



**Indoor Environmental Quality + Workplace Environment  
MnSCU Minnesota State University, Moorhead: Livingston Lord Library  
Renovation (MSUM-LLL)**

**April 2016, Minneapolis, MN  
Sustainable Post-Occupancy Evaluation Survey (SPOES)  
B3 Guidelines**

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## 1.0 Overview

The purpose of this report is to examine the connection between sustainable design criteria used in the design of the MnSCU Minnesota State University, Moorhead: Livingston Lord Library (MSUM-LLL) facility and occupants' satisfaction with their work environments located in the facility. The MSUM-LLL facility was designed using the 2008 B3 Guidelines (formerly known as the Minnesota Sustainable Building Guidelines or MSBG), which were in effect at the time that the building was funded. It was completed for occupancy in three phases; most of it was occupied in August 2013, with the remainder occupied in May 2014. 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 from the survey conducted in February 2016.

This SPOES report focuses on employees' satisfaction with the physical environment as related to 26 indoor environmental 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).

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:

- 1.00 - 3.50 dissatisfied (or hinders)
- 3.51 - 4.50 neither dissatisfied (or hinders) nor satisfied (or enhances)
- 4.51 - 7.00 satisfied (or enhances)

An IEQ Score is also calculated for employees' satisfaction with IEQ criteria in their primary workspaces. This is a statistical combination of all category-level (explained below) IEQ scores, which results in a single IEQ score for all respondents 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 respond to questions about their satisfaction with their primary workspaces in relation to IEQ criteria from the B3 Guidelines. Additionally, employees' demographic, physical activity, and commuting practice data are collected to provide context for the study.

In the SPOES questionnaire, the 26 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 14 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 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**

- Access to electric outlets

### **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**

## 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. This study is limited to employees' perceptions.

## 3.0 Sample Description

### 3.1 Description of Building

The MSUM-LLL facility is located at 1104 7<sup>th</sup> Avenue South, Moorhead, MN. The building (see Figure 1) is a four-story 131,993 square foot building that includes 34,344 square feet of office space that are comprised of private offices, shared enclosed offices, workstations, open desk areas, and a work area in a lab for employees. There are also employee support areas, a data server room, and a workshop. Only the overall facility and primary workspaces were included in this study. The building serves to support the academic and cultural experience of the university's students, faculty, and citizens of the region and to encourage their active, life-long learning.



Figure 1. MSUM-LLL (Photo courtesy of MSUM-LLL)

### 3.2 Description of Respondents

This survey was administered to 43 employees with workspace in the facility during February 2016. The response rate to the questionnaire was over 53%. Of those responding, 67% were male, 29% were female, and 5% responded as other. The mean age of respondents was 45 years, with a range from 32-60 years of age.

The MSUM-LLL was renovated and ready for operation in three phases; the majority of the facility was occupied in August 2013 and the remainder was occupied in May 2014. Since that time, 86% of the respondents reported that they worked at the MSUM-LLL facility for more than 2 years and 14% have

worked at the facility for 1-2 years. Relating to hours worked during a typical week at MSUM-LLL, 35% of the employees reported they spend 40+ hours a week in the facility; 60% spend 30-40 hours a week at MSUM-LLL; and 5% spend 20-29 hours at MSUM-LLL.

Relating to the time employees spend per week in their primary workspace, 52% of the employees reported they spend more than 75% of their weekly time in their primary workspace and 48% spend 51-75% of their time in their primary workspace. These responses indicate the amount of time employees are exposed to IEQ conditions in their workplace environment.

MSUM-LLL is a workplace with private offices, enclosed shared offices, workstations (cubicles) with low partitions, desks in open office areas, and work areas in a lab serving as primary workspaces. Employees indicated that 52% of their primary workspaces were located within 15 feet of an exterior window and 48% of the employees were not within 15 feet of an exterior window.

## **4.0 Findings and Discussion**

### **4.1 MSUM-LLL Facility (Site, Building, and Interior): Overall Satisfaction, Work Performance, and Health**

Employees responded to questions concerning the MSUM-LLL 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, which is identified 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. In cases where there were no dissatisfied responses, the bar may be all green or gray and green. This graph is simply a visual image of the findings from Table 1.

