroom was photographed in its current state to compare with the photographs taken directly after its first installation. The original images of the altered bedroom taken directly after its installation were shared with 22 individuals at four different shelter locations within Florida who were resident case managers, shelter directors, or shelter residents. Twenty hours of interview data were gathered. Twenty-one open-ended interview questions prompted these participants to observe the altered and unaltered bedrooms through the photographs and respond to a series of open-ended questions that addressed 'supply side' matters including constructability and budget feasibility.

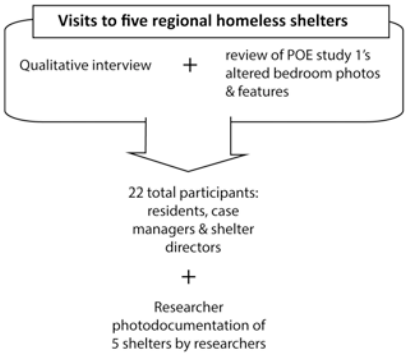

Figure 5: Detailed methodology of POE study 2.

In addition to 'supply side' information, the second POE also gave the authors the chance to further confirm the findings from the first POE. This was deemed necessary because of the very small sample size in the first POE. Therefore, in the second POE, the authors elected to ask more residents about their 'demand side' perceptions of the altered bedroom, even though these residents were not themselves living there. All resident interview participants ranked the bedroom's 18 installed features by their degree of usefulness using a four-point Likert scale structure ranging from 'helped a great deal' to 'helped not at all' for residents. Case managers and shelter directors also ranked the features on a similar Likert scale with a four-point scale of 'critically important' to 'not important at all'.

4. RESULTS

The first POE

Generally, the first study's findings reported that the parent occupying the altered bedroom exhibited preferences for its features over the unimproved bedroom that they had occupied. Results of the analysis on crowding, internal control and helplessness are discussed below.

Crowding: A 13-question quantitative measure of crowding derived from Gove and Hughes' instrument [19] was completed by both parents three times with administrations at the beginning, middle and end of the three month observation period. This instrument asked the parent to complete a sentence, choosing from a range of 7-step range of likert-style adverbs that described how they felt about a particular idea from 'never', 'rarely', and 'occasionally' up to 'sometimes', 'frequently', 'usually', and finally, 'always'. For example, residents were asked to complete the sentence "I am _____ able to do what I want to do in the bedroom." See Table 4 for the results of this analysis for both parents in the study.

When both parents initially occupied unaltered rooms they confirmed that they perceived uncomfortable closeness in their environment. After relocating, the parent who had moved to the altered room indicated reduced crowding on more of the instrument's measures than the parent in the unaltered room.

Some of the responses from the parent in the altered room indicated a significant reduction in her sense of crowding, with a

large change in her a multi-step improvement in choice of Likert-scale answers:

- The parent indicated she was '*usually* able to do what I want to do' with a notable 5-step improvement from the first administration reporting '*never* able to do what I wanted to do in the unaltered bedroom (an indicator of 'felt demands', one quality of feeling crowded as identified by Gove & Hughes [19].

Table 4. Change in perceptions of crowding from pre-test to post-test administrations of the Gove & Hughes crowding instrument [19]. The instrument had a 7-item Likert scale for each of its 13 questions.

Change from pre-test to post-test administrations	Parent living in the altered bedroom	Parent living in the unaltered bedroom (control)
Percentage of questions indicating reduced perception of crowding from pre-test to post-test	38%	15%
Percentage of questions indicating increased perception of crowding from pre-test to post-test	31%	62%
Percentage of questions indicating unchanged perception of crowding from pre-test to post-test	31%	31%
Total number of Likert-scale steps within all question responses that indicated positive change (reduced crowding) from pre-test to post-test	13	2
Total number of Likert-scale steps within all question responses that indicated negative change (increased crowding) from pre-test to post-test	7	17

- She reported a three-step improvement and was *never* tired in the altered bedroom at the end of the observation period (with '*sometimes*' reported in first administration in the unaltered bedroom).
- She reported a two step improvement that there is *never* so much going on around her that she couldn't think straight (with the first administration reporting '*occasionally*')

Additionally, when asked to identify the degree of crowding in the bedroom after living in it for one week, this parent reported a '10' on a scale of 1 to 10 (with 1 being very crowded and 10 being not crowded at all), explaining it's "very spacious, and organized with things put in their place".

