Indoor Environmental Quality + Workplace Environment
DEED Minnesota Children's Museum (MCM) Renovation and Addition
Saint Paul, MN

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Sustainable Post-Occupancy Evaluation Survey (SPOES)
B3 Guidelines

Caren S. Martin, PhD
(contact: caren@mgdesignresearch.com)
Martin & Guerin Design Research, LLC
Minneapolis, MN

Abimbola Asojo, PhD
(aasojo@umn.edu)
Suyeon Bae, MS
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 renovation and addition to the Minnesota Children's Museum (MCM) facility and occupants' satisfaction with their work environments located in the facility. This report communicates responses from employees about the overall facility and their workplace (WP). The facility was designed using the B3 Guidelines (formerly known as the Minnesota Sustainable Building Guidelines or MSBG), which were in effect at the time that the renovation and addition were funded. It was completed for occupancy in March 2017. 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 April 2018.

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 Minnesota Children's Museum (MCM) is located at 10 West 7th Street, St. Paul, MN. The building (see Figure 1) is a four-story, 67,439 square foot building that is and education and exhibition space that accommodates educational programming and events for children within the community. To support the MCM's administrative staff, the workplace includes office and conference space, support areas, and storage.

Figure 1. MCM. (Photo courtesy of Bruce Silcox)

3.2 Project Team

The relevant project team members to the SPOES process for the MCM was comprised of the owner, design team, commissioning agent, and general contractor. They are identified below, relative to their capacity and involvement.

Owner	Minnesota Children's Museum
Architect	MSR
Mechanical and Electrical Engineer	KFI, Inc.
Interior Designer	MSR
Acoustical Consultant	Kvernstoen, Ronnholm & Associates
Landscape Architect	Damon Farber Associates
Commissioning Agent	KFI, Inc.
General Contractor	JE Dunn Construction

3.3 Description of Respondents

This survey was administered to 58 employees with workspace in the facility during April 2018. The response rate to the questionnaire was over 65%. Of those responding, 25% were male and 75% were female. The mean age of respondents was 42 years, with a range from 18-59 years of age.

The administration area of the MCM was completed and ready for operation in March 2017. Since that time, 79% of the respondents reported that they worked at the MCM facility for more than two years, 12% of the respondents reported that they worked at the MCM facility for 1-2 years, and 9% of the respondents spent less than one year at this facility. Relating to hours worked during a typical week at the MCM, 46% of the employees reported they spend 40+ hours a week in the facility, 37% spend 30-40 hours a week at the MCM, nearly 6% spend 20-29 hours at the facility, and over 11% spend less than 20 hours a week at the facility.

Relating to the time employees spend per week in their primary workspace, 22% of the employees reported they spend more than 75% of their weekly time in their primary workspace; over 58% spend 51-75% of their time in their primary workspace; and over 19% spend 25-50% of their time in their primary workspace. These responses indicate the amount of time employees are exposed to IEQ conditions in their workplace environment.

The MCM is a workplace with workstations (cubicles) with low partitions or benching workstations (multiple worksurfaces aligned together) serving as primary workspaces. Over 83% of employees indicated that their primary workspaces were located within 15 feet of an exterior window, nearly 14% of the employees were not within 15 feet of an exterior window, and nearly 3% were not sure how far they were from an exterior window.

4.0 Findings and Discussion

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

Employees responded to questions concerning the MCM 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 MCM facility - overall satisfaction, work performance, and health

Overall	Mean	SD	N	Interpretation
Satisfaction	5.63	0.81	38	Satisfied
Work Performance	4.84	1.11	38	Enhanced
Health	4.68	0.83	38	Enhanced

