

COMBINING POST OCCUPANCY EVALUATION
WITH THE UNITED STATES GREEN BUILDING COUNCIL'S
LEADERSHIP IN ENERGY AND ENVIRONMENTAL DESIGN
RATING SYSTEM

by
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This Thesis for the Master of Environmental Study Degree

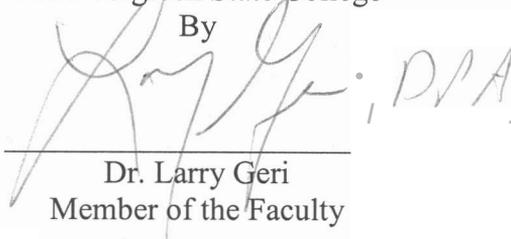
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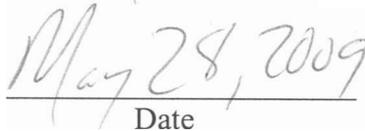
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The Evergreen State College

By

A handwritten signature in black ink, appearing to read "Larry Geri, DPA". The signature is written in a cursive style and is positioned above a horizontal line.

Dr. Larry Geri
Member of the Faculty

A handwritten date in black ink, "May 28, 2009", written in a cursive style. The date is positioned above a horizontal line.

Date

ABSTRACT

Combining Post Occupancy Evaluation with the United States Green Building Council's Leadership in Energy and Environmental Design Rating System

Lucienne C. Guyot

Experts report that occupant surveys are a missing link in assessing building successes, failures and in identifying opportunities to build upon. Providing ongoing data to industry professionals and academics has the potential to help further innovation in the sustainable building industry. In a 2008 Annual Report, the US Green Building Council noted they desire more data to gauge green building performance. The US Green Building Council has one of the most popular green building certification processes in the country and perhaps the world: The Leadership in Energy and Environmental Design (LEED) rating system. Requiring post occupancy evaluations with each LEED rated building is one feedback mechanism in the process of studying and measuring green building performance. Post occupancy evaluation involves interpreting the human experience with a building, by way of occupant surveys. Improving structures based on data from human subjects is not a novel idea. It is, however, an underutilized concept not currently required by any green building rating or certification system for new construction in the United States. A survey of The Evergreen State College's Seminar II LEED Gold rated structure provides some insight on post occupancy evaluation and green buildings. The two-fold research question is: How can we integrate the human perspective with other methods of measuring green building operation to assess green building performance? How can we improve the future of sustainable design so buildings reflect interests of end users?

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SEMINAR II Photograph by Author

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To the volunteer opportunities left undone, the rare cookie left unbaked and the social events left unattended, I am available now.

QUOTES

"Any building without a feedback system is stupid. It will continue to make the same dumb mistakes rather than interesting new ones"

-Amory Lovins

"Designers should be clever and creative and give users time to catch up with them. You make progress by collaboration between user and designer with prototypes ..."

-Tom Stewart

"Without innovation we are left with traditional methods which are no better than poorly managed new systems."

-Robert Cohen

"The law doth punish man or woman / That steals the goose from off the common!

But leaves the greater felon loose / That steals the common from the goose."

-Found in Bernard Hare's Urban Grimshaw and the Shed Crew (from

<http://www.usablebuildings.co.uk/>)

ACRONYMS

AS-HRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers
BREEAM	Building Research Establishment Environmental Assessment Method
BUS	Building Use Studies LTD
CASBEE	Comprehensive Assessment System for Building Environmental Efficiency
CBE	Center for the Built Environment
CGBC	Cascadia Green Building Council
EPA	Environmental Protection Agency
LEED	Leadership in Energy and Environmental Design
LEEDAP	Leadership in Energy and Environmental Design Accredited Professional
LEEDNC	Leadership in Energy and Environmental Design New Construction
POE	Post Occupancy Evaluation
PROBE	Post-Occupancy Review of Buildings and their Engineering
UFAD	Under Floor Air Distribution
USGBC	United States Green Building Council
WGBC	World Green Building Council

I. Introduction

The built environment includes the places we live, the schools we attend, the libraries we love and the offices we travel to for work each day; but building severely impacts the environment. Building more wisely can significantly reduce solid waste, carbon emissions, water and energy use. (United States Green Building Council 2008) Due to increasing awareness and rising social responsibility on the part of both the of the building industry and clients, the scarcity of natural resources and ecosystem services are more often taken into consideration. Sustainable design and green building techniques (terms used interchangeably in this paper) are frequently employed when designing and creating new structures to house the burgeoning number of people in offices, work spaces and buildings. This is important because if we continue construction at the current rate, by 2030 we will have 200 billion square feet of new building stock in the United States (McLennon 2008), in addition to the estimated 300 billion square feet of existing building stock today.

This potential 500 billion square feet of building stock is an enormous amount of space in the US alone, and we have little or no knowledge of how the human beings inside are served by these buildings. (National Trust for Historic Preservation 2009) Researchers note that end users are an underused source of data. End users can help contribute valuable feedback to the building industry. In return, their voices will be heard and reflected in the future of green building design and construction. The potential for a relationship that provides mutual benefit to end users, in the form of user friendly buildings, and the green building

industry, in the form of performance measures from occupants, shows promise.

Though end users of green buildings have not yet been surveyed a great deal, my research and literature review shows that the entities and individuals involved in the process of designing, creating and building green structures have been surveyed and studied by the industry at length. For example, the Building Owners and Managers Association, the Association for Facilities Engineers and the United States Green Building Council (USGBC), as well as its chapters, are industry entities that have conducted surveys and consultations. The Building Codes Assistance Project has also done a study that included a survey on the interaction between green building certification systems and building energy codes in the commercial sector. (USGBC 2008) Much less is known about the experiences of the occupants of green buildings.

In this paper I argue that systematic study of user satisfaction with green buildings that includes post occupancy evaluation can help the industry to gauge consumer reaction to the current and future stock of products. Furthermore, an ongoing study of green buildings that includes post occupancy evaluation data is likely to reflect interests of end users and provide performance measures for the sustainable building industry. This is likely to improve sustainable design, as well as improve long term user satisfaction.

This thesis essay is a study of one of the most popular sustainable building rating methods in the world, the United States Green Building Council's (USGBC) Leadership in Energy and Environmental Design (LEED), and how it could better serve the building industry by infusing the human viewpoint into

planning. The research question is: How can we incorporate the human perspective in order to assess green building performance and improve sustainable design so it is suitable to end users? This essay presents an argument for performing post occupancy evaluations on sites that achieve the USGBC's green building rating certification.

In order to provide a clearinghouse for green building performance data in the public domain useful to architects, building managers, engineers, other industry professionals and academics, the USGBC could combine post occupancy evaluations (POE) with the LEED rating system and publish the results on a section of their website or in an accessible annual report. These data are useful to individual industry professionals, to specific building owners and to the general industry as a whole. When compiled over time, the trends and benchmarks gathered from the end users will help inform the direction of the industry in the creation of best practices and blueprints for select building types. Most significant is the role that human input can play in the design of sustainable buildings that perform well and that consumers and users are satisfied with.

Section II of the thesis will open with an introduction to green building and sustainable design and certification systems, concluding with the LEED rating system. Section III is an introduction to post occupancy evaluation, which goes on to introduce two specific industry organizations called the Center for the Built Environment (CBE) at Berkeley and Building Use Studies LTD (BUS) in the UK, as well as two case studies. Section IV presents an occupancy evaluation of a building on The Evergreen State College campus that is certified to LEED

Gold standard and briefly discusses the results of that evaluation. Section VI will look at both the benefits and the challenges of coupling post occupancy evaluations with each LEED rated structure in the New Construction and the Major Renovation building categories. Section VII outlines recommendations and opportunities for future exploration and discussion of post occupancy evaluation and green building. Section VIII offers a conclusion for the potential relationship between the LEED rating system and post occupancy evaluation.