In contrast, the parent in the untreated room reported indicated *increased* sense of crowding over the three month period of the study on 8 of the 13 measures in the instrument. This parent expressed frustration over the way the room made her feel, and assessed her sense of crowding as a 2 on a scale of 1 to 10 at the end of the observation period. Follow up interviews on the topic with both parents revealed a close connection between ability to organize and store one's possessions (which the treatment bedroom offered and the untreated one did not) and sense of crowding.

Sense of Internal Control: While caution should be taken when generalizing quantitative data gathered from small sample sizes, the resident occupying the treatment bedroom indicated a +10% percent of change toward improved sense of control when pre-test and post-test administrations were compared on Duttweiler's Internal Control Index [18]. In contrast, the parent occupying the unaltered bedroom experienced a 2% increase over the same time period. It should be noted, however that this parent indicated a higher degree of sense of control at the start of the study. This finding suggests an intriguing possibility of the role the built environment may play in boosting residents' sense of internal control, which in turn has been linked to enhanced capacity to secure a permanent place to live and stable employment [20].

Helplessness: A seven-question test of helplessness was adapted from Burn's [20] instrument and administered to the two parents as a pre-test and post-test at the beginning and end of the three month observation period. This instrument asked the parent to choose from a range of 7-step range of likert-style adverbs to complete a sentence that described how they felt about a particular idea from 'never', 'rarely', and 'occasionally' up to 'sometimes', 'frequently', 'usually', and finally, 'always'. They reacted to sentences such as "I _____ feel a sense of ownership for my family's bedroom".

Results were not clearly supportive of the notion that changes in sense of helplessness over the course of the observation period are associated with occupation of the altered bedroom. See Table 5. While caution should be taken in generalizing from an qualitative instrument in a small case study such as this showing small change effect, it is at least possible that the results indicated here may imply that detectable change in helplessness may take more time than three months to develop, or may need more than just physical environment change to activate. Further studies with larger sample sizes could explore whether a demonstrable difference is detectable on measures of helplessness with the altered room.

Table 5. Change in perceptions of helplessness from pre-test to post-test administrations of the Burn helplessness test [20]. The instrument had a 7-item Likert scale for each of its 7 questions.

Change from pre-test to post-test administrations	Parent living in the altered bedroom	Parent living in the unaltered bedroom (control)
Percentage of questions indicating reduced perception of helplessness from pre-test to post-test	57%	71%
Percentage of questions indicating increased perception of helplessness from pre-test to post-test	0%	14%
Percentage of questions indicating unchanged perception of helplessness from pre-test to post-test	43%	14%
Total number of Likert-scale steps within all question responses that indicated positive change (reduced helplessness) from pre-test to post-test	4	7
Total number of Likert-scale steps within all question responses that indicated negative change (increased helplessness) from pre-test to post-test	0	1

In general, the results of the first POE gave the authors a sense that the improvements were of sufficient worth to residents to pursue replication, both in other bedrooms in this facility and potentially in other shelters with similar populations and circumstances.

The second POE

The second POE study was undertaken 18 months later and primarily addressed the project's operational 'supply side' considerations- the larger context of the shelter setting, installation scheduling, budget matters and funding. Findings of the research questions discussed above in the methods section for the second POE are discussed below.

What design should be replicated (or, what corrections should be made to the first design)? What other factors external to user perceptions would affect the design's replication? It was on the topic of what design to build that the usefulness of a second POE became particularly clear to the authors. That is, a return visit to the altered bedroom 18 months later revealed stark contrasts to the first post-installation photos. After only hosting four to eight families during the time period (shelter records made it difficult to confirm the exact number), the authors estimated that 75% of the installed design features were significantly changed or missing altogether. Inquiries made to the current bedroom's resident and case managers identified several forces at work that led to this change. For example,

- A case manager identified that a well-meaning charity group was permitted to renovate the family bedrooms about one year after the bedroom's installation. In order to repaint, the permanently affixed bolsters that permitted residents to comfortably use the side walls of the beds as a sofa back were removed, as were permanently affixed wall bulletin boards. The bolsters were forgotten in a storage closet and were not re-installed, and the whereabouts of the bulletin boards were unknown.

- Many items were simply missing, such as task lighting, radios and the room's stepladder. Eighteen wireframe storage bins were among these items, leaving only blank fixed shelves where they used to be kept. Case managers identified that residents who departed the shelter took the bins with them, and that no policing of the room's effects was undertaken by case managers.

