Indoor Environment Quality + Workplace Environment Integrated Science and Engineering Laboratory Facility (ISELF) St. Cloud State University, St. Cloud, MN Report 1

April 2015, Minneapolis, MN
Sustainable Post-Occupancy Evaluation Survey (SPOES)
B3 Guidelines

Denise A. Guerin, PhD (contact: denise@mgdesignresearch.com)
Theresa R. Bauer, MA
Abimbola Asojo, PhD

College of Design
University of Minnesota

1.0 Overview

The purpose of this report is to examine the connection between sustainable design criteria used in the design of the Integrated Science and Engineering Laboratory Facility (ISELF) and occupants' satisfaction with their work environments located in the ISELF. The ISELF facility was designed using the B3 Guidelines (formerly known as the Minnesota Sustainability Guidelines or MSBG) and completed for occupancy in 2013. The B3 Guidelines track specific state-funded, B3 buildings as a means of demonstrating real outcomes aimed at the conservation of energy resources, creation and maintenance of healthy environments, and occupants' satisfaction with their work environments. The Sustainable Post-Occupancy Evaluation Survey (SPOES) was developed to assess human outcomes in workplace, classroom, and residence hall settings in compliance with the B3 Guidelines project tracking requirements. This is a report of occupants' (hereafter called employees) responses at 18 months post-occupancy. The survey was conducted in April 2015 and is the first of two required survey events for this building.

This SPOES report focuses on employees' satisfaction with the physical environment as related to 25 indoor environment quality (IEQ) criteria such as lighting, thermal, and acoustic conditions in their primary workspaces, i.e., offices. Employees' satisfaction with the facility (site, building, and interior) and the effect of the facility's physical environment on their perceptions of their work performance and health also are included. Finally, a brief look at employees' commuting and physical activities within the building are reported. The report provides descriptive information about employees' perceptions of the IEQ of their work environments. In addition, this information serves the broader development of knowledge regarding the influence of IEQ on employees.

2.0 Method

SPOES consists of a self-administered, Internet-based, questionnaire submitted to and completed by employees. The SPOES questionnaire has been tested for **validity (**measures what it is intended to measure) and **reliability (**repeatability or replicability of findings). Employees rate their level of satisfaction on a **Likert-type scale** (measurement scale) from 1 (very dissatisfied) to 7 (very satisfied) with IEQ of the facility and their primary workspaces. They also rate the influence of their physical environment on their perception of their work performance and health on a scale from 1 (hinders) to 7 (enhances). There were no physical measurements taken of environmental conditions such as temperature or acoustic level. This study is limited to employees' perceptions.

The report provides a descriptive summary of the results stated as a **mean** (average of all responses), **standard deviations** (SD) (how different scores are from each other and the mean), and **number of responses** (N) for each question analyzed. The mean for a 7-point scale is 4.00. Lower or higher means reflect stronger tendencies towards dissatisfaction/satisfaction and hinders/enhances. Means that are close to the center of the scale (4) are considered to be neither dissatisfied/hinders or satisfied/enhances.

When interpreting **mean** responses, the following labels were used:

- 1.0 - 3.5 dissatisfied (hinders)
- 3.51 - 4.5 neither satisfied (enhances) nor dissatisfied (hinders)
- 4.51 - 7.0 satisfied (enhances)

An IEQ Score is also calculated for employees' satisfaction with IEQ in their primary workspaces. This is a

statistical combination of all IEQ scores, which results in a single IEQ score for all employees on all IEQ variables and is reported in an IEQ Scorecard.

2.1 Description of the Questionnaire

Employees first rate their level of satisfaction with the facility (site, building, and interior) and the influence of their physical environment on their perception of their work performance and health. Then they responded to questions about their satisfaction with their primary workspaces in relation to IEQ criteria from the B3 Guidelines.

In the SPOES questionnaire, the 25 IEQ criteria listed below are evaluated. There are two levels of criteria, categories and attributes. As shown in the list, the 'overall' criteria are boldfaced and called 'categories' or 'category level' criteria. A category is broader or more general such as Overall View Conditions or Overall Indoor Air Quality. Some categories have 'attributes' or 'attribute level' criteria and provide greater detail about the category. For example, Overall Thermal Conditions is a category level question, and there are four attribute level questions related to thermal conditions such as adjustability, air velocity (draft), humidity, and temperature. Overall Acoustic Conditions is a category with attributes of employees' ability to hear desired sounds and their ability to limit undesired sounds. There are 12 category-level and 13 attribute level questions. Means are calculated and reported for all category and attribute-level criteria.