Before beginning the section on green building and sustainable design, some definitions are in order. An oft cited definition for sustainability is the one from the United Nation's Brundtland Commission: "meeting the needs of the current generation without compromising the needs of future generations." (Brundtland 1987,43) While that is useful as an overarching goal, it is not specific enough for the purpose of this paper. More to the point of this study, but still somewhat lacking, The United States Environmental Protection Agency (EPA) states that:

"Green or sustainable building is the practice of creating healthier and more resource-efficient models of construction, renovation, operation, maintenance, and demolition." (United States Environmental Protection Agency 2009)

Clearly, an industry specific definition of sustainability is required. Thus, the following definitions are from an industry perspective. In 1999, the Washington State University School of Architecture combined concepts from leaders in the field and noted that:

"Sustainable developments are those which fulfill present and future needs while [only] using and not harming renewable resources and unique human-environmental systems of a site: [air], water, land,

energy, and human ecology and/or those of other [off-site] sustainable systems." (Washington State University 1999)

Further, Kaatz et al, from the Department of Construction Economics and Management in Cape Town, South Africa, in their paper on advancing outcomes of building assessment apply a good working definition of sustainability. They define it as "implementing ecological principles and promoting resource efficiency." (Kaatz et al 2006)

The preceding definitions were presented as a means to further our understanding of how various actors perceive sustainability, and high-performance and green building efforts. In all of them, a sense of responsibility is present.

It appears that humankind has since made an effort to embrace this sense of responsibility and to move away from a wasteful building industry by embracing innovation and sustainable design practices. The endeavor is gaining credibility and is becoming culturally relevant as a result.

Significantly, the Energy and Extension Act of 2008, part of the approved multi-billion dollar United States bailout plan, includes tax benefits for some aspects of green building, such as a tax deduction based on the square footage for energy-efficient commercial buildings. (Library of Congress 2008) Additionally, some state and federal agencies are requiring certification by a rating system not only for buildings that they fund to construct, but also those that they rent, purchase and own. (Retzlaff 2008)

Today global climate change is at the forefront of many environmental conversations, and the issue has become one of political importance. This is

significant here because building green can help to decrease the heavy impact that traditional building design and operation have on the atmosphere. The World Green Building Council (WGBC) notes that "buildings and communities are responsible for 40% of greenhouse gas emissions into our atmosphere." (World Green Building Council 2008)

Another notable sign of the times is worldwide formation of many sustainable design organizations and green building councils. These councils aim to meet the challenges of designing and building structures across the globe that are more sustainable than many of those that are typical of the recent past. Accordingly, the WGBC reports that green building councils have a proven record of success in implementing change in the built environment by engaging sector leaders with input and cooperation from local industry, government and academia. (WGBC 2008) For example, Gennany Sustainable Building Council, UK Green Building Council and Taiwan Green Building Council are members of the WGBC. The USGBC is a member as well and the entity most significant to the content of this paper.

II. Green Building

Sustainable design is on the rise. The following is a discussion about entities and processes connected to the movement, including different assessment methods.

The United States Green Building Council (USGBC)

The USGBC is a 15 year-old non-profit organization dedicated to sustainable design and construction in the following sectors of the industry:

one source of demonstrating green building performance and this goal of demonstrating building performance is prominent in the USGBC's plans for 2008.

The USGBC reports on its website that its membership has quadrupled since the year 2000. (USGBC 2009) The Cascadia Green Building Council is one of many regional non-profit chapters of the USGBC. Other chapters across the country are the New York Upstate chapter, the Delaware Valley Green Building Council in Philadelphia, and the Hawaii chapter. There are over 60 chapters listed on their website. Accompanying the popularity of green building and the creation of these councils worldwide are many different sustainable building certification and assessment processes.

The certification and assessment programs aim to realize sustainable design by providing a third party certification for integrating green practices into building. The USGBC's LEED rating system has four levels: Certified, where a project meets minimum criteria; on up to Platinum where the building must meet all the criteria. Before going into detail about the USGBC's LEED rating system, it is worthwhile to mention some others available on the market worldwide.

Certification, Rating, and Assessment Entities

In order to meet sustainability goals, and to gain recognition, building owners and developers often pay to use building assessment systems, in return for promotional and marketing materials. (Retzlaff 2008, 506) Here are a number of options from a few different countries that owners and developers have to choose from. Take note that thus far, none require conducting a post occupancy evaluation as part of their building assessment process.

Green Globes

Green Globes is an assessment method that is part of the Green Building Initiative in the United States. On their website, they mention that the method arose from an interest in promoting awareness and providing resources for the numerous US Home Builders Associations to integrate sustainable building practices. Today the Green Globes system serves the commercial sector as well. Each project is tracked on a web application via an in depth questionnaire, which is able to provide sustainable enhancement suggestions to the project manager throughout the process. Upon completion, the project is assigned a rating. The rating is derived from the number out of 1000 points the project receives in 7 categories: energy; indoor environment; site; resources; water; emissions and effluents; and project management.

Green Star

Green Star is used in the countries of Australia, New Zealand and South Africa. According to the Australian Green Building Council's website, it was created by the Australian Green Building Council in 2003 for a variety of sectors, including commercial offices, schools and universities. As further noted on their own website, the South African Green Building Council chose the Green Star rating system after researching others in the field. It uses a customized Green Star rating system suitable for use in South Africa and is referred to as Green Star SA. The New Zealand Green Building Council website has an overview of their similar product, called Green Star NZ. The Certification process starts with registration, is followed by documentation and document submission, then

involves assessment and is finalized by the awarding of the appropriate Green Star NZ rating. The ratings range from four to six stars. The four stars signify 'Best Practices'; the five star rating is for 'New Zealand Excellence'; and the six star rating, the highest, is reserved for 'World Leadership.' These are similar to the ratings assigned by the original Australian version and the adapted South African version. The points associated with each star level are reached by meeting factors in these differently weighted categories: management at 10%; indoor environmental quality at 20%; energy at 25%; transport at 10%; water at 10%; materials at 10%; land use and ecology at 10%; and emissions at 5%. (World Green Building Council 2009)

Comprehensive Assessment System for Building Environmental Efficiency (CASBEE)

CASBEE is Japan's version of a green building certification process and has been in development since 2001. The website asserts that it is promoted under the Kyoto Protocol, an international protocol to the United Nations Convention on Climate Change, as a tool to reduce emissions. As per the CASBEE website, the two assessment categories for CASBEE are Building Environmental Quality, and Performance and Reduction of Building Environmental Loadings. The CASBEE system arrives at a score from a formula that is derived from the form that the client fills out for their building. Scores range from poor (C) to excellent (S) and buildings are assigned one of the 5 different classification letters, C, B-, B+, A and S. Uniquely, this system rates all

levels of building performance from best to worst, instead of praising the good alone.

Building Research Establishment Environmental Assessment Method (BREEAM)

A very popular British program of the Building Research Establishment in the UK is BREEAM and the world was eventually introduced to BREEAM International. Building project managers work with a BREEAM Assessment Organization from the beginning of the planning phases. As indicated by their website, the method

"...assesses buildings against a set criteria and provides an overall score which will fall within a range providing either a PASS, GOOD, VERY GOOD, EXCELLENT or OUTSTANDING rating."
(BREEAM 2007)

Similar to BREEAM, the USGBC has a green building rating process called LEED, which is one of the industry standards in the US and abroad. More detail about the LEED rating system that many local governments in the States are employing follows.

Leadership in Energy and Environmental Design (LEED)

As stated by the USGBC website, the LEED rating and certification program has been in existence since the year 1999. Projects are required to have a LEED Accredited Professional (AP), much like the BREEAM program, in order to register a project and obtain any of the four rating levels. The LEED rating system includes four levels of certification: Certification for meeting the prerequisites and reaching 26-32 points; Silver for achieving the next level of points: 33-38; Gold for achieving an even higher level of points: 39-51; and

Platinum for meeting or exceeding all criteria for certification: 52-69 points. A site or project earns one of these different certification levels by achieving points listed for a variety of credits under six categories:

- Sustainable Sites;
- Water Efficiency;
- Energy & Atmosphere;
- Materials & Resources;
- Indoor Environmental Quality (IEQ); and
- Innovation & Design Process.

Criteria listed under these 6 categories include making efforts to reduce use of toxic materials, local materials sourcing, site selection, access to transit alternatives, provision of bicycle storage, water efficient landscaping and the introduction of innovative wastewater technologies.

Regardless of the project nature, the process for using the LEED rating system requires the project managers to register the LEED project, whether the project is a minor dormitory remodel or the full construction of a new library. Once the project is completed, the team submits their application which reflects both the prerequisites executed in the project and the team's attempted credits they hope the project will receive. Following the payment for certification, the review process begins. Costs for certification vary depending on USGBC membership status, project size and project type. Projects awarded Platinum certification for several different categories, including New Construction, receive their certification fees back in the form of a rebate. As mentioned previously,

post occupancy evaluation is not yet incorporated into the process. Providing a rebate as an incentive for project managers to conduct a post occupancy evaluation is an option that the USGBC could employ in order to encourage participation in surveying building occupants. This would add an additional step to the certification process. The rewards for the USGBC in the form of green building performance data provided by the end user survey results have great potential. This LEED rating method is popular as a mandate for sustainable building.