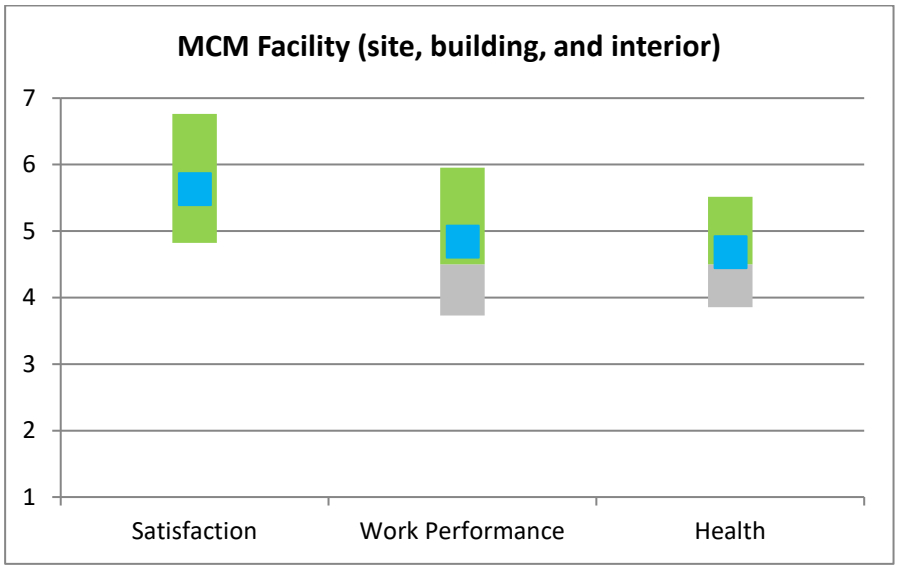

Figure 2. MCM facility - overall satisfaction, work performance, and health

Results indicate that employees were **satisfied (M = 5.63)** with the physical environment of the MCM facility (building, site, and interior) and reported that their overall work performance was **enhanced (M = 4.84)** by the facility. Employees reported that their overall health was **enhanced (M = 4.68)** 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., workstation or benching 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. MCM primary workspace – overall satisfaction, work performance and health

Overall	Mean	SD	N	Interpretation
Satisfaction	4.82	1.17	38	Satisfied
Work Performance	4.58	1.16	38	Enhanced
Health	4.55	1.04	38	Enhanced

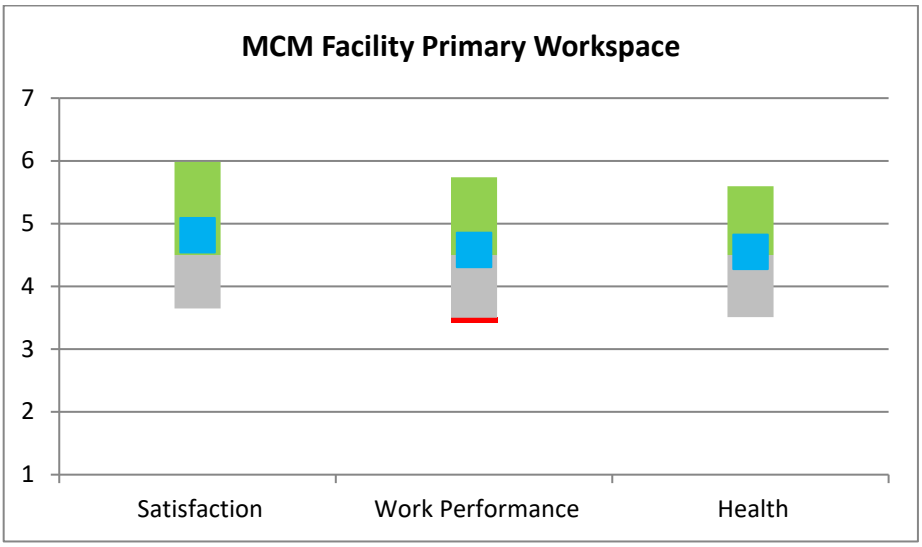

Figure 3. MCM primary workspace - overall satisfaction, work performance, and health

Results indicate that employees were **satisfied (M = 4.82)** with their primary workspace, their overall work performance was **enhanced (M = 4.58)** by their primary workspace, and their overall health was **enhanced (M = 4.55)** 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. MCM primary workspace - satisfaction with IEQ criteria