An IEQ Satisfaction Score is also calculated for employees' satisfaction with IEQ in their primary workspaces. This is a weighted mean statistical combination of the 12 category-level criteria only and results in a single, mean IEQ Satisfaction Score for all employees' satisfaction with the physical conditions of their primary workspaces. Attribute-level criteria are not included in the IEQ Score because unequal weight would be given to criteria that have both category and attribute-level questions.

In the following list, **category (boldface)** criteria are listed in alphabetical order. If a category has attributes, they are listed with the category.

Overall Acoustic Quality
- Ability to hear desired sounds
- Ability to limit undesired sounds

Overall Appearance (aesthetics)
Overall Cleaning and Maintenance
Overall Daylighting Conditions
- Amount of daylighting
- Adjustability of daylighting

Overall Electric Lighting Conditions
- Amount of electric lighting
- Adjustability of electric lighting
- Adjustability of task lighting

Overall Furnishings
- Function of furnishings
- Adjustability of furnishings

Overall Indoor Air Quality
Overall Privacy
Overall Technology
Overall Thermal Conditions
- Adjustability of thermal conditions
- Air velocity (drafty/stagnant))
- Humidity (dry or moist)
- Temperature (hot or cold)

Overall Vibration and Movement
Overall View Conditions

Additionally, employees' physical activities, commuting practices, and recycling behaviors within the building were investigated.

2.2 Limitations

Employees' participation is voluntary, and responses are self-reported. As is true with all survey research, the responses indicate employees' perceptions. There were no physical measurements, e.g., temperature, humidity, or lighting levels, of the environment taken.

3.0 Sample Description

3.1 Description of Building

The ISELF facility is located at 8th St S and 2nd Ave S, St Cloud, MN. The building (see Figure 1) is associated with the College of Science and Engineering (COSE) on the St. Cloud State University campus. The ISELF facility is a four-story 102,000 square foot building that includes universal laboratories, classrooms, offices, and meeting spaces supporting COSE research initiatives. The building serves a multi-disciplinary academic environment supporting collaboration, experiential learning, and innovation between students, staff, and regional business.

Figure 1. ISELF (Photo: http://www.rrtlarchitects.com)

3.2 Description of Respondents

The ISELF is used by faculty and members of the business community for research purposes. Approximately 1,000 students have classes in this facility. This survey was administered to 21 full-time employees (faculty) with workspace in the facility during the spring semester period. The response rate to the questionnaire was approximately 71%. Of those responding, 73% were male and 27% were female. The mean age of respondents was over 49 years, with a range of 42 to 58 years.

The ISELF was completed and ready for operation in August, 2013. Since that time, 93% of the respondents reported that they worked at the ISELF since the building opened and7% of the respondents spent less than one year at this site. Relating to hours worked during a typical week at ISELF, 21% of the employees reported they spend 40+ hours a week in the facility; 7% spend 30-40 hours a week at ISELF; 36% spend 20-29 hours at ISELF; and 36% spend less than 20 hours in the ISELF facility.

Relating to the time employees spend per week in their primary workspace, 20% of the employees reported they spend more than 75% of their weekly time in their primary workspace; 25.6% spend 51-75% of their time in their primary workspace; 7.7% spend 25-50% of their time in their primary workspace; and 5.1% spend less than 25% of their time in their primary workspace. These responses indicate the amount of time employees are exposed to IEQ conditions in their workplace environment.

ISELF is a research facility with private offices, workstations (cubicles), and laboratories serving as primary workspaces. Results indicated 67% of the employees work in a laboratory setting, 20% have private offices and 13% work in a cubicle (enclosed by partitions). Employees also indicated that 47% of their primary workspaces were located within 15 feet of an exterior window and 53% of the employees were not within 15 feet of an exterior window.