Green building design has become a public issue because it is making its way into policy. The LEED New Construction standards (v2.2) provide a metric for establishing green building policies. Many publicly funded buildings are mandated to meet requirements set forth by LEED. These policy decisions in the United States are reflecting sustainable design ideals. Some jurisdictions, including state governments, are requiring that any new, publicly funded building of a certain size achieve green building status. (International Council for Local Environmental Initiatives) The act of state and local governments providing leadership in an organized, defined manner is beneficial to the efforts of sustainable development. A Washington State High Performance Building Bill in the 2005-06 session (Senate Bill 5509 and House Bill 1272) required a LEED Certified rating or higher for most buildings that house public agencies with 5,000 or more square feet. (Nelson 2005,26) This requirement is now in the Revised Code of Washington: 3935D RCW High-performance public buildings. (Washington State Legislature 2009) Significantly, many other governors and

mayors have adopted similar green/sustainable building policies for their states and cities respectively, as reported at the website of the Western Governors' Association. Among the jurisdictions included in the report are Western Governors of Nevada, California, Colorado and New Mexico.

Complementing this report, it is of local interest to note that according to their Department of Planning and Development website, since the year 2000 the City of Seattle's Sustainable Building Policy has required LEED Silver certification for City-funded renovation and new construction projects with 5000+ occupied square footage. The publicly funded Central Library in downtown Seattle is LEED Silver certified. Beyond the local area, an REI store in Boulder, Colorado was recently awarded LEED Gold certification and The American Embassy in Sofia, Bulgaria is rated LEED Certified. (USGBC)

The USGBC reports that they have 10,189 registered new construction projects and 1,434 certified new construction projects. (USGBC 2009) While these efforts are commendable and the reports are favorable, it is important to consider occupant satisfaction after the building is finished and the offices are occupied by bookshelves, computers, furniture and people. The Post-occupancy Review of Buildings and their Engineering (PROBE) study authors substantiate the importance of feedback when they say "managed feedback produces better buildings." (B.J and RA 2003) The USGBC has already expressed an interest in more data on the performance of green buildings. Is this not a timely opportunity to create a new format for the LEED rating system that includes occupant

evaluations? Furthermore, according to Rebecca Retzlaff, assistant professor in the Community Planning Program at Auburn University, Auburn, Alabama:

"More research is needed to identify these opportunities, to determine how best to adapt building assessment systems to local planning conditions and goals, and to learn from cases in which building assessment systems were used successfully to achieve local sustainability goals." (Retzlaff, 2008, 517)

Post occupancy evaluations hold promise as a tool for capturing perspectives on these sustainability goals. Answers to pointed questions in the surveys can reflect the ideas and feelings of the local members that make up the community. While the surveys are feedback mechanisms for green buildings in general, they can also serve to improve the rating systems. More detail on post occupancy evaluation is provided in the next section.

III. Post Occupancy Evaluation

The literature supports the theory that "green buildings...have been linked to the quality of indoor environment." (Paul and Taylor 2008) This is one claim about green buildings that should undergo evaluation in the near future. In order to substantiate this link, we should continue to study buildings after completion. Today there is no argument that post occupancy evaluation is valuable to the site owners, users and facilities managers of a specific subject building, complex or campus. (post Occupancy Evaluation) The CBE notes that owners, designers and building managers can all use assessments of building environments to learn about their buildings. Owners learn about the quality of their buildings, designers can learn about how occupants are using technology and building managers can obtain data about performance and reasons behind occupant complaints. (Arens

2007) A large collection of POEs that study only green buildings would be invaluable in order to uncover practices that do not please end users and to highlight the consistent successes of sustainable design.

Documented use of post occupancy evaluation by the building industry in the United Kingdom dates back to the early 1960s. "POE is a proactive process which feeds into the next building cycle through strategic planning/needs analysis and programming/briefing." (Preiser 2001) These POEs are used to gauge fitness for purpose and how a building is performing after construction from the occupants' perspectives. They also aid in improving building design. (Turpin-Brooks and Viccars 2006) These studies can include any or a combination of the following: direct surveys; one-on-one interviews; group interviews of the end user; and direct observation. (B.J and RA 2003) The POE process is typically conducted after about a year of use in order to understand how a building behaves during different seasons and to allow time for the development of a usage pattern. (Way and Bordass 2005)

In an article from 2005, Workplace Performance Metrics team leader with Herman Miller Inc. Services, Michael O'Neill states that surveying end users can help create optimal office spaces. (O'Neill and Duvall 2005) It is important to evaluate any shortfalls and to highlight the positive attributes of green building in a timely manner so adjustments are made to improve the process. With innovation in sustainable design and green building increasing in popularity and application, we are currently facing a shift in the building industry. (Enright 2002) The timing is right to do something innovative on the side of measuring

performance and utilizing the perspectives of occupants of green buildings. The process of improving this building technique is more effective if the human perspective is incorporated as a feedback mechanism for the success of the designs. According to an article on the United States Federal Facilities Council's report on post occupancy evaluations entitled *Learning from Our Buildings*, benefits include:

- Support of policy development;
- Getting lessons from buildings in use back to the supply side;
- Making designers and owners accountable for building performance; and
- Aiding communication among stakeholders. (Bordass 2003)

The usefulness of employing occupant surveys is substantiated by Suzanne Enright, chair of the Society of College National and University Libraries, who writes that asking questions of occupants can help provide lessons for the construction industry. Flaws in design or construction related mistakes can be avoided with inquiries about the human perspective to "show what works and what does not." (Enright 2002)

Cathy Turner, consulted as an expert in the capacity of environmental performance measurement consultant, was involved in the Cascadia Green Building Council (CGBC) January 2006 post occupancy evaluation report. She states in an industry journal article that "Green building aims to reduce energy use while also creating buildings that occupants prefer to work in." The article goes on to report the results of a number of user surveys which note that occupants are

"somewhat dissatisfied with acoustics...and less satisfied with their personal workspaces." (JB & RA 2006) If these issues are consistently reported in occupancy evaluation results, these negative findings could be ameliorated over time through improved design techniques. These studies can help the industry to understand the successes, the opportunities to build upon and the shortcomings of a sustainably designed building from the human perspective. The evaluations would compliment energy performance reviews, water audits and other environmental monitoring data.

The authors of the UK PROBE study would like to see a large collection of evaluations accessible to the public. (BJ and RA 2003) As indicated on the website of Building Use Studies LTD, between 1995 and 2002 the PROBE survey was principally used for structures in the educational, public and commercial sectors. The survey results of the 20 reviews are held in the public domain. PROBE originated in the UK from collaboration among the Department of Environment, Transport and the Regions; the Chartered Institution of Building Service Engineers; *Building Services Journal*; and a research team that included, among others, POE scholars Anthony Leaman and William Bordass. According to Enright, the PROBE project was very timely. It came about when the construction industry was transitioning and changing to accommodate a need for mixed-use spaces, for lower project costs, and for rising interest in lowering environmental impact and energy use. (Enright 2002) Authors of a recent study on occupant comfort, Paul and Taylor, posit that claims of performance need to be warranted in order to foster the continuation of green building technologies.