#	**IEQ Criteria (1-26)** (Category level criteria are **bold** face)	**Mean**	**SD**	**N**	**Interpretation** (D = Dissatisfied) (S = Satisfied)
1	**Overall cleaning and maintenance**	**5.62**	**1.30**	**37**	**Satisfied**
2	**Overall indoor air quality**	**5.59**	**1.17**	**37**	**Satisfied**
3	**Overall vibration and movement**	**5.43**	**1.34**	**35**	**Satisfied**
4	**Overall appearance (aesthetics)**	**5.42**	**1.23**	**36**	**Satisfied**
5	Access to electric outlets	5.41	1.46	37	Satisfied
6	Function of furnishings	5.28	1.33	36	Satisfied
7	**Overall furnishings**	**5.22**	**1.20**	**36**	**Satisfied**
8	Amount of electric light	5.19	1.37	37	Satisfied
9	Humidity (dry or moist)	5.11	1.45	37	Satisfied
10	Ability to hear desired sounds	5.05	1.47	37	Satisfied
11	**Overall daylighting conditions**	**5.05**	**1.74**	**37**	**Satisfied**
12	**Overall electric lighting conditions**	**5.03**	**1.38**	**35**	**Satisfied**
13	Amount of daylighting	4.92	1.83	36	Satisfied
14	Air velocity (drafty or stagnant)	4.86	1.56	37	Satisfied
15	Adjustability of daylighting	4.81	1.80	37	Satisfied
16	Adjustability of furnishings	4.73	1.70	37	Satisfied
17	Adjustability of task lighting	4.59	1.73	37	Satisfied
18	Adjustability of task lighting	4.36	1.77	36	Neither S or D
19	**Overall thermal conditions**	**4.27**	**1.70**	**37**	**Neither S or D**
20	**Overall technology**	**4.25**	**1.36**	**36**	**Neither S or D**
21	Temperature (hot or cold)	3.97	1.76	36	Neither S or D
22	**Overall view conditions**	**3.95**	**1.64**	**37**	**Neither S or D**
23	**Overall acoustic quality**	**3.89**	**1.73**	**36**	**Neither S or D**
24	Adjustability of thermal conditions	3.69	1.63	36	Neither S or D
25	Ability to limit undesired sounds	3.47	1.76	36	Dissatisfied
26	**Overall privacy (sound and visual privacy)**	**3.22**	**1.49**	**37**	**Dissatisfied**

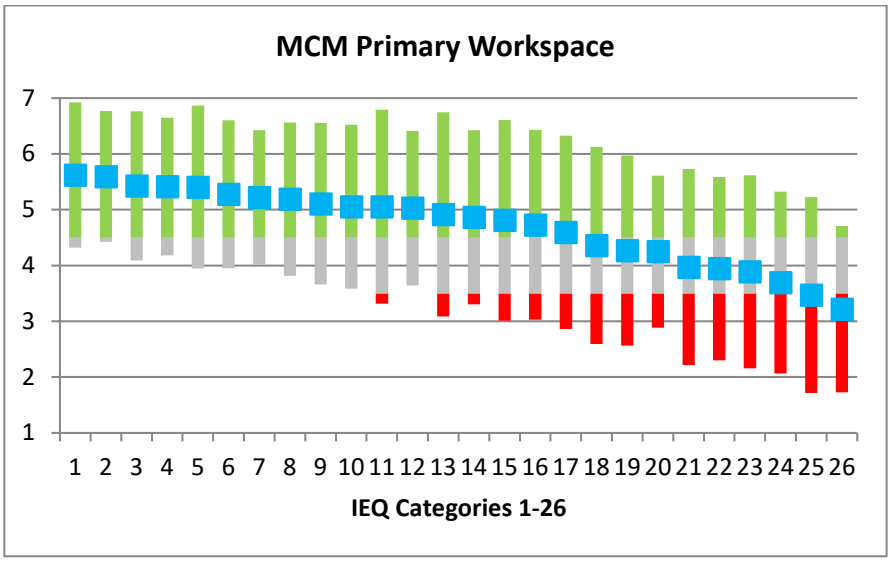

Figure 4. MCM primary workspace - satisfaction with IEQ criteria (IEQ 1-26 refer to Table 3)

Results indicate that employees were **satisfied** with 17 of the IEQ criteria in their primary workspaces, i.e., means at or above 4.50. Employees were **neither satisfied nor dissatisfied** with seven (7) IEQ criteria, ranging from a mean of 3.69 (adjustability of thermal conditions) to 4.36 (adjustability of task lighting). Employees were **dissatisfied** with two (2) of the IEQ criteria, ranging from 3.22 (Overall privacy, sound and visual) to 3.47 (ability to limit undesired sounds). The criteria in the 'neutral' and dissatisfied satisfaction ranges should be 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 the MCM is **4.74**, which falls in the lower end of the satisfied range (4.51 to 7.00), i.e., a moderately low satisfied IEQ Score**.**