Clearly, the authors had attended to the durability of the installed features as assessed by the positive findings from the first POE study that occurred right after installation, but had not anticipated the full extent of theft or well-intentioned alteration that could happen later on. Discussions with case managers revealed that the shelter was understaffed with too many residents to each case manager who needed to devote their time to craft the residents' recovery plans. This therefore left little time to supervise the details of room maintenance and checkout procedures. The extent of the room degradation led the authors to joke to each other that the second POE was in reality a 'post occupancy autopsy'. Humor aside, this significant and unanticipated change showed the authors that theft resistance would have to play a much stronger role in the design's next evolution for the design to endure beyond only months.

Was this design feasible to build economically? Another fundamental result from the second POE related to funding and budget. While the prototype room's cost of $8000 did not elicit strong negative reactions from the POE's case managers and shelter directors through the interviews, it also became clear that the design would need to accommodate the perceptions and desires of those most likely to pay for it. Surprisingly, these are not the shelter administrators themselves, but instead donors who seek to make a positive impact on shelter facilities. This discovery has led the authors to envision strategic marketing that would produce a high-quality brochure on the design and its benefits that shelter organizations could share with their donors. Donors might be convinced to fund one or more bedroom renovations as they are interested in seeing real and tangible results from their invested dollars. Shelter directors also described that donors like choices and input in the interior improvements that they fund (and especially choices with significant visual impact like color schemes and surface finishes). Therefore, the authors are considering a bedroom renovation product line with some flexibility that permits donors to select from a range of color and finish palettes that maintain durability levels, but permit variety in the appearance of neighboring rooms.

The second POE also provided the opportunity to gather the various participants' perceptions of the value of the 18 added room features—broadening it substantially from the first POE's query of the room resident to also include case managers and shelter directors. Table 6 reports these findings. Not surprisingly, these results varied by participant type. For example, residents ranked others more highly based solely on the features' 'demand side' usefulness to their stay at the shelter, such as personal ventilation fans, wall mirrors and seating cubes. In contrast, shelter directors found that these features were not positive additions, generally due to the problems these objects presented to durability and maintenance concerns (fans and mirrors could break, and seating cubes would be stolen). Case managers' perceptions of the features' usefulness varied, but were generally not as negatively appraised as were that of the shelter directors, perhaps because the case managers were in more continuous contact with residents and their lived experience in the shelter.

Pertinent to the discussion here, the second POE that included opinions of the case managers and shelter directors brought diversity to the question of the usefulness and utility of the 18 bedroom features. These added participants' opinions brought the benefit of a more long-term perspective on these features that residents did not bring to the interview conversations.

5. DISCUSSION

The contrast in the state of the bedroom renovation project from the first POE assessment at installation to the second POE evaluation 18 months later was striking. The authors note that had the second POE inquiry not been undertaken, the design might have proceeded toward replication without significant change from its first design. Had more rooms been produced in this way, many rooms, instead of only one, would have had the problem of being easily dismantled by residents or others. Instead, the second POE has caused a reorganization of priorities for the original design with greater emphasis placed on theft resistance and also donor participation and appeal.

Table 6. Assessment of added bedroom features by the second POE study's sample of shelter residents, case managers and shelter directors. 4= very positive feature 3=somewhat positive feature 2= not a significantly positive feature 1= not a positive feature at all.

Bedroom added feature	Resident mean rating (n=4)	Case worker mean rating (n=4)	Shelter director mean rating (n=5)*
LED-bed lighting fixtures	4.00	4.00	3.00
Bedside tables	4.00	3.25	
Cubicle-style bed curtains	3.25	3.25	3.25
Wall marker magnetic boards	4.00	3.00	
Bulletin boards	4.00	3.00	3.00
Divided Dutch entry door with lock	2.25	3.00	1.00**
Combination lockbox for valuables	2.00***	2.50	
Changeable hallway signage holder	2.75	1.50	
Bookcases and shelving	3.75	3.75	3.00***
Clock radio with headphones	3.33***	2.25	1.66***
Laptop writing desk	3.75	2.75	
Roller shade for window	3.00	2.50	
Personal fan	3.25	3.75	1.66***
Mirror	3.75	2.75	1.00
Wall hooks	4.00***	3.25	
Storage bins	4.00	4.00	2.33***
Area rug	3.25***	3.00	
Wall mounted bolster cushions	3.33***	3.25	
Seating cubes	4.00***	2.50	1.00***
Fitted bed covers	3.00***	2.50	

Blank cells indicate no applicable responses or only one response, a quantity deemed insignificant for reporting.

*Shelter director rankings were based on director's proactive comments on select bedroom features with rankings based on investigators' follow-up questioning.