Performance evaluations through occupancy surveys are one course of action. (Paul and Taylor 2008) The Center for the Built Environment at the University of California Berkeley notes that "... 'green' and 'sustainable' design needs to be thoroughly assessed as it evolves." (Arens 2007)

The entire POE process can involve many stages. The level of POE differs according to the aims. An indicative level includes assessment by experienced personnel to highlight POE issues; an investigative POE focuses on building performance evaluations and consequent solutions to issues that arise; and the diagnostic level POE aims to establish data in order to prevent uncovered deficiencies in the design and building of future projects. Depending on the level of-POE, the methods can include structured interviews, focus groups, mobile evaluations while walking the building, group meetings, physical measurements (water and energy use data, for example), and general inspections. Two advantages of performing these interviews are the cost savings of walk-through surveys and the ability to gain detail from the focus group. Bordass notes that if a trained surveyor is utilized at the building, he or she has the skills and abilities to see, hear and learn things about the background that can help to interpret the findings. (Bordass 2003, 409) Some disadvantages are the potential subjectivity of a walk-through survey and the need for a skilled facilitator to ensure success of the focus group. The time commitment for the different levels listed above is a quick inspection stage for the indicative phase; one week to several months for the investigative phase; and from months up to some years for the diagnostic level process. (Turpin-Brooks and Viccars 2006, 180)

Each method or level of POE has both advantages and disadvantages. Turpin-Brooks and Viccars note that the BUS survey method is valuable because it includes quantitative *and* qualitative data. They also comment that the surveys are a good way to encompass as many respondents as the survey administrator can afford. Turpin-Brooks and Viccars say that the questionnaire surveys are "essential for base data." (Turpin-Brooks and Viccars 2006, 186) If funds are available and if time allows, these survey findings can combine with other data collection, for instance temperature and humidity levels, to validate the results.

To judge the success of green building, a standardized method of POE is necessary to reach benchmarks and make comparisons of the individual buildings and case studies. For effective qualitative data collection, the data need to:

"Give results that are easy to compare with other studies... give good value in terms of quality and content. ..be reliable (i.e. give roughly the same results when used by different people in similar circumstances); and address the factors that relate to the needs, activities and goals of the people using the building." (Turpin-Brooks 2006, 181)

The following are two organizations that have created and have conducted in the past post occupancy evaluations of the people using buildings. These are the premier organizations in the field of post occupancy evaluation.

Center for the Built Environment (CBE), University of California - Berkeley

Researchers from The University of California, Berkeley Center for the Built Environment (CBE) collaborate with industry professionals toward the goal of producing quality buildings. The CBE was established in 1997 and receives funding and support from corporate and organization industry partners, and the National Science Foundation. Their mission, as stated on their website, "is to

improve the design, operation and environmental quality of buildings." CBE initially created a specific post occupancy evaluation for a building controls company. This building controls survey from CBE was loosely based on some of the standardizations from Building Use Studies LTD, another industry group discussed later in this section. The same building controls survey was further adapted by CBE and is used today to assess building performance for new building designs and technologies, including furnishings. The questionnaire has multiple tiers that expand to gather more information if a survey taker is dissatisfied with a particular aspect of the nine categories. The layered questions do not appear if an occupant is satisfied with the environmental category; the participant is moved to the next question. The results end up in a database. "As the database of surveyed buildings grows, users... [can] explore trends for specific building design characteristics and features." (Zagreus, et al. 2004, 73)

In some cases, researchers with the CBE take physical measurements and study people's activities and actions within buildings and the close surroundings. The responses to the questions and the physical measurements are compiled together. The CBE website states that they have noticed that "this feedback is highly valuable to those who manage, operate, and design buildings." In writing about the results of a case study of under floor air distribution (UPAD) technology in California, Leah Zagreus of the Center for the Built Environment said that whole-building performance data of the UPAD technology is meager. The study included occupant comfort results of a pre- and post- occupancy evaluation of a large office building. The pre-occupancy results were the baseline

data collected prior to moving the employees to the new office space with UFAD. In the same case study, a new concept of task lighting did not function well for many of the users. Management came up with a solution after hearing about the issue. (Zagreus, et al. 2004) This is yet another endorsement for using post occupancy evaluations with a green building assessment method. Managers can correct complaints and the industry can collect performance data on and study new building technologies and concepts: under floor air distribution and lighting are notable examples.

The Center for the Built Environment (CBE) is developing a software tool that provides access to a database of CBE generated post occupancy evaluation results. The tool is intended for users, mainly facilities managers, owners and anyone else who administers user surveys for their own buildings, to test their green building hypotheses. Eventually, the CBE hopes to provide the ability for users to look into the relationship between occupant satisfaction with their building and specific building technologies. In the testing phases of the software, one large organization compared the results of POEs for 15 of their own new buildings to gauge whether they were on target with self-imposed design goals. This tool will also serve any CBE industry partner by allowing them to do comparisons of the post occupancy evaluation results of all the buildings in the database. And it will still be a useful tool for managers and owners with multiple sites who are not partners, because they will have the ability to compare their own suite of buildings. However, they will not have access to the entire database of CBE building surveys. (Zagreus, et al 2004)

A searchable database concept similar to the CBE one described above is an idea the USGBC should consider for warehousing POE survey data of their LEED rated buildings. When professionals from the industry and academics seek out the database of green building performance data, exposure for the USGBC and for its LEED rating system will increase.

The Building Use Studies LTD (BUS)

The independent consultancy Building Use Studies LTD (BUS) was created in 1981 in London, England. "BUS examines how buildings work, notably from the viewpoints of building occupants." Further, part of their mission from the outset was to integrate the human experience into the building design process. Though the home base for BUS is the UK, they have worked with organizations and people in the US, Norway, Sweden and the Netherlands. They have won major clients including Nokia, Xerox, British Petroleum and the United Nations Development Program. According to BUS associate Adrian Leaman, they have done nearly 600 surveys over the years. Currently, their database houses approximately 380 surveys. The Seminar II survey I conducted is one of 85 in an international data set from their database. The following two studies provide some context for post occupancy evaluation. After the case studies, we will delve into the aforementioned Seminar II survey.

Two Post Occupancy Evaluation Case Studies

The American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Thermal Comfort Case Study

In 1985 the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) used occupant surveys as part of a study to

better understand how buildings were performing related to thermal comfort. This one is an example of a rigorous POE. The main goal of this study was to maximize energy savings in buildings. During the study a number of buildings were toured by the researchers. Detailed physical measurements that effect comfort were recorded. Simultaneously, the occupants were surveyed for their sense of thermal comfort. A direct comparison was made between indices and the comfort-related responses of the occupants. The outcome of the study supports a theory that people are more comfortable with a wider range of indoor temperatures if they have exposure to the weather outdoors and operable windows. Naturally ventilated buildings have high energy conservation potential. (Arens 2007)

The Cascadia Green Building Council (CGBC) Case Study

The Cascadia Green Building Council (CGBC), which serves Oregon, Washington, British Columbia and Alaska, completed a post occupancy evaluation in 2006 that gauged the experiences of individuals in ten buildings, including portions of a Cascadia region landmark, Portland State University. The study was not limited to office space and included multi-family residences, libraries and multi-use higher education campus buildings. The building sizes and rating levels were varied. The ten buildings were surveyed and the survey was administered via an email link to a 10-minute survey to occupants in nine of the ten buildings. Due to limited computer and internet access, the same evaluations were handed out in paper form at a Traugott Terrace (the tenth building-clean and sober living apartments) residents meeting in Seattle. The study also

included a water and energy audit done by consulting 12 months of utility bills. The energy audit required some modeling based on the EPA Energy Star program.

Cathy Turner, the environmental performance measurement consultant who prepared the POE report for the CGBC, says she hopes others will follow in their path and conduct post occupancy evaluations as well because these survey instruments contribute to the understanding of green building by creating research questions and pinpoint areas for additional inquiry. Turner says "I am looking forward to seeing more results emerge." (BJ and RA 2003, 4)

This study identified a few areas for improvement, including improvement in personal workspaces. These issues are just the things that a database of POEs could help to address in green building projects in the future by alerting the industry and academia. (BJ and RA 2003) If the reader's interest has been piqued, the POE results in their entirety are found on the CGBC's website, listed in the works cited.

Though much of the literature supports the use of POEs, not every stakeholder in the building industry appreciates what they feel are implicit in these studies if they have any negative connotations. The USGBC should not frame or interpret the evaluations as building performance measures for the industry professionals behind each building project. There is some reluctance to conduct POEs in our "culture of blame", including especially the reluctance on the part of the design and building teams. (Enright 2002) Architects, designers and builders fear that the results of post occupancy evaluations that indicate

dissatisfaction with their buildings will find their way to the forefront of the issue. Removing the blame might help the USGBC foster and promote collaboration, not create finger pointing. It would seem that interest in furthering innovation in the future would not mean to indicate that the previous attempts were failures, but rather the interest would allow the innovators and the industry to consider the endeavors as pathfinders. Joining together to make continuous progress and moving forward with improvements needs to garner the primary focus.