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

<b>Overall</b>	<b>Mean</b>	<b>SD</b>	<b>N</b>	<b>Interpretation</b>
Satisfaction	4.41	1.40	22	Neither dissatisfied nor satisfied
Work Performance	4.09	1.28	22	Neither hindered nor enhanced
Health	4.23	0.95	22	Neither hindered nor enhanced

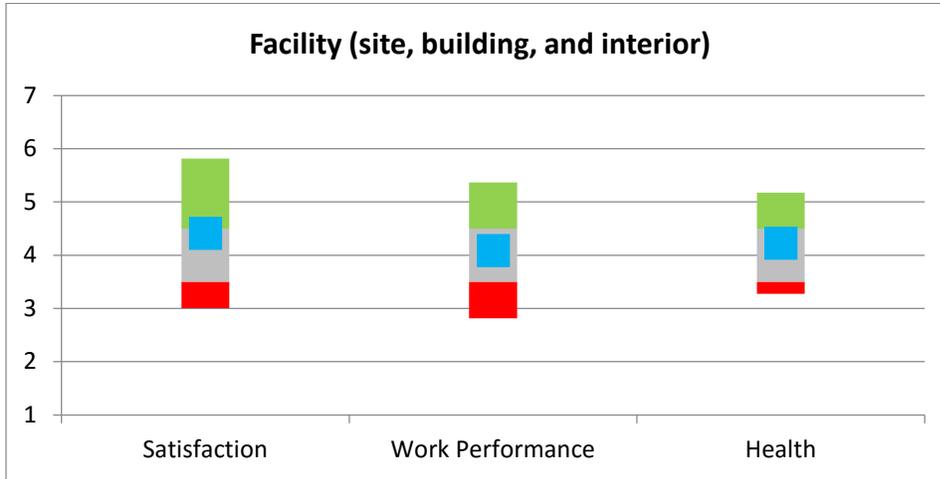


Figure 2. MSUM-LLL facility - overall satisfaction, work performance, and health

Results indicate that employees were **neither dissatisfied nor satisfied (M = 4.41)** with the MSUM-LLL physical environment of the facility (building, site, and interior) and reported that their overall work performance was **neither hindered nor enhanced (M = 4.09)** by the facility. Employees reported that their overall health was **neither hindered nor enhanced (M = 4.23)** 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. MSUM-LLL primary workspace – overall satisfaction, work performance and health

Overall	Mean	SD	N	Interpretation
Satisfaction	3.45	1.47	22	Dissatisfied
Work Performance	3.52	1.37	21	Neither hindered nor enhanced
Health	4.00	0.85	22	Neither hindered nor enhanced

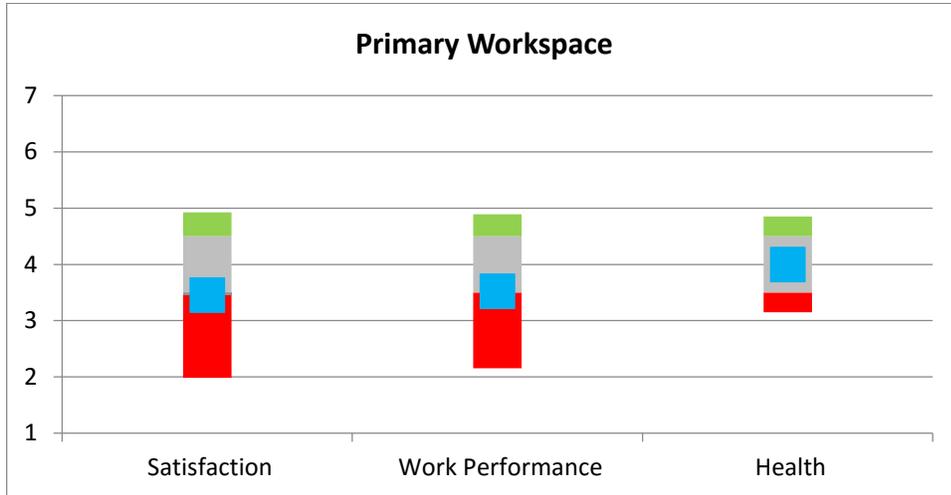


Figure 3. MSUM-LLL primary workspace - overall satisfaction, work performance, and health

Results indicate that employees were **dissatisfied (M = 3.45)** with their primary workspace, their overall work performance was **neither hindered nor enhanced (M = 3.52)** by their primary workspace, and their overall health was **neither hindered nor enhanced (M = 4.00)** by their primary workspace.