4.0 Findings and Discussion

4.1 ISELF Facility (Site, Building, and Interior): Overall Satisfaction, Work Performance, and Health

Employees responded to questions concerning the ISELF facility (site, building, and interior) and their overall satisfaction with the facility, overall perceptions of their work performance in relation to the facility, and their overall perception of their health in relation to the facility. Table 1 shows the means and standard deviations of their responses as well as how the responses are interpreted. Figure 2 is a graph that shows the mean for each question with a blue mark. The standard deviation is shown by the green/red, vertical bar with green representing satisfied (or enhanced) and red representing dissatisfaction (or hindered). Gray represents the 'neither/nor' range of responses. This graph is simply a visual image of the findings from Table 1.

Table 1. ISELF facility - overall satisfaction, work performance, and health

Facility (site, building, and interior)	Mean (1-7)	SD	N	Interpretation
Overall satisfaction	5.60	1.30	15	Satisfied
Overall work performance	5.67	1.45	15	Enhances
Overall health	5.27	1.16	15	Enhances

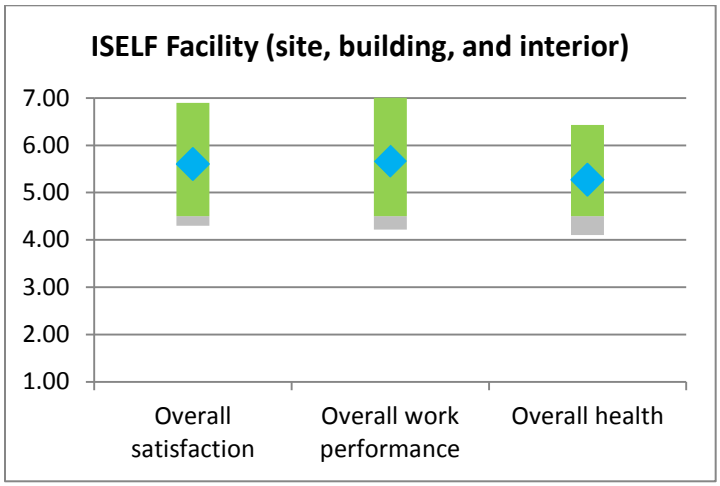

Figure 2. ISELF facility - overall satisfaction, work performance, and health

Results indicated that employees were **satisfied** (**M = 5.60**) with the ISELF facility (building, site, and interior) and reported that their overall work performance was **enhanced** (**M = 5.67**) by the facility. Employees reported that their overall health was **enhanced** (**M = 5.27**) by the facility.

4.2 Primary Workspace: Overall Satisfaction, Work Performance, and Health

Employees responded to questions concerning their overall satisfaction and overall perceptions of their work performance and health as related to their primary workspace (e.g., private office, workstation, or other primary workspace). Table 2 shows the means and standard deviations of their responses as well as how the responses are interpreted. Figure 3 is a visual image of the findings from Table 2; an explanation of the graph was given for Figure 2.

Table 2. Primary workspace – overall satisfaction, work performance and health

Primary Workspace	Mean	SD	N	Interpretation
Overall Satisfaction	5.20	1.93	15	Satisfied
Overall Work Performance	5.13	1.36	15	Enhances
Overall Health	4.86	1.66	14	Enhances