IV. The Seminar II Survey

I administered the survey of Seminar II for the purpose of learning the value of and gaining an intimate understanding for the process of a post occupancy evaluation and the survey instrument, and gaining experience with the technique. The reader should consider the survey and its associated data as part of the paper's premise; not the focus. The exercise was not aimed at my uncovering benchmarks or trends, because that is difficult to do with a single survey of one building alone.

Dr. Rob Knapp, Master in Environmental Studies Faculty at the Evergreen State College, happened to know Mr. Adrian Leaman of Building Use Studies LTD and he encouraged me to include a post occupancy evaluation of the LEED Gold rated "Seminar II" building. Since I was offered a connection with one of the leaders in the field, I chose to heed Dr. Knapp's advice and gain hands-on experience in administering a post occupancy evaluation.

Mr. Leaman and I corresponded and he agreed to provide me with the BUS post occupancy evaluation for Seminar II free of charge as an educational

endeavor. The fee for this survey and data analysis is normally £1,000 United Kingdom Pounds or about \$1,429 United States Dollars at the current exchange rate. I received a license from BUS with permission to proceed with their evaluation to study Seminar II. I returned the signed license and was sent the survey pack. With the materials in hand I completed the Human Subjects Review process at The Evergreen State College and was able to move forward without making any changes to the proposed process. BUS provides helpful instructions on administering surveys and recommends survey implementation in the middle of the work week, as that is when most employees are in their offices. The invitation to the survey, administered via web link, was emailed once, followed by two follow-up email reminders, for a total of three invitations.

Seminar II is a large five cluster multipurpose building with office spaces, seminar rooms, classrooms, a public lounge, and a satellite cafe. **(Figures I and II)** The ventilation system is natural. The 160,000 square foot cement building is LEED Gold certified. It opened with classrooms and offices in April of 2004. This study was limited to individuals with office space, and passive users (primarily students and faculty only using classrooms) were purposely not included. The objective of the survey was to capture the experiences of subjects who spent time in the building on a regular basis. The list of faculty offices was provided by The Evergreen State College's Program Coordinator for the Academic Deans, Sherri Willoughby. I personally gathered other user email addresses for the non-faculty office occupants, such as those in the Public Service

Centers, and ultimately the BUS questionnaire was distributed via email to a total of 139 current or former Seminar II office occupants.

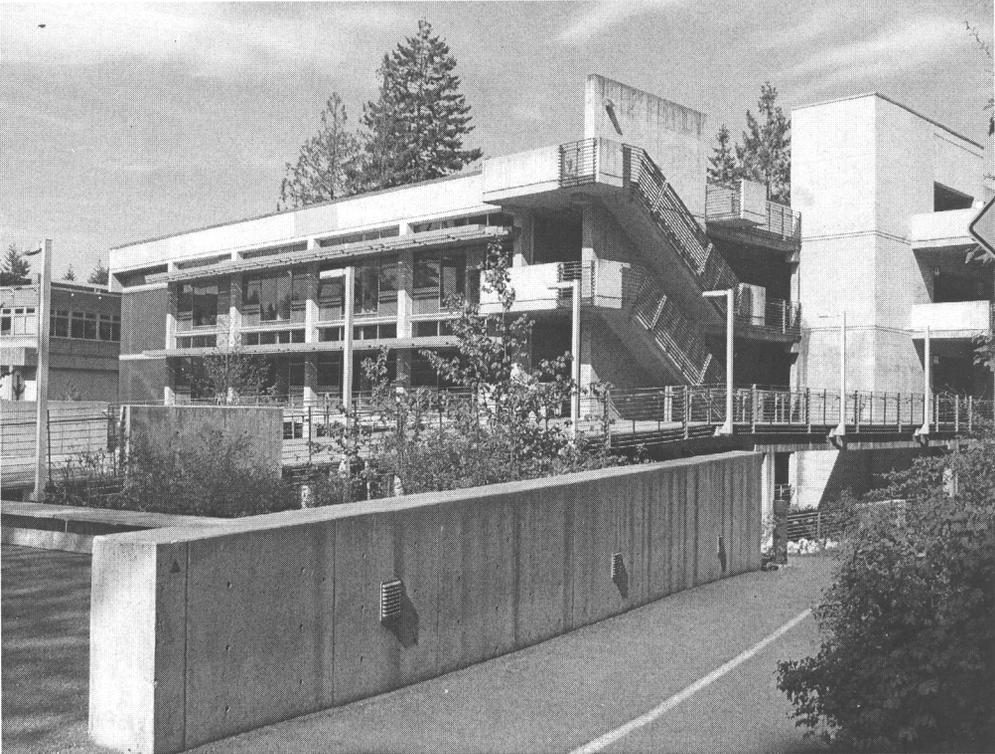


Figure 1

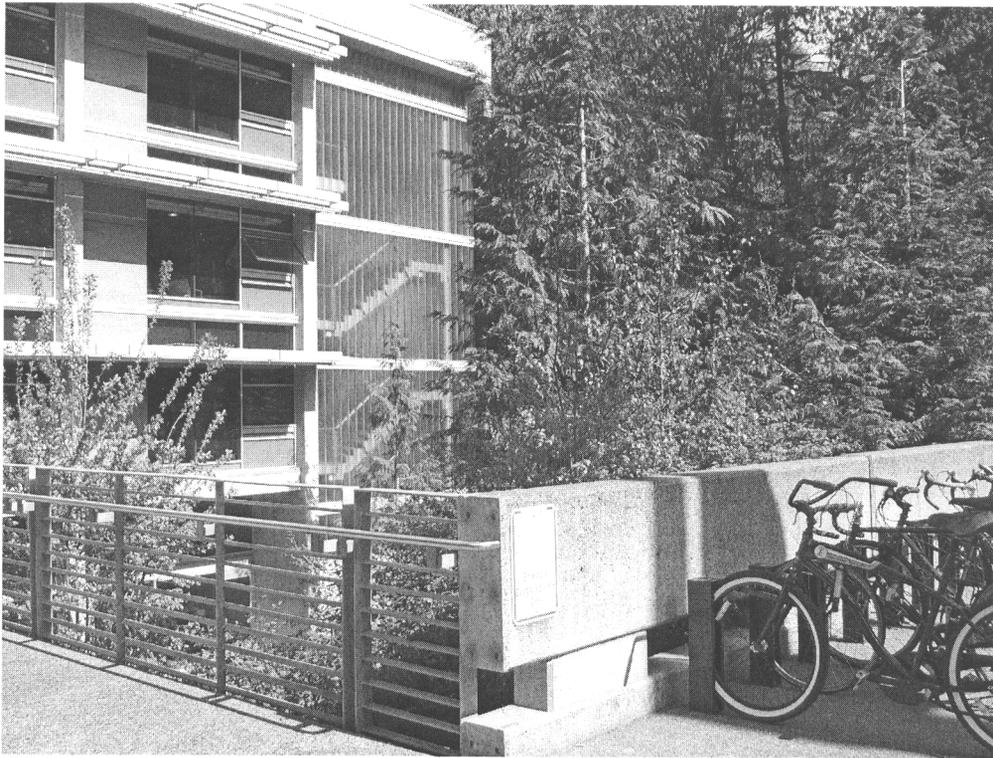


Figure 2

The survey was administered via email during February of Winter Quarter 2009. The questionnaire was accompanied by an email letter that explained the purpose of the survey and assured anonymity. The letter copy is included in the appendix. Response to the questionnaire was voluntary. Additionally, the BUS instrument does not require a name for electronic submission so respondents were able to answer questions anonymously. I found the process simple and straightforward. One recommendation on conducting evaluations from Leah Zagreus of the CBE was that rates of participation were higher when an online survey was sent from a well known decision maker from the organization. (Zagreus, et al. 2004) In this survey case, for example, a survey coming from the facilities manager's email address may have received more attention. An email from the President of the College would have likely garnered still more attention.

However, I did not want to add any burden to The Evergreen State College facilities manager and felt it inappropriate to ask the President, nor did I want to lose any control over survey administration. Survey response rates were important, but were not the main reason for the exercise.

Instrument

A licensing agreement prevents me from including a copy of the survey instrument herein, but a brief overview will help the reader understand the web survey. The Building Use Studies LTD 2008 survey includes inquiries about the air and temperature in the building according to the season; lighting; noise; comfort; design; needs; health; image to visitors; and productivity. It uses a 7 point scale, and has some areas for written comments at intervals deemed appropriate by BUS. Out of the 139 emails sent with the survey web link, I received 45 responses for a response rate of 32.4%. Mr. Adrian Leaman with Building Use Studies LTD compiled the data and compared Seminar II to the other 85 buildings in this specific set of international surveys.