#### 4.3 Primary Workspace: Satisfaction with Indoor Environmental 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 from highest to lowest mean, 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 3. MSUM-LLL primary workspace - satisfaction with IEQ criteria

#	IEQ Criteria (1-26) (Category level criteria are bold face)	Mean	SD	N	Interpretation (S = Satisfied) (D = Dissatisfied)
1	<b>Overall vibration and movement</b>	<b>5.24</b>	<b>0.97</b>	<b>21</b>	<b>Satisfied</b>
2	<b>Overall technology</b>	<b>5.19</b>	<b>1.43</b>	<b>21</b>	<b>Satisfied</b>
3	<b>Overall cleaning and maintenance</b>	<b>4.71</b>	<b>1.28</b>	<b>21</b>	<b>Satisfied</b>
4	Access to electric outlets	4.71	1.67	21	Satisfied
5	Humidity (dry or moist)	4.38	1.36	21	Neither S or D
6	<b>Overall indoor air quality</b>	<b>4.24</b>	<b>1.54</b>	<b>21</b>	<b>Neither S or D</b>
7	Amount of electric light	4.19	1.62	21	Neither S or D
8	Air velocity (drafty or stagnant)	4.19	1.59	21	Neither S or D
9	Adjustability of task lighting	4.19	1.50	21	Neither S or D
10	<b>Overall appearance (aesthetics)</b>	<b>4.14</b>	<b>1.42</b>	<b>21</b>	<b>Neither S or D</b>
11	<b>Overall daylighting conditions</b>	<b>4.00</b>	<b>1.93</b>	<b>21</b>	<b>Neither S or D</b>
12	<b>Overall thermal conditions</b>	<b>3.95</b>	<b>1.50</b>	<b>21</b>	<b>Neither S or D</b>
13	<b>Overall electric lighting conditions</b>	<b>3.95</b>	<b>1.62</b>	<b>21</b>	<b>Neither S or D</b>
14	Ability to hear desired sounds	3.95	1.43	21	Neither S or D
15	Amount of daylighting	3.76	2.04	21	Neither S or D
16	Temperature (hot or cold)	3.62	1.53	21	Neither S or D
17	Function of furnishings	3.62	1.40	21	Neither S or D
18	Adjustability of daylighting	3.62	1.99	21	Neither S or D
19	<b>Overall furnishings</b>	<b>3.52</b>	<b>1.47</b>	<b>21</b>	<b>Neither S or D</b>
20	Adjustability of task lighting	3.48	1.79	21	Dissatisfied
21	<b>Overall view conditions</b>	<b>3.29</b>	<b>1.39</b>	<b>21</b>	<b>Dissatisfied</b>
22	Adjustability of furnishings	3.10	1.63	21	Dissatisfied
23	<b>Overall privacy (sound and visual privacy)</b>	<b>2.90</b>	<b>1.72</b>	<b>21</b>	<b>Dissatisfied</b>
24	<b>Overall acoustic quality</b>	<b>2.90</b>	<b>1.41</b>	<b>21</b>	<b>Dissatisfied</b>
25	Adjustability of thermal conditions	2.81	1.56	21	Dissatisfied
26	Ability to limit undesired sounds	2.62	1.53	21	Dissatisfied