** Two responses were received for this question.

*** Three responses were received for this question.

This case study supports the notion that to fully assess a project's success in meeting both its user ('demand' side) and project ('supply side') goals, it may be necessary to discover and integrate findings from multiple POE investigations. One reason for this is that these collective findings can pull in very different directions. As POE authors Preiser and Vischer describe, the variety of performance requirements that a built environment must attend to are 'systemic', and it is in this inter-related nature that unforeseen interactions can arise that serve to reduce the design solution's success [3, p. 8]. That is, as this example shows, a focused 'demand side' POE that examines user suitability may show promise of great assistance, but may also be prone to other problems, operationally speaking. It may also be valuable that the POE studies address the project at different times in the life of the project, as the effect of time passage can affect project success in ways that a sole initial assessment cannot reveal.

A number of further examples from this study's two POE assessments bear out this tension between first and second POE study findings and by extension, the related nature of project issues:

- In the first user 'demand side' POE, residents described that storage bins for the organization of possessions lent calmness to the environment, and aided their desire to stay in the room because its visual order was increased. It also likely contributed to residents' perceptions that they felt less crowded, and therefore, felt less stressed. However, the follow-up operational 'supply side' POE showed that lack of shelter policies permitting residents to take these storage bins with them when they left the shelter negated the aid the storage bins could have lent to the next residents (see figures 6 and 7).

- The user 'demand side' POE revealed that privacy was one of the most desired qualities for residents in their bedrooms, as real or perceived theft was a problem in the building. They also reported that case managers would knock and then immediately enter, even though residents may not be fully dressed. However, the follow-up visit in the second POE showed that shelter managers had removed the altered bedroom's door lock because they concluded it interfered with required bed check procedures.

- The theft of room components reduced the room's visual appeal, as did its renovation by an external charity group. Shelter directors describe that this situation makes the room less viable to show to donors on whom they rely for financial support. This is important, because well-maintained facilities, according to shelter directors, imply to donors that the shelter is managed well, and therefore more likely to be a good steward of donors' funds. Thus a vicious circle is at play- a poor-looking room is more likely to stay that way due to lack of funding, which the 'supply side' second POE revealed.

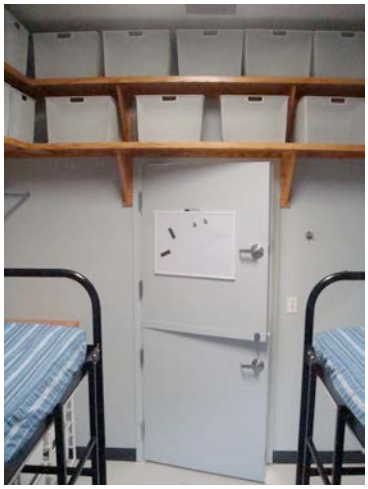

Figure 6. The altered bedroom directly after installation showing the many storage bins provided on dedicated shelving.

The findings of both the first and second POE studies will likely alter the re-design of the space in significant ways. For example, another solution must be found for the storage of possessions whereby the drawers or bins are not removable from the room. This will counter the problem of theft and innocent relocation of components by others. Second, participants confirmed that certain components proved helpful, and others less so. Some components such as space for homework and a refrigerator should be explored for inclusion. Third, given the importance of donors to the feasibility of such projects, a marketing approach must be developed to permit donors to have a say in some

aspects of the design such as color palette and materiality. A 'packaged' approach that facilitates donors' selection of an entire room solution would seem appropriate here based on study findings.

Figure 7. The altered bedroom photographed 18 months later. The bins are no longer there and residents are using the permanently affixed shelves for their belongings in other ways.

6. CONCLUSION

Based on review of literature on recent developments in POE thinking and the results of this case study, the authors conclude that first, multiple POE assessments by the project's designers and building construction personnel can lead to a more thorough understanding of a built environment's successes and failures. It can also at times reveal issues at cross purposes that require resolution. Second, these POE studies may benefit from a multiple-scale approach, devoting some time to the deep and relatively narrow 'demand side' user issues, but also conducting a POE study that addresses broader 'supply side' operational matters. Doing so may help projects to both accommodate their users and maintain their feasibility. Third, the authors recommend that the POE studies should be scheduled to permit evaluation of the building at points over a thoughtfully chosen time span to capture the powerful impact of applied usage. Investigating the chronological maturation of a project can be striking.