I was pleased that the instrument gave individuals an opportunity to express themselves, as perhaps the pre-determined, non-building specific questions would not reflect each unique building concern thoroughly. BUS tries to avoid tailoring questions to a specific building because data collection and then establishing benchmarks across the industry would prove difficult for them. Furthermore, tailoring a survey for each building would also present a larger time commitment on the part of BUS and the particular building's survey administrator.

One individual who responded to the survey noted that the survey did not look at "visual comfort", or aesthetics. I support the survey respondent's interest in expanding the survey questions to include questions about the appearance of the building. This comment could help BUS decide whether to include aesthetics in future building evaluations. The user surveys that include comments are useful to the building industry and the survey creator alike.

I find the presence of two types of data, both qualitative and quantitative, in the survey findings of great value since quantitative and qualitative data are able to present similar information in differing ways to the different types of people who might read and interpret the results. In general, I think that combining POE methods (interviews, walk-throughs, physical measurements, surveys, group meetings) would add context, however due to the nature of this essay I limited the study to the web based survey. Ease of administration is the characteristic of the BUS online questionnaire I capitalized on when I chose to administer the survey. Following are some of the data results for the Seminar II occupant survey.

Qualitative Data

The collection of both quantitative *and* qualitative data is central to producing feedback and implementing change. Mr. Leaman from BUS compiled the data and included 17 and one half pages of written comments. There were over 300 total written comments that were organized under the categories similar to those listed in the instrument section. Some of the anonymous comments on the survey included concerns about noise levels in Seminar II:

- "Noise carries a lot;"
- "It's difficult to believe that much thought was given to noise. Hallway conversations interfere greatly with work in classrooms;"
- "The walls of Seminar II do not absorb sound well; thus I can hear conversations all up and down the hallway."

In coding the qualitative data, there were 20 comments concerning too much noise and 20 concerning not enough task lighting or too bright sun light. This is a considerable finding, since these comments account for close to half of the 45 respondents. However, with regard to lighting, seven said they really appreciated the lighting in Seminar II. It would be appropriate here in the survey to probe deeper with follow up questions to better understand the grievances about lighting and noise. This case shows the value in the aforementioned CBE post occupancy evaluation survey, which includes layers of further inquiry to each negatively answered question. With regard to noise complaints, in an article that mentioned a different BUS survey, Turpin-Brooks and Viccars noted that the building manager could later test the acoustics with an instrument to see if the building layout's open concept theme was part of the reported problem. These types of follow up studies and data collection can help substantiate the qualitative findings from occupant surveys.

I consider most of the 300 plus comments valuable because they provide information that can help resolve problems or concerns for users. These responses provide a reaction to noise levels and lighting in sustainable buildings in general, which will provide the industry with feedback.

These complaints may seem intractable after construction and might appear as issues the building manager could not remedy. However, placement of signs could discourage people from disruptive behavior (when possible) during hours of classroom learning. If others understood that conversations in the hallway breakout areas were distracting for students and instructors during class, perhaps they would find an alternative meeting area or conduct their conversations quietly. Communicating the special circumstances and needs of an area or entire building with all users is possible even after the design is set in stone. Creative problem solving can only occur if problems are known.

An illuminating comment is one person's perception of the design of Seminar II:

- "They did not hear us when we were participating in teh (sic) design process, why would they hear us now?"

This person must have felt locked out of the process, suggesting that building users would appreciate consultation and the integration of their input.

On an encouraging note, many people made comments about how much they appreciated the natural light and the views afforded by the windows. This feedback is a positive response for Seminar II. Builders, architects, and owners can consider including windows and access to natural light in their design plans in order to improve the perceived comfort of the occupants. If The Evergreen State College had been required in the LEED process to conduct a POE after the construction of Seminar II, these findings would be available from a USGBC survey database, which is where I recommend they house them. In fact, the data set may have been more robust had the email survey come from the President or

the well known head of facilities, as we have learned that surveys sent from people with high standing in the community get more attention.

Quantitative Data

Graphs and histograms of this particular survey are copyrighted by BUS and are not permitted in the public domain. These survey data, when analyzed, totaled 60 pages including slider and percentile graphs, and indices. Verbal interpretation is necessary here. The scale had seven points, 7 being the most positive and 1 being the least positive, with the number 4 at the midpoint. One concern was that the 7 point scale was not explained, so 4 could have been interpreted as slightly A or slightly B, or neutral about A or neutral about B. Here are some data gathered on the Seminar II building:

Basic Information

- Of the 45 respondents, 90% have been in the building one year or longer;
- The building is roughly in the top third of the summary index;
- The building is precisely in the top third of the satisfaction index; and
- 90% of individuals reported that they are close to a window.

Feedback

- 58% of occupants who responded to the Seminar II survey felt they had little or no control over noise. The building was in the 38th percentile of the 85 buildings in the Building Use Study. This means that 61 buildings out of 85 had better control over noise than the Seminar II building;
- 70% of survey participants felt that the image portrayed to visitors by the building was good (7 on the scale) or pretty good (6 on the scale);

- 70% also felt that the facilities met their needs very well (7 on the scale) or close to very well (6 on the scale);
- Nearly one-half (49%) of survey participants indicated that they felt that the air in the building during the summer was fresh (7 on the scale) or close to fresh (6 on the scale); however,
- 33% responded that in the summer the same air was too hot (1 on the scale) or close to too hot (2 on the scale).

Another interesting finding was that people felt an increase in productivity in the building. Improved understanding of whether a relationship between the social nature of the design of Seminar II and the perception of increased productivity is significant to learning about the how the design of a building can affect productivity within. This is outside the scope of this paper.

Early in the process, the Seminar II facilities manager indicated to me that they would happily look at survey results and correct anything that fit into The Evergreen State College's pre-determined facilities related budget. While it is unclear if the issues or grievances are part of the college budget for the 2009-11 biennium, in particular given the dire economic climate, his interest in listening to the occupants is encouraging and a testament to the use of a survey. The data are also of value to members of the industry interested in providing optimal circulation and air quality in a building. Furthermore, the support in this survey for how well the building portrays a good image on campus is a marketing tool for green building advocates and industry professionals.

V. Combining POE with LEED

People are a source of data, as evidenced by the post occupancy evaluation methods and results included in this essay. Written comments can provide rich

and meaningful feedback for building owners, architects and builders. The LEED rating system for New Construction as noted previously, omits a POE process, but **does** offer a single point under the Energy and Atmosphere category for evaluating the building's energy consumption for, at minimum, one year post-occupancy. While this is a good start, the LEED rating process needs to consciously incorporate the human perspective. Another of the LEED rating categories that builders, designers and owners aspire to earn points in is innovation: new and creative solutions to recognized problems. Surveys of occupants are a tool to gauge whether, with time, the green buildings are effectively incorporating known innovations. Paul and Taylor have said that "identifying and solving problems with green buildings should serve to build customer confidence and ensure the continued implementation of green building technologies." (Paul and Taylor 2007, 1867) This testimony supports the previously stated goal of the USGBC. The USGBC is interested in collecting data. What better way than to implement building use studies or POEs?

The reach of the LEED name positions the USGBC to provide leadership and gain a great deal of data from doing occupant evaluations for green buildings achieved via different strategies worldwide. According to the USGBC, projects are in progress in 41 different countries. Sharing results from post occupancy evaluations done for LEED India, LEED Canada NC 1.0, LEED Mexico, and LEED Brazil will diversify the data set by evaluating buildings built with the popular technologies employed in each area of the world. Due to LEED's exposure in a variety of countries, collection of post occupancy evaluation data

coupled with the LEED rating system has potential to impact the green building industry worldwide.

To the USGBC's credit, it has been flexible and has responded to input and criticism from industry professionals, including the product industry. The development of the LEED rating process has included industry professionals. The Current 2009 USGBC Board of Directors includes men and women representing multiple sectors and has a number of different committees with members from the industry and the field of sustainability. Specifically, it has a LEED Steering Committee, which "has the principal responsibility for developing and implementing LEED, both in the U.S. and internationally." (USGBC 2008) The Committee meeting minutes are posted on the website too, a gesture which allows for public oversight.