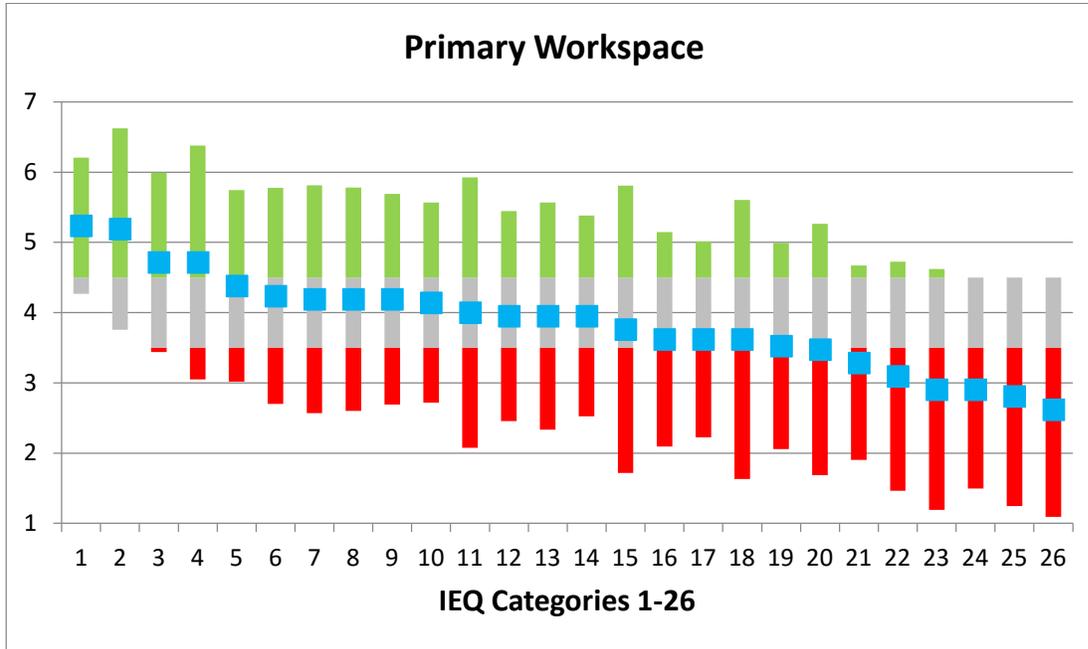


Figure 4. MSUM-LLL primary workspace - satisfaction with IEQ criteria (IEQ 1-26 refer to Table 3)

Results indicate that employees were **satisfied** with four of the IEQ criteria in their primary workspaces, i.e., means at or above 4.50. Employees were **neither satisfied nor dissatisfied** with 15 of the IEQ criteria, ranging from a mean of 3.52 (Overall furnishings) to 4.38 (humidity, dry or moist). Employees indicate that they were **dissatisfied** with seven IEQ criteria, e.g., adjustability of task lighting (3.48), Overall view conditions (3.29), adjustability of furnishings (3.10), Overall privacy (sound and visual privacy) (2.90), Overall acoustic privacy (2.90), adjustability of thermal conditions (2.81), and ability to limit undesired sounds (2.62). The seven criteria that employees were dissatisfied with are ripe for change to improve employees’ satisfaction with their primary workspaces. However, those criteria in the ‘neutral’ satisfaction range can also be reviewed and considered for change. Potential for change 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 the 12 ‘Overall’ category level IEQ criteria. At this time, criteria are weighted equally in this calculation as little evidence exists that provides rationale for weighting some criteria 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 MSUM-LLL is **4.00**, which falls at the central point of the **neither satisfied nor dissatisfied** range. The large number of criteria with scores near or below the mean contribute to this low IEQ Score.



Figure 5. MSUM-LLL primary workspace - IEQ Satisfaction Score

As shown in Table 3, satisfaction with the Overall vibrations and movement, Overall technology, and Overall cleaning and maintenance were the criteria with the highest satisfaction means (4.71 or higher) and pulled the IEQ Satisfaction Score in a positive direction. However, nine mean scores below 4.5 out of 12 category-level criteria pulled the IEQ Score down. Please note that the IEQ Satisfaction Score only uses the category level criteria (those labeled ‘Overall’; see section 2.1, paragraph 3 for explanation).

### 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 MSUM-LLL (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 4. Overall physical activity (walking, stair use, etc.) affected by the MSUM-LLL facility

MSUM-LLL facility (site, building, and interior)	Mean	SD	N	Interpretation
Overall physical activity (walking, stair use, etc.)	4.71	0.72	21	Enhanced

Results indicate that employees felt that MSUM-LLL **enhanced (M = 4.71)** their physical activities (walking, stair use, etc.).