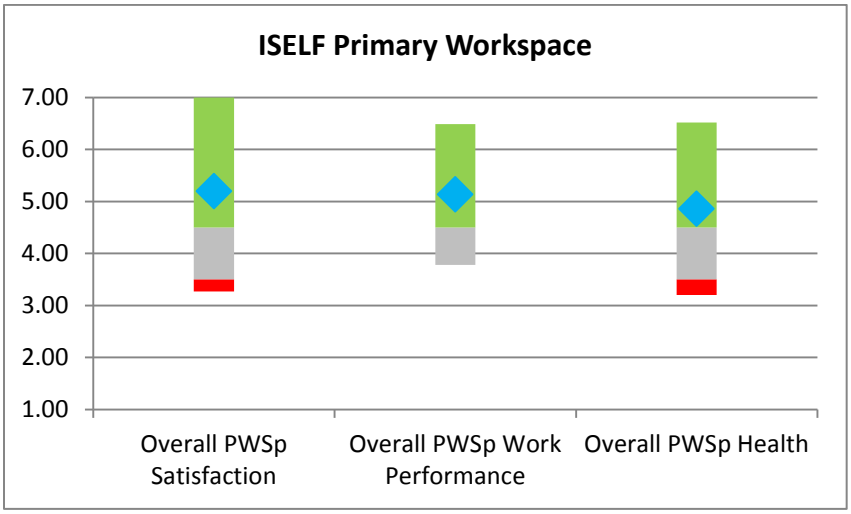

Figure 3. Primary workspace - overall satisfaction, work performance, and health

Results indicated that employees were **satisfied** (**M = 5.20**) with their primary workspace, their overall work performance was **enhanced** (**M = 5.13**) by their primary workspace, and their overall health was **enhanced** (**M = 4.86**) by their primary workspace.

4.3 Primary Workspace: Satisfaction with Indoor Environment Quality (IEQ)

Employees responded to questions concerning their satisfaction with IEQ categories (thermal conditions, indoor air quality, acoustic conditions, etc.) related to their primary workspace (e.g., private office, workstation, or other primary workspace). Table 3 shows the means and standard deviations of their responses as well as how the responses are interpreted. Figure 4 is a visual image of the findings from Table 3; an explanation of the graph was given for Figure 2.

Table 1. Primary workspace - satisfaction with IEQ conditions

#	IEQ Criteria (1-25) (Category level criteria are bold face)	Mean	SD	N	Interpretation (D = Dissatisfied) (S = Satisfied)
1	**Overall daylighting conditions**	5.93	1.71	15	**Satisfied**
2	Amount of daylighting	5.80	1.66	15	Satisfied
3	**Overall view conditions**	5.80	1.70	15	**Satisfied**
4	**Overall vibration and movement**	5.73	1.62	15	**Satisfied**
5	Air velocity (drafty or stagnant)	5.73	1.58	15	Satisfied
6	Ability to hear desired sounds	5.60	1.30	15	Satisfied
7	**Overall indoor air quality**	5.53	1.46	15	**Satisfied**
8	Humidity (dry or moist)	5.53	1.41	15	Satisfied
9	Amount of electric light	5.47	1.60	15	Satisfied
10	Adjustability of daylighting	5.33	1.84	15	Satisfied
11	**Overall appearance (aesthetics)**	5.33	1.63	15	**Satisfied**
12	Adjustability of task lighting	5.27	1.58	15	Satisfied
13	**Overall thermal conditions**	5.27	1.58	15	**Satisfied**
14	Air velocity (drafty or stagnant)	5.13	1.73	15	Satisfied
15	Temperature (hot or cold)	5.00	1.89	15	Satisfied
16	Adjustability of furnishings	5.00	1.77	15	Satisfied
17	Function of furnishings	4.93	1.71	15	Satisfied
18	**Overall cleaning and maintenance**	4.93	2.20	14	**Satisfied**
19	**Overall acoustic quality**	4.71	2.05	14	**Satisfied**
20	**Overall furnishings**	4.67	1.63	15	**Satisfied**
21	Adjustability of electric lighting	4.47	2.29	15	Neither S or D
22	**Overall technology**	4.27	1.79	15	**Neither S or D**
23	Ability to limit undesired sounds	4.27	2.09	15	Neither S or D
24	Adjustability of thermal conditions	4.14	2.03	14	Neither S or D
25	**Overall privacy (sound and visual privacy)**	3.93	2.05	15	**Neither S or D**