The USGBC has an opportunity to enhance its work in promoting sustainable design and gathering green building performance data from the perspective of the end user. The USGBC could model a committee after one they currently operate and create an Advisory or Steering Committee on post occupancy evaluations. Beyond that, the USGBC could create a searchable online database with the results of the post occupancy evaluations. It is conceivable that due to its unique nature, this database will generate inquiries from architects, designers, builders and academics, and thus increase exposure for the USGBC. The USGBC has implemented the LEED rating system with a great deal of ongoing feedback and continues to improve it collaboratively. This would suggest that to foster the development of green building into a successful industry

worldwide and for it to become a building industry norm, flexibility, malleability and inclusiveness is necessary for a certification method to achieve success. POE can help serve this end by including the perspective of people with the most exposure to the finished products, that is, the end users. The USGBC could integrate the trends that manifest from the post occupancy survey data into the LEED rating systems categories as prerequisites or in the list of additional optional points under the six categories. A paper written on green building assessment systems notes a major criticism. The complaint is that the standards of the rating system seem arbitrary because there is no straight forward explanation for them. (Retzlaff 2008) Post occupancy evaluations may help to clarify and fine tune some of the criteria and standards.

As discussed in an earlier section, the LEED rating system is imposed by many state agencies and utilized by institutions of higher education. The data from conducting end user surveys of state, city, college and university campuses alone would provide a considerable set of data for measuring green building performance. A cursory look at the list of USGBC registered LEED projects for New Construction (LEED NC) in the State of Washington alone had projects from 25 colleges and universities. Some of these schools are committed to sustainability and thus choose to build green. The LEED rating system is even mentioned in Evergreen's strategic plan for any future renovations. (The Evergreen State College 2007) Other institutions of higher education are State funded and are required to construct buildings using the level of LEED Certification. The State of Washington requires a LEED Silver rating for publicly

funded building projects for public agencies that meet or exceed 5,000 square feet. About 15 local government projects were listed for the State of Washington as well.

According to *The College Sustainability Report Card*, 126 schools in the US and Canada have one or more green building on campus. *The College Sustainability Report Card* provides profiles for 300 of the largest endowment colleges and universities in the US and Canada. It boasts a high response rate of 97 percent: 290 of 300 schools responded to at least one survey requesting information about their sustainability profile. *The College Sustainability Report Card* is an initiative of the nonprofit Sustainable Endowments Institute.

(Sustainable Endowments Institute 2008) Surveying occupants of some or all of these campus buildings would add to the dataset of green building performance from the perspective of end users.

Moreover, who better than the future leaders and members of the building industry to study the effectiveness of green building? Involving up-and-coming architects, project managers, developers and urban planners, to name just a few careers of college departments, in evaluating green buildings is a good fit for schools and universities interested in advancing sustainability in the building industry. "In becoming aware of environmental degradation...colleges and universities have an important role to play in shaping our future." (Barlett and Chase 2004, 177) According to a student from a Master in Energy Engineering program at Stanford University, helping to develop the guidelines for green building at Stanford gave students the opportunity to put their learning to work in

order to help better the world, starting with one campus building. (Barlett and Chase 2004, 5) University of Cincinnati architecture students learn about post occupancy evaluation during their coursework. They have opportunities to conduct building POEs in the community through service learning. The architecture students that have conducted the POEs take with them the concepts they have applied to live buildings in their area to the industry through 21 month internships at well over 400 architecture firms. (Preiser 2001) Harnessing the energy of students interested in sustainability on higher education campuses would only add to the efforts of the United States Green Building Council to gather performance data.

VI. Benefits and Challenges of Combining

Benefits

As outlined by POE expert Dr. Wolfgang Preiser of the University of Cincinnati, conducting post occupancy evaluations has advantages for multiple stakeholders and these benefits are characterized to occur in three time frames: short term benefits include modifying the building and fixing problems expressed by the end-users; mid-term benefits include integrating feedback to improve projects that follow; and long term benefits include creating design guidelines or blue-prints long into the future. (RJ and RA 2003)

According to Turpin-Brooks et al, results of a study that uncover problems with the building "could lead to change, which is [actually] a sign of value from a POE." (Turpin-Brooks 2006, 183) Suzanne Enright, from her post as Director of Information Systems and Library Services at University of Westminster, writes

about the Higher Education Design Quality Forum's (HEDQF) efforts to conduct "strategic and non-recriminatory" post occupancy evaluations. The main pursuit has little to do with finger pointing and noticing wrong doing, and everything to do with framing the process as a positive one, as in: what was done right? The HEDQF evaluation process looks at context and design; at construction and cost; at space and management; and at environment and sustainability. (Enright 2002)

It is important to note that negative issues with the buildings are not ignored entirely. Actually, the Building Use Studies LTD site notes that avoiding issues later is the main focus of conversations around problems that do come up for HEDQF POEs, and therefore negative issues *are* addressed. At any rate, innovators should welcome the critique, as praise is bound to follow eventually. The Building Use Studies LTD observes something profoundly important here: "Even successes can be overlooked where there is no feedback."

Because occupants feel more connected to the facilities they work in, building and facilities managers can benefit from learning about shortcomings of buildings as reported by the occupants. This relationship between building manager and occupier is beneficial. An international architectural firm called Post Occupancy Evaluation, home to world-class experts in the field, notes on its' website, "This participation [between manager or owner and occupant] has been shown to engender greater commitment to solutions, and more willingness to accept shortcomings." Aside from the relationships developed between the managers and occupants, building users form relationships with their buildings. Enright says that post occupancy evaluations help to increase occupants'

understanding of how the building works and is run. "Post occupancy evaluations can clearly be used [for the] dissemination of expertise." (Enright 2000, 19) Further, the information provided in the survey results helps management to address the specific concerns or complaints occupants have about the subject building.

A number of states require different levels of LEED rating for state funded buildings over a certain amount of square footage and many colleges and universities are governed by these rules. Thus, many institutions of higher learning have LEED rated buildings on their campuses. The Center for the Built Environment at the University of California at Berkeley promotes industry/university collaborations:

"The intellectual objective of graduate research in building science is uncovering the processes by which a building affects its occupants, evaluating the human/economic/energy consequences of the effects, and incorporating this knowledge in new procedures to design more acceptable buildings." (Center for the Built Environment)

Many higher education institutions are interested in advancing sustainability and are committed to serving as sustainability laboratories. Appropriate departments at colleges and universities could survey occupants in green buildings as part of student learning objectives. An architecture department, an engineering program or another program based on the built environment could conduct research to further their learning. A number of student researchers could serve as survey administrators, thus advancing their knowledge and adding to the data set. Megan Paul, program coordinator of The Arizona State University's (ASU) Master of Real Estate Development program,

shared with me in an early April 2009 phone conversation that during the 200812009 academic year ASU recently offered LEED AP training and sponsored the test for students who wished to take it. 20 plus of the 32 enrolled students participated in the training and went on to take the LEED AP exam, which ASU paid for.

Now that we have looked at some benefits, we shall move on to discuss some of the challenges of combining a post occupancy evaluation component with the LEED rating system.

Challenges and Barriers

Not all buildings that are built using sustainable design measures seek certification from an outside party for cost saving reasons, among others. Data for the buildings not affiliated with the USGBC will not be captured. Further, though not likely in the near future, if certifying with LEED falls out of vogue, an ongoing collection of data and benchmarks for green buildings will prove difficult.

Researching and/or creating a novel survey instrument to capture the perspectives of occupants in green buildings will cost someone money and in challenging economic times, this may prove a barrier. Conducting post occupancy evaluations will also add additional cost to the certification fees for the managers of the building project if the USGBC requires them to shoulder the financial burden. It could end up costing the USGBC potential revenue if they offer a rebate to projects that are willing to conduct the POEs. However, I would argue that the investment on the part of the USGBC would serve them well since

they are seeking performance data. In earlier works, Bordass concludes that sharing information from POE can lower costs in the building design process. (Rordass 2003) The financial issue is a challenge here. The Usable Building Trust notes in a brochure on their website that "... although everybody benefits [from the feedback loop] nobody wants to pay." Mark Way and Bill Bordass (Bordass a team member at the Usable Building Trust) report that "once a building is physically complete, designers and builders move on to the next project. Few of them stay around to learn from what they have done and pass on their insight to the occupants." (Way and Bordass, 2005)

There is also the matter of reluctance from the building industry. Buy in from industry professionals is critical and their support and understanding is necessary to get this concept off the ground. Architects and builders may look down upon critiques and input coming from non-colleagues or individuals not in the industry. Framing the effort as an opportunity to do research to improve the green building industry for the people inside is part of the mission of integrating user evaluations of green buildings. Industry professionals and building managers should not consider this a finger pointing exercise aimed at uncovering negative aspects of a building through post occupancy evaluations.