#### 5.2 Commuting Practices

MSUM-LLL is located in Moorhead, MN, just across the Red River from Fargo, North Dakota. There are general and reserved parking lots on the west, south, and east sides of campus. Also, within one block of the building are two bus stops with scheduled stops every 15 minutes during peak rider hours and every 30-minutes during non-peak hours. The MSUM-LLL facility is located in the center of campus.

Table 5 provides results on employees' primary mode of transportation; Table 6 summarizes commuting distances between home and the MSUM-LLL 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 insight into employees' commuting behaviors and opinions. These data can provide important information about commuting practices that can reduce transportation energy consumption.

Table 5. Commuting Practices – MSUM-LLL Primary mode of transportation

Primary Mode of Transportation (N=21)	Drive Alone (or w/children <16)	Van or Carpool	Walk
Commuting to MSUM-LLL	81%	14%	5%

Related to primary modes of transportation, 81% of employees drive alone (or with children under 16), 14% carpool or vanpool with others, and 5% walk.

Table 6. Commuting Practices – MSUM-LLL Commuting distance traveled

Miles Traveled (N=21)	0-5 miles	6-15 miles	16-30 miles	31-45 miles	46+ miles
Home-to- MSUM-LLL (One-way)	33%	33%	19%	10%	5%

Results indicate that 33% of employees commute 0-5 miles one-way between home and the MSUM-LLL and another 33% commute 6-15 miles, followed by 19% who commute between 16-30 miles, 10% who commute between 31-45 miles, and who 5% commute 46+- miles to the MSUM-LLL facility. All of these are one-way miles.

Table 7. Commuting practices – MSUM-LLL location and alternative commuting behaviors

Alternative Commuting	Mean	SD	N
Ability to commute in alternative ways	4.1	0.89	21

Results indicate that location of the MSUM-LLL **neither hindered nor enhanced** (M = 4.1) employees' ability to commute to work in alternative ways, e.g., walk, bicycle, public transit, van or carpool, etc.

## 6.0 Conclusions

### 6.1 Summary

A post-occupancy evaluation was conducted of employees of MSUM-LLL at approximately 30 months after it was first occupied. This MSUM-LLL facility is used as university campus library and contains staff offices and support service space. This survey reports responses from employees and their satisfaction with the physical environment of the facility and their primary workspace. Results indicate that 95% of employees spend more than 30 hours per week in the MSUM-LLL facility, and 100% of employees spend more than 50% of their time at MSUM-LLL in their primary work space.

The survey included questions related to employees' satisfaction with the facility (site, building, and interior) and influence of the facility on their work performance and health. Employees were **neither dissatisfied nor satisfied** with the facility (M = 4.41); they found the facility **neither hindered nor**

**enhanced** their work performance (**M = 4.09**) and **neither hindered nor enhanced** their health (**M = 4.23**). In addition, slightly lower results were reported when employees were asked these same questions about their primary workspaces (private office, shared office, cubicles, etc.). They reported **dissatisfaction (M = 3.45)** with their primary workspaces, that their work performance was **neither hindered nor enhanced (M = 3.52)**, and their health was **neither hindered nor enhanced (M = 4.00)** by their primary workspace. As the range of scores was from 1-7, no positive association with employees' overall satisfaction and enhancement is demonstrated via their facility and primary workspace scores; all were below the satisfied/enhanced level.

Most of the survey questions related to employees' satisfaction with the IEQ criteria in their primary workspaces (private office, cubicles, etc.). Employees' responses showed they were **satisfied** with four of the 26 IEQ criteria. The mean satisfaction scores ranged from **4.71** (access to electrical outlets) to **5.24** (Overall vibration and movement). Again, this shows a moderately positive level of **satisfaction**. Employees responded **neither dissatisfied nor satisfied** to 15 IEQ criteria and were **dissatisfied** with seven IEQ criteria: adjustability of task lighting (3.48), Overall view conditions (3.29), adjustability of furnishings (3.10), Overall privacy (sound and visual privacy) (2.90), Overall acoustic privacy (2.90), adjustability of thermal conditions (2.81), and ability to limit undesired sounds (2.62).