What could be learned from larger, more complex projects if both an immediate and later POE study was undertaken? The effect of time has long been underestimated as a change agent, as writer Stewart Brand explains in How Buildings Learn [21]. Brand describes that buildings perhaps adapt best when constantly refined and reshaped by their occupants. Perhaps it is logical to further consider that buildings may best serve their users when assessment is not a one-time event, but a series of checks that assess its accommodation to its users and larger context over time. These authors suspect that projects generated by other fields may also be subject to great change if assessed at different points in post-mortem time, and on the basis of various stakeholder points of view. Future studies could confirm that this is indeed the case.

REFERENCES

[1] M. Rouse, "Project Post-Mortem"; Accessed on February 1, 2015 http://searchcio.techtarget.com/definition/project-post-mortem. In **Essential Guide: Project management strategies that transform businesses: A CIO guide**, 2015.

[2] L. Wolf, **The project post-mortem: a valuable tool for continuous improvement**. In University of California Digital Library; Accessed on February 1, 2015 at http://www.cdlib.org/cdlinfo/2010/11/17/the-project-post-mortem-a-valuable-tool-for-continuous-improvement/, 2010.

[3] W. Preiser & J.C. Vischer, **Assessing Building Performance**. Amsterdam, Netherlands: Elsevier, 2005.

[4] W.M. Pena & S.A. Parshall, **Problem Seeking: An Architectural Programming Primer**, 4th ed., New York: Wiley, 2001.

[5] S. Mallory-Hill, W. F. Preiser & C. Watson, "Introduction to Building Performance Evaluation: Milestones in Evolution", in **Enhancing Building Performance** edited by S. Mallory-Hill, W. F. Preiser, & C. Watson, 1-18. West Sussex, UK: Blackwell Publishing Ltd, 2012.

[6] W. Preiser & U. Schramm, "A Process Model for Building Performance Evaluation (BPE)." In **Enhancing Building Performance** edited by S. Mallory-Hill, W. F. Preiser, & C. Watson, 19-30. West Sussex, UK: Blackwell Publishing Ltd., 2012.

[7] C. Zimring, C. & J. Reizenstein, "Post-Occupancy Evaluation: An Overview", **Environment and Behavior**, Vol. 12, No. 4, 1980, pp. 429-450.

[8] R. Levy, "Design Education: Time to Reflect", **Design Issues,** Vol. 7, No. 1, 1990, pp. 42-52.

[9] W. Preiser, "The habitability framework: a conceptual approach towards linking human behaviour and physical environment", **Design Studies**, Vol. 4, No. 2, 1983, pp. 84-91.

[10] Vitruvius. **De architectura libre decem (Ten Books of Architecture);** Accessed on February 1, 2015 from http://www.gutenberg.org/files/20239/20239-8.txt

[11] ASTM International, **Standards for Whole Building Functionality and Serviceability**, 3rd ed., West Conshohocken, PA: ASTM International, 2009.

[12] D. Hewitt, C. Higgins, P. Heatherly & C. Turner. **A Market-Friendly Post-Occupancy Evaluation: Building Performance Report**, Portland, OR: Northwest Energy Efficiency Alliance, 2005.

[13] R. Wener & R. Olsen, "Innovative Correctional Environments: A User Assessment", **Environment and Behavior**, Vol. 12, No. 4, 1980, pp. 478-493.

[14] M. Kantrowitz and R. Nordhaus, "The Impact of Post-Occupancy Evaluation Research: A Case Study", **Environment and Behavior,** Vol. 12, 1980, pp. 508-519.

[15] N. Watkins, E. Peavey & D. Clarke, "Research in Practice: Lesson 4: Using Post-Occupancy Evaluations Can Help Drive Innovation in the Design of Inpatient Unit Layouts

and Decentralized Care Delivery", **Healthcare Design**, Vol. 12, No. 12, 2012, pp. 26-33.

[16] J. Gerring, **Case study research,** New York: Cambridge University Press, 2007.

[17] R. Yin, **Case study research**, Thousand Oaks, CA: Sage Publications, 1994.

[18] P. Duttweiler, "The Internal Control Index: A Newly Developed Measure of Locus of Control. **Educational and Psychological Measurement**, 44, 1984, pp. 209-221.

[19] W. Gove & M. Hughes, **Overcrowding in the household: An analysis of determinants and effects**, San Diego, CA: Academic Press, 1983.

[20] S. Burn, "Loss of Control, Attributions, and Helplessness in the Homeless", **Journal of Applied Social Psychology**, 22(15), 1992, pp. 1161-1174.

[21] S. Brand, **How Buildings Learn**, New York: Penguin Books, 2005.