VII. Recommendations and Further Research

This essay explores the reasons for coupling post occupancy evaluation with the LEED green building rating method and touches briefly on means to achieve this end. There is room for further exploration and more discussion in this particular area.

First, an interesting question has come up in the literature: Do respondents favor green building, thus skewing the reality of their experience? This subject needs more research so the creation of a new occupancy survey specifically for green buildings can evaluate performance from an occupant's perspective *without* potential bias.

Second, an important step in the process is evaluating the available instruments and selecting the appropriate one to couple with the LEED rating process. The BUS post occupancy evaluation questionnaire employed in concert with this thesis essay is one of the survey instruments available. The similar CBE survey is another. Development of a rigorous survey of any kind is time consuming, but the USGBC should consider studying the instruments in existence and creating one to specifically provide feedback for the green building industry and their LEED rating system. In order to make comparisons and indicate improvement, standardization of the POE method for green building is critical. (Turpin-Brooks 2006) Further, it is not clear how the USGBC would couple POE with the LEED rating system. The question remains whether it would be a required step in the LEED process, or whether a rebate of a portion of the certification fees upon completion of a POE is incentive enough to garner participation by building project managers.

Third, it stands to reason that post occupancy evaluations done by geographic region would reflect particular trends and necessities particular to each specific region of the world. Countries have adjusted the United States LEED standards for their own cultural norms and climates. According to a presentation

on the non-profit organization the Confederation of Indian Industry's Green Business Centre website, LEED India adapted the standards for flooring and carpets: dust accumulation is an issue in their region of the world. They also needed to accommodate many more two wheeled vehicles, motorcycles for example, in their parking plans. Collecting data specific to the country could help to tailor make the LEED rating system requirements and reflect cultural norms and climates. Perhaps POEs could help uncover priorities and interests or concerns specific to different regions. This could assist future builders, designers and owners in planning for "locally relevant sustainability goals and concerns." (Retzlaff 2008) Unfortunately, during the research period, I was unable to access LEED International's site because they are integrating the new LEED 2009 standards. Opportunities to collaborate with LEED International or green building councils worldwide and the potential impacts of regionally focused green building require more research.

Finally, many publicly funded buildings in the United States are mandated to meet requirements set forth by LEED, and therefore green building design has become a public issue. This means buildings built using the LEED rating process are accountable to the users and ought to perform well since tax dollars are spent on such projects. Another line of research would involve seeing if users are satisfied with the buildings and if the buildings are cost effective and a good use of the public's money.

VIII. Conclusion

First of all, including the human perspective as part of the feedback mechanism for buildings is not a novel idea, but coupling it with a green building rating system is a start in the direction of considering end users during the design process of green buildings. Given the United States Green Building Council's interest in establishing green building performance data, looking at the LEED rating system as a partner to post occupancy evaluations and use studies is a good place to begin.

Next, the United States Green Building Council has created a name for itself and the LEED rating system in the United States and worldwide, and thus it is well situated to serve the purpose of collecting data on green building performance. Along with measuring energy use, water audits and other natural resource monitoring, I view this as an opportunity to utilize the human perspective to improve upon sustainable design for the future.

Furthermore, interest from the international community in sustainable design, green building and building assessment is high; therefore now is an opportune time to start on this endeavor. Ultimately, if coupled with energy audits and water use data, a large set of post occupancy evaluation data collected over time can provide information for green building practices that are as sustainable as technically possible, high performing and pleasing both to owners and to occupants. In the long run, the idea is to cut and paste the quality parts from existing buildings. Dr. Larry Geri, faculty in the Master in Public

Administration department, has likened this to setting up a system of blueprints from successful building models.

Next, standardizing the inclusion of post occupancy evaluations into normal operating procedures for campuses, including higher education campuses, government campuses or corporate campuses, will provide an opportunity to collect a great deal of data on the final green building products. Enright says POEs can "allow fine-tuning and learning lessons for the future." (Enright 2003, 42) It is possible that more data will help increase the practice of building sustainably, while also improving existing buildings that are built green.

Finally, post occupancy evaluations can assist in vetting the good features and the bad features in green building design by learning about which design and building concepts work well and which do not. Using evaluations will help acceptance, innovation and success to prevail for the green building industry. Coupling user surveys or occupancy evaluations with the LEED rating system is a logical solution. A suitable location for the results of the evaluation information is with the USGBC. Industry professionals should view creating quality and high performance green buildings as a challenge or, better yet, as an opportunity to build upon for the future. Pursuing the endeavor should avoid entirely aiming any criticism at particular builders, designers, architects and others industry professionals involved in the process. In actuality, combining a post occupancy evaluation component to the USGBC's LEED rating system and post occupancy evaluation may help shed some light on the performance of green buildings and include the human perspective in the process.

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The Usable Building Trust website

<<http://www.usablebuildings.co.uk/WebGuideOSM/AboutBus.html>>

APPENDIX

Invitation letter emailed to Seminar II occupants

<begin email>

[Link to the Occupant Survey for Seminar II Below you will find a message to you and the IMPLIED CONSENT FORM. After reading, please click on this link, or copy it and paste it into your browser, to take the ~5 minute survey <http://www.usablebuildings.co.uklQ978/TwoPageStandard.html>]

Dear Seminar II Occupant & Survey Invitee:

As a student in the Evergreen Masters in Environmental Studies program I have chosen to write a thesis on the US Green Building Council's use of Post Occupancy Evaluation in their Leadership in Energy and Environmental Design (LEED) certification process. The purpose of this thesis is to illuminate the value of post occupancy evaluation for the field of sustainable building. It will also provide survey data for future building industry professionals. I am administering an online survey for Seminar II faculty, staff & deans.

The information you provide in the surveys will only be seen by me & Adrian Leaman, a professional in the field who will only report summaries, no personal info. **PLEASE DO NOT INCLUDE YOUR NAME.** Any risks to you are minimal and the survey results will be anonymous. There will be no compensation for your participation, which is voluntary.

I will use your responses only as resource material for my Master's Thesis on post occupancy evaluation and LEED certification. A copy of the final draft of the thesis will be available in Evergreen's library, which you may look at upon completion. Adrian Leaman of Building Use Studies in the UK will provide the survey results collected in the aggregate and will add the data set to his collection of BUS surveys worldwide.

Thank you very much for your participation and assistance. High response rates are important in any study, and your taking the time to contribute to my learning is invaluable.

Sincerely,

Lucienne Guyot, MES Graduate Student

IMPLIED/PASSIVE INFORMED CONSENT AGREEMENT

I hereby agree to serve as a subject in the Master's Thesis on integrating post occupancy evaluation with the US Green Building Council's LEED certification program. It has been explained to me that the purpose of conducting a post occupancy evaluation is to substantiate the student's research, to establish benchmarks and to explore the value of a relationship between LEED certification and requiring post occupancy evaluation. I am also aware that the information I provide will only be viewed by Lucienne Guyot for her Master's Thesis and Adrian Leaman of Building Use Surveys in Great Britain, who created and compiles the feedback for these surveys. I understand that my identity will be kept confidential and that any comments, if documented, will be done so anonymously. I WILL NOT INCLUDE MY NAME ON THE ONLINE SURVEY.

There is no compensation of any kind for my participation. Lucienne Guyot has explained to me that the final thesis will be available in the Evergreen library upon completion.

If I have any questions or comments, I may call Lucienne at 206-234-1211 or email her at guyluc07@evergreen.edu or guyotl@evergreen.edu. Likewise, the person to contact if I experience problems as a result of my participation in this thesis project is Eddy Brown, Academic Dean at The Evergreen State College, SEM II D4107; Tel 360-867-6972.

I understand that my participation in this thesis project is completely voluntary, and that my choice of whether to participate in this project will not jeopardize my relationship with The Evergreen State College. I understand that providing my name is optional. I am free to withdraw at any point if I do not wish to complete and/or submit the survey. I am not to include my name. I have read and agree to the foregoing and by finishing and submitting this online survey, I imply consent to serving as a subject for these purposes.

Lucienne Guyot

MES Graduate Student

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