From employees' responses, an IEQ Score was developed and shows respondents' satisfaction with the IEQ of all category level criteria. For MSUM-LLL, the IEQ Satisfaction Score was **4.00**. This score reflects the influence of the low satisfaction level with many of the categories. Finally, employees reported that MSUM-LLL **enhances (4.71)** their physical activity, which is one of the sustainable design criteria that influences occupant behavior.

It seems obvious that employees' satisfaction can be improved by addressing the categories that had dissatisfied (7 criteria) or 'neither dissatisfied nor satisfied' (15 criteria) scores. Also, the Overall furnishings category is an area that might want to be addressed as its score (3.52) is only .02 above the dissatisfied range (3.50). The following recommendations can help address change in these criteria to further improve employees' satisfaction. Exploring these areas in more detail and making adjustments also may increase overall satisfaction at the primary workspace. It must be noted that the expense of building and operating a facility is second only to employee-related expenses over the life of the building. Therefore, maintaining or improving employees' satisfaction is a sound investment, 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 a low level of 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.

## **6.2 Recommendations**

A few of the IEQ criteria satisfaction scores are in the positive direction, however, improvement on the 'neutral' and dissatisfied criteria may be possible. For IEQ categories that can be physically measured (e.g., thermal, acoustic, and lighting), it is recommended that these measurements be taken in the primary workspaces. Specific recommendations for the most common areas of occupants' concern follow:

### **Acoustic Conditions**

- Identify acoustic criteria for overall requirements.
- Determine if any task areas differ now from their original spatial layout/use (i.e., collaborative work spaces now located adjacent to focused work areas, individual workstations).
- Develop specialized 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). Identify and apply appropriate acoustics modeling software for the project.
- Measure acoustic performance onsite with full building systems (heating, ventilation, and air conditioning) running.
- Identify employees' privacy concerns via focus groups and/or log complaints relative to acoustical conditions for further evaluation.
- Consider employees' tasks within shared spaces to determine if spatial layout changes can be made for increased acoustic control.

### **Lighting Conditions**

- Identify employees' lighting performance criteria that are to be met to achieve goals by conducting onsite measurements of existing illumination and compare them to standards for employees' tasks as identified by the Illuminating Engineering Society (IES).
- Determine if any task areas differ now from original intent to be sure illumination level and quality of lighting are not impeded by physical changes to the space (i.e., walls, ceilings, furnishings, fixtures, or equipment).
- Develop additional quality lighting criteria as needed for special facility (e.g., influence of daylight quality or quantity) or employee (e.g., age, task duration) issues.
- Log complaints related to lighting conditions for further evaluation.
- Identify poor lighting conditions in the workspace caused by a lack of control over daylighting, which can cause glare and eyestrain.

### **Personal Adjustability**

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

### **Privacy Conditions**

- Identify employees' privacy concerns via focus groups or log complaints relative to privacy to determine if visual or audio privacy is most affected.
- Determine if any task areas or responsibilities differ from original intent and develop alternatives or modifications.
- Consider adding noise masking equipment and/or visual screening depending on the nature of the complaints.

- Document and compare acoustic privacy problem areas with acoustic measurements to pinpoint specific problem areas.

### **Thermal Conditions**

- Measure thermal performance conditions on site.
- Log complaints related to thermal conditions for further evaluation.
- Determine special thermal comfort requirements or problems that may be encountered in the building due to physicality of work activities, duration of sitting, or design/layout considerations. Focus groups can be useful in identifying problem locations.
- Determine if any employees' task areas differ now from original layout to determine if air flow is meeting systems design intent.
- Review conditions that affect thermal comfort using ASHRAE Standard 55-2004 or *Human Factors Design Handbook* (see B3 Guidelines).

## 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 survey responses. MSUM-LLL employees raised specific concerns about the following themes: acoustics, cleaning and maintenance, furniture, control of lighting, space/layout, technology, and thermal conditions. Though these qualitative responses overall appear as if employees are dissatisfied; it does not mean they represent the overall sentiment from employees. However, comments do give insight into specific issues that should be addressed by building management. Generally, comments are summarized below.