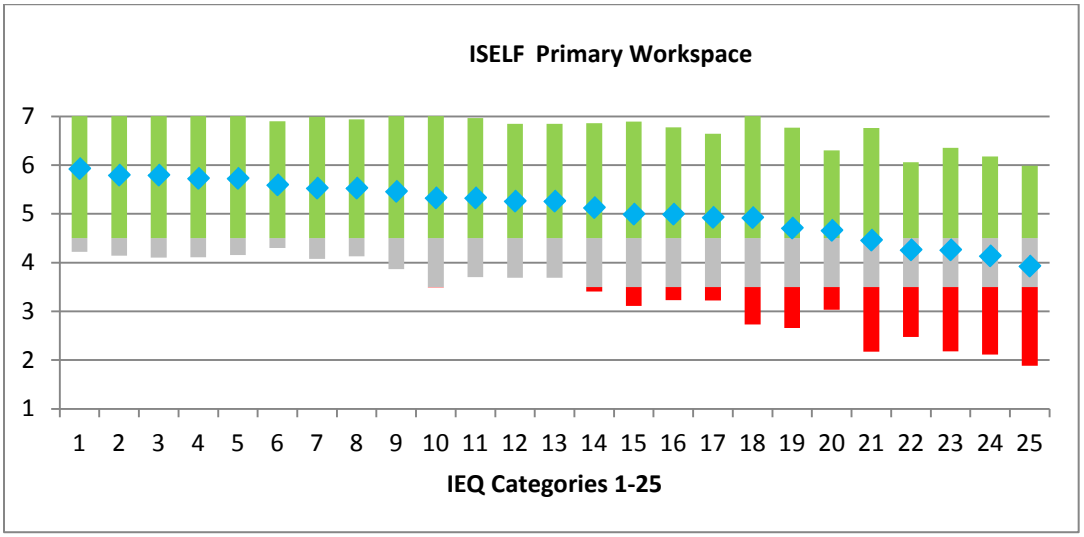

Figure 4. Primary workspace - satisfaction with IEQ categories (IEQ 1-25 are listed in Table 3 above)

Results indicate that employees were satisfied with 20 of the IEQ criteria in their primary workspaces, i.e., means at or above 4.50. Employees indicated that they were neither dissatisfied nor satisfied with five IEQ criteria e.g., adjustability of electric lighting, overall technology, ability to limit desired sounds, adjustability of thermal conditions, and overall privacy (sound and visual privacy). The bottom five criteria are ripe for change to improve employees' satisfaction with their primary workspaces and will be addressed in Section 6.2 Recommendations. Further explanation of these scores also can be found in Appendix A. Open-Ended Responses.

4.4 IEQ Satisfaction Scorecard

The IEQ Satisfaction Score is determined by calculating a mean of all overall category level IEQ criteria. At this time, all variables are weighted equally in this calculation as little evidence exists that provides rationale for weighting some variables heavier than others. The IEQ mean is representative of a fair overall IEQ score and can serve as a benchmark of employees' satisfaction with the physical environment of their primary workspace. As shown in Figure 5, the **IEQ Satisfaction Score** for ISELF is **5.11.**

Figure 5. Primary Workspace - IEQ Satisfaction Score

Overall, the employees showed a positive, but low level of satisfaction with IEQ as indicated by the weighted mean score of **5.11**. As shown in Table 3, satisfaction with the Overall daylighting conditions in the workplace and the Overall view conditions were the criteria with the highest satisfaction and pulled the IEQ Satisfaction Score in a positive direction. However, neutral satisfaction with the overall technology conditions and Overall privacy (sound and visual privacy) pulled the IEQ Score down. These issues can be addressed by building management to increase employees' satisfaction. Please note that the IEQ Satisfaction Score only uses the category level criteria (those labeled 'Overall'; see section 2.1, paragraph 3 for explanation). There were neutral mean scores with other criteria that must be addressed as well. These will be noted in Section 6.2 Recommendations

5.0 Physical Activity Engagement and Commuting Practices

In the final section of the survey, employees responded to questions regarding their overall physical

activity while at ISELF (site, building, and interior) and their commuting practices.

5.1 Physical Activity Engagement

Providing employees with opportunities for alternative paths of travel around the workplace, e.g., taking stairs as opposed to the elevator, provides opportunities to engage in additional types of physical activities. Engaging in physical travel throughout the work environment can be associated with healthier lifestyles.

Table 2. Overall physical activity (walking, stair use, etc.) affected by the ISELF facility

ISELF facility (site, building, and interior)	Mean (1-7)	SD	N	Interpretation
Overall physical activity (walking, stair use, etc.)	5.93	1.22	15	Enhances

Results indicated that employees felt that ISELF **enhanced** (**M = 5.93**) their physical activities (walking, stair use, etc.). Further, of the 15 employees responding to this question, 80% said they were **satisfied** with the facility's influence on their overall physical activity and 20% said they were **neither dissatisfied nor satisfied**.