### Overall Negative

- It could have been so much more.
- This redesign is terrible.
- There was no consideration for employee health and well-being in this area when this was redesigned.
- I would have liked greater input to my working space when the planning phase was happening. We were invited to a few meetings but after that decision meetings were closed to us to add input or suggestions for improvements.
- I was not allowed to review or input any mid to later timeline design requirements to the workshop space that I use for my job duties.

### Acoustics

- The ITV conference room next door could have used some sound deadening between the walls. The auditorium was designed for the Film Studies Major and anytime they show movies the sound travels through the walls very easily.
- In the cube world we work in these conversations travel and are disruptive to others in our area. The conference rooms also have very poor sound insulation.
- There is no means of having a private conversation. It can be difficult when in a webinar or on the phone to hear well if others are also speaking elsewhere within cube-land. There is no way to block out sound or people popping in when needing to have focused concentration.
- The cube environment is awful, no sound containment at all.
- I use a personal oscillating fan on my desktop to give me a little white noise. I've worked in a cubical environment most of my career and sometimes a fan will help buffer noise in the neighboring cubes (i.e., phone conversations, etc.).

### Cleaning and Maintenance

- It would've been nice if they would've cleaned the brick on the walls after the remodeling was complete. There are white blotches of something all over the walls in the building and it looks extremely tacky. It's embarrassing when outsiders come to visit the Library.

### Furniture

- It would have been nice to have the option of an adjustable desk, standing or sitting option.
- Office desk configuration is ok but awkward. The lateral file drawers have a great amount of wiggle to them when they are pulled out and the whole cabinet seems unstable. The bookcase is also wobbly and the edges come over the front of the binders on the shelf and you need to take out a binder next to it to get the one on the end of the shelf out.

- The desk height is not adjustable which is not functional. Not everyone is the same height.
- Our work space is not adequate enough for all of the storage and work area we need in the office.
- I think it is important in this day in age to have work space areas have the ability to adjust the height of their desk as we are on them all day and going from standing to sitting as needed would be most beneficial.

### Lighting

- I have an office north facing window and it is great for bringing in daylight but I don't have the direct sunlight that would affect seeing my computer. So benefits without most of the downsides.
- Working in a cubicle environment is not pleasant. We have no windows for any sort of natural lighting.
- The lighting is not adjustable.

### Space / Layout

- The area our group was placed in isn't very conducive to the type of work we do - frequent meetings with faculty that require a level of confidentiality (looking at student specific work/scores/etc.).
- We are crammed in like sardines, my cubicle has been converted to more of a storage area to help accommodate all of the storage space we need, but it's still not adequate enough to accommodate all that we need.
- Working in a cube that is all interior (no exterior walls or windows) is very confining and depressing.
- Work space seems to be unevenly disbursed in the building. We seem to have been either an after-thought to the space allocation or our space allocation was restricted due to failed negotiations of the space during space planning.
- The physical environment of my primary workspace conforms to standards established by MnSCU. That is the most that can be said about it.
- Not enough space for our equipment. Too many people in one small room. People tripping over stuff. Feels like I work in a frat house and live in a discarded technology basement some days. My work area is functional but it's nothing to brag about to anyone.
- Outside view from the office is great with trees but the interior view looks out to a closet in the hallway.

### Technology

- The outlets are on one wall only which forces me to use outlet strips to get my computer equipment plugged in.
- I cannot access the Internet via WiFi in my office. It's very frustrating. If I take my laptop three steps out of my office, the WiFi works fine - but NOT while I am INSIDE of my primary workspace.
- Something that resembles a thermostat is on the wall, we were told by the contractors early on that it has no function.

## Thermal

- This building is way too humid in the summer!!!!
- The air handling system does not work as designed. We have had many instances where the rooms are too cold and others are too hot. There doesn't seem to be a working balance.
- Overall the climate control works well, except when the air exchangers go out.
- It is still pretty bloody cold in this building at times.

## 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).