5.2 Commuting Practices

ISELF is centrally located on the St. Cloud State University (SCSU). The facility and SCSU campus area is serviced by the Metro Bus and provides students with free transportation throughout the city. The campus is also serviced by shuttle service and provides several parking lots and ramps for commuters. The SCSU campus supports a bicycle program to promote healthy and eco-friendly around campus.

Table 5 provides results on employees' primary mode of transportation; Table 6 summarizes commuting distances between home and the ISELF facility; and Table 7 summarizes employees' ability to commute using alternative choices (walk, public transit, bike, van, or carpool, etc.). These results, although not related to IEQ, do offer the University insight into employees' commuting behaviors and opinions. These data can provide important information about commuting practices that can reduce transportation energy consumption.

Table 3. Commuting Practices – ISELF Primary mode of transportation

Primary mode of transportation	Drive alone (or with children < 16)	Van or Carpool	Combo Drive/Bike
Commuting to ISELF	87%	6.5%	6.5%

Related to primary modes of transportation, 87% of employees drive alone (or with children under 16), 6.5% carpool or vanpool with others, and 6.5% drive a car in the winter / bike in the summer.

Table 4. Commuting Practices – ISELF Commuting distance traveled

Miles Traveled	0-5 miles	6-15 miles	16-30 miles	31+ miles
Home-to-ISELF (One-way)	26.5%	19.5%	26.5%	26.5%

Results indicated that 26.5% of employees commuted 0-5 miles one-way between home and the ISELF,

followed by 19.5% who commute 6-15 miles, 26.5% who commute between 16-30 miles, and 26.5% who commute over 31+- miles to the ISELF facility. All of these are one-way miles.

Table 5. Commuting practices – ISELF location and alternative commuting behaviors

Alternative Commuting	Mean (1-7)	SD	N
Ability to commute in alternative ways	3.93	1.16	15

Results indicated that location of the ISELF **neither enhances nor hinders** (M = 3.93) employees ability to commute to work in alternative ways, e.g., walk, bicycle, public transit, van or carpool, etc. Further, of the 15 respondents, 7% said the location **enhanced** their commuting options, 80% were **neither hindered nor enhanced** by the location of ISELF, and 13% indicated that the location **hindered** their ability to commute in alternative ways.

6.0 Conclusions

6.1 Summary

A post-occupancy evaluation was conducted of employees of ISELF at approximately 18 months after it was first occupied. This ISELF facility is used by faculty, students and regional business partners; however, this survey was only administered to the full-time employees. Results indicated that 66% of the employees spend less than 30 hours per week in the ISELF facility, 46% of the employees spend less than 50% of their time at ISELF in their primary work space, and 67% of the employees work in a laboratory setting. Future POE investigation for this site should consider other user groups for this survey to develop a broader scope of understanding of the workplace and IEQ conditions.

The survey included questions related to employees' overall satisfaction with the facility (site, building, and interior) and influence of the facility on their overall work performance and health. Employees were **satisfied** with the facility (**M = 5.60**); they found the facility **enhances** their overall work performance (**M = 5.67)** and **enhances** their overall health (**M = 5.27**). In addition, slightly lower results were reported when employees were asked these same questions about their primary workspaces (private office, shared office, laboratory, etc.). They reported overall **satisfaction** (**M = 5.20**) with their primary workspaces, and that their overall work performance was **enhanced** (**M = 5.13**) and overall health was **enhanced** (**M = 4.86**) by their primary workspace. As the range of scores was from 1-7, scores that showed satisfaction is in a low to mid-level range, although still positive.

Most of the survey questions related to employees' satisfaction with the IEQ categories in their primary workspaces (private office, laboratory, etc.). Employees' responses showed they were **satisfied** with the majority of the IEQ categories. The mean satisfaction scores ranged from **4.67** (Overall furnishings) to **5.93** (Overall daylighting conditions). Again, this shows a moderately positive level of **satisfaction**. Employees responded **neither dissatisfied nor satisfied** to five IEQ criteria**:** Adjustability of electric lighting (4.47), Overall technology (4.27), Ability to limit undesired sounds (4.27), Adjustability of thermal conditions (4.14), and Overall privacy (3.93). There were no IEQ criteria rated in the Dissatisfied range, however, improvements can still be made.

From employees' responses, an IEQ Score was developed and shows respondents' satisfaction with the IEQ of all category level criteria. For ISELF, the IEQ Satisfaction Score was **5.11.** This score reflects the

moderate satisfaction level with the other categories. Finally, employees reported that ISELF **enhances** their physical activity, which is one of the sustainable design criteria that influence occupant behavior.

6.2 Recommendations

The satisfaction scores are certainly in the positive direction, however, improvement may be possible. For IEQ categories that have physical measurement possible, e.g., thermal, acoustic, and lighting, it is recommended that these measurements be taken in both overall workspaces and primary, individual workspaces. Recommendations follow:

Thermal Conditions

- Determine special thermal comfort requirements or problems that may be encountered in the building due to work activities or sitting or design considerations. Focus groups can be useful in identifying problem locations.
- Determine if any employees' task areas differ now from original intent to be sure air flow is the same as originally designed.
- Review conditions that affect thermal comfort using ASHRAE Standard 55-2004 or Human Factors Design Handbook.
- Measure performance variables on site.
- Log complaints related to thermal conditions.

Lighting Conditions

- Identify employees' performance criteria that are to be met to achieve goals.
- Determine if any task areas differ now from original intent t to be sure light patterns, quantity, and quality are not impeded by changing walls, ceilings, or fixtures.
- Develop additional quality lighting criteria as needed for special facility issues such as employees' ages, duration of task, influence of daylight quality or quantity.
- Conduct onsite measurements using Illuminating Engineering Society standards for employees' tasks.
- Log complaints related to lighting conditions.
- Identify problem locations that may be affected most by lack of control over daylighting, which can cause glare and eyestrain.

Acoustic Conditions

- Identify acoustic criteria for overall requirements.
- Determine if any task areas differ now from original intent including collaborative work spaces now being located adjacent to focus work areas (individual workstations).
- Develop any additional special acoustical performance requirements to support functional programming employees' tasks, e.g., sources of recurrent noise that need to be controlled, special user populations that may have distinct auditory performance limitations, or multiple uses of building spaces that may have different acoustic criteria. Investigate and choose appropriate acoustics modeling software for the project.
- Measure acoustic performance onsite with full systems running.
- Identify employees' privacy concerns via focus groups or log complaints.
- Consider employees' tasks within shared spaces to determine if change can be made for increased acoustic control.

Privacy Conditions

- Identify employees' privacy concerns via focus groups or log complaints to determine if visual or audio privacy is most affected.
- Determine if any task areas or responsibilities differ from ordinal intent.
- Consider adding noise masking equipment and/or visual screening depending on nature of complaints.
- Compare acoustic privacy problem areas with acoustic measurements to pinpoint specific problem areas.

Personal Adjustability

- Determine if adjustability issues arise with temperature, lighting, or furnishings via focus group.
- Identify personal, individual problem areas and relate to other IEQ issues via log of complaints.
- Provide education to employees about adjustability of any applicable adjustment options, e.g., furnishings, air diffusers, lighting, temperature control, etc.

It seems obvious that employees' satisfaction can be improved by addressing the categories that had 'neither dissatisfied nor satisfied' scores. However, the rest of the criteria can receive some attention as well. The above recommendations can help address change in these criteria to further improve employees' satisfaction. Exploring these areas in more detail and making adjustments may increase overall satisfaction at the primary workspace. It must be noted that employee expense is second only to the cost of the actual facility in most business operations. It is a good investment to improve employees' satisfaction, which, in turn affects their performance and their health.

This study investigated employees' satisfaction with the facility and primary workspaces. IEQ satisfaction is individual, but the results of the survey show a central tendency of moderate satisfaction with the facility and most of the IEQ categories. The results can be used as a diagnostic tool to aid in improving IEQ conditions for employees and to set the benchmarks from which improvement can be measured in the future.

Appendix A. Open-Ended Responses

Employees had the opportunity to raise specific concerns on the overall facility and their primary workspaces. Important information can be gleaned from the open-ended responses. ISELF employees raised specific concerns about the following themes: cleaning and maintenance, furnishings, elelctric lighting, space/layout, privacy, technology, and thermal/ indoor air quality (IAQ) . Though these qualitative responses overall appear as the employees are dissatisfied; it does not mean they represent the overall sentiment from employees. However, the comments do give insight into specific issues that should be addressed by building management. Generally, the comments are shown as written.

Overall Positive

- I am so happy that I DO have a private space, no matter how old, not-maintained and outdated it is!
- Benches and cabinets are excellent.

Cleaning and Maintenance

- Regarding overall maintenance, floor drains were requested in numerous spaces. Where they were installed, floors were sloped toward the drains only within a 3-foot radius of the drain, which requires that a squeegee be used to move water to the drain. Also, in many spaces, water on a floor simply migrates into other spaces. Very poor floor design.

Furniture

- Need more chairs and cabinets in open lab space.
- Not all research activities require a basic lab bench. Many require space use activities that do not involve lab benches. The building was poorly furnished. Many spaces do not have lab chairs or cabinets in which users may secure research supplies. This latter issue has resulted in substantial theft of lab items.

Lighting

- Electric lighting is on a digital light management system. In most cases, after settings have been implemented for a space, such settings change in a seemingly random manner. Most building occupants would have preferred non-automated lighting systems (i.e., simple light switches controlling lighting in limited areas within a space). Instead, frequently one has to troubleshoot the DLM in order to remedy lighting issues. Simple light switches would have been preferable.
- Lighting and HVAC controls are consolidated for energy management, which is a good thing, but this has an overall negative impact on working conditions.
- The lights flicker on and off all the time. Very disturbing!

Space / Layout

- Too few sinks in open lab space.
- Too few small rooms for isolation projects
- Lack of office space (secure office space) hinders work activities.

Privacy

- Privacy within ISELF is, in a general sense, non-existent. Lab spaces were designed to be very open, particularly within the integrated research space. This physically prohibits isolation of research projects that require control of selected environmental variables (e.g., lighting, particulate debris in the air, contamination by other space occupants, etc...).

Technology

- Limited Ethernet capabilities in the building make it difficult to work sometimes.

Thermal / IAQ

- Basement air is stale and too warm.
- Air temp and humidity bad in early morning.
- Seems to be issues with controlling humidity especially in the basement. Some labs/instrument spaces do not have air returns in them. Temperature seems to fluctuate with season. Maybe after the bugs are worked out this will less of an issue.
- Thermal conditions should be adjustable by occupants or at least set more or less uniformly in the building at approximately 72 degrees F. Instead they are determined by facilities personnel who are encouraged to implement energy-conserving (i.e., cold) thermal conditions. There are frequent concerns from building occupants regarding temperature. The vivarium within ISELF is supplied air by an air handler that frequently draws in odors from the diesel-powered generator situated next to ISELF and from construction activities outside of the building. For reasons that cannot be explained, we do not detect such odors in spaces supplied by other ISELF air handlers.
- The enclosed walkway connecting ISELF to the adjacent Wick Science Addition is typically well below 72 degrees F. Most building occupants find the walkway cold.

Appendix B. Glossary

Descriptive statistics
Statistics used to summarize large sets of data (i.e., means, frequencies, medians). Descriptive statistics describe only the sample under consideration and are not intended to infer results to the larger population.

Frequency
A descriptive statistic that provides information about how many of a particular response or measurement is observed.

Likert-type scale
A measurement technique, employed in questionnaires and interviews, that utilizes a range of standardized response categories such as strongly agree, agree, etc.

Mean
The average score of a set of data calculated by adding all scores together, then dividing by the number of scores.

N
The number of subjects or participants responding to the questions, or a single question, in the study.

Reliability
The repeatability or replicability of findings; the same results are produced each time. Instruments and procedures should produce the same results when applied to similar people in similar situations, or on a second occasion.

Standard deviation
A statistic used to measure the variability of a group of scores (how different scores are from each other and the mean). For example, if the range of scores is 1-7 and the mean (average) is 5.0 with a standard deviation of 1.0, then the scores are closely clustered around the mean, i.e., there is one unit of variation among all scores. If the mean was 5.0 and the SD was 3.0, there is a broader range of variation among the scores…a smaller SD means the scores are similar and the mean score is likely to be more accurate and more useful (this is better!).

Validity
The extent to which an instrument or procedure measures what it is intended to measure (internal validity). The generalizability of results to another population (external validity).