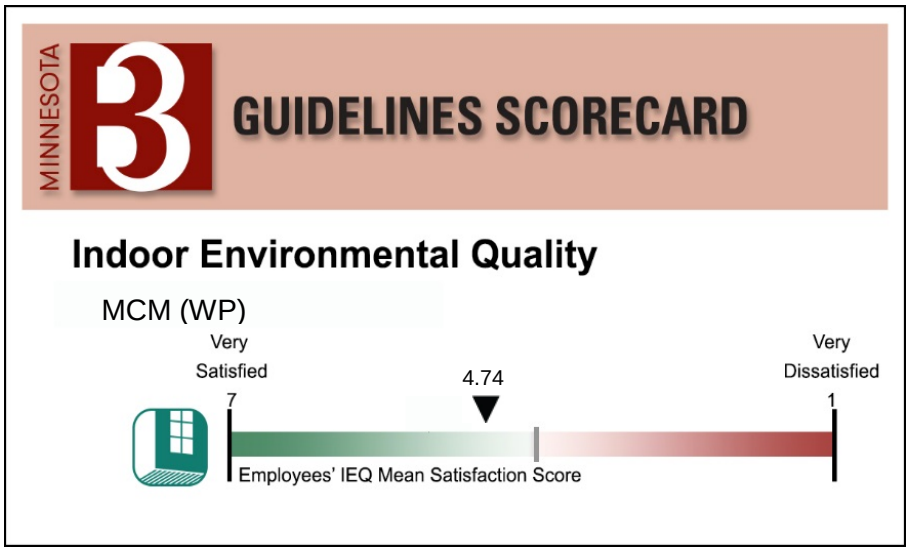

Figure 5. MCM primary workspace - IEQ Satisfaction Score

As shown in Table 3, satisfaction with the Overall cleaning and maintenance, Overall indoor air quality, Overall vibration and movement, and Overall appearance (aesthetics) were the categories with the highest satisfaction means (5.42 or higher) and pulled the IEQ Satisfaction Score in a positive direction. Additionally, three (3) other mean scores were relatively high, with scores between 5.22 (Overall furnishings) and 5.03 (Overall electric lighting conditions). Of the remaining five (5) mean scores below 4.5 out of 12 category-level criteria, four (4) were in the neutral range, with Overall thermal conditions (4.27) as the highest score through Overall acoustic quality (3.89) as the lowest. Also, Overall privacy (sound and visual privacy) was the single category of 12 IEQ category-level criteria in the dissatisfied range (3.22). Both the neutral and dissatisfied criteria pulled the IEQ Score down somewhat. 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 MCM (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 MCM facility

MCM facility (site, building, and interior)	Mean	SD	N	Interpretation
Overall physical activity (walking, stair use, etc.)	5.53	0.88	36	Enhanced

Results indicate that employees felt that MCM **enhanced (M = 5.53)** their physical activities (walking, stair use, etc.).

5.2 Commuting Practices

MCM is in downtown St. Paul and is located on West Seventh Street between St. Peter Street and Wabasha Street North. Public access is on West Seventh Street. There are several mass transit bus stops nearby and contract parking is available as well as limited street metered parking.
Table 5 provides results on employees' primary mode of transportation; Table 6 summarizes commuting distances between home and the MCM 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 – MCM Primary mode of transportation

Primary Mode of Transportation (N=36)	**Drive Alone (or w/children <16)**	**Public Transit**	**Carpool or Vanpool**
Commuting to MCM	72%	20%	8%

Related to primary modes of transportation, 77% of employees drive alone (or with children under 16), 20% use public transportation, and 8% use carpools or vanpools. No employees used walking, a bicycle, or another mode of transportation.

Table 6. Commuting Practices – MCM Commuting distance traveled

Miles Traveled (N=36)	**0-5**	**6-15**	**16-30**	**31-45**
Home-to-MCM (One-way)	36%	39%	19%	6%

Results indicate that 36% of employees commuted 0-5 miles one-way between home and the MCM, followed by 39% who commute 6-15 miles, 18% who commute 16-30 miles, and 6% who commute between 31-45 miles to the MCM facility. These are one-way miles.

Table 7. Commuting practices – MCM location and alternative commuting behaviors

Alternative Commuting	**Mean**	**SD**	**N**
Ability to commute in alternative ways	4.56	1.957	36

Results indicate that location of the MCM **enhances (M = 4.56)** employees' ability to commute to work in alternative ways, e.g., public transit, van or carpool, etc.

6.0 Conclusions

6.1 Summary

A post-occupancy evaluation was conducted of employees of the MCM at approximately 13 months after the administration area was first occupied. This MCM facility is used educational and exhibit space for children and the community and includes workspace to support the administrative staff. This survey reports responses from employees and their satisfaction with the physical environment of the facility and their primary workspace. Results indicate that over 83% of employees spend more than 30

hours per week in the MCM facility, and over 80% of employees spend more than 50% of their time at the MCM 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 **satisfied** with the facility **(M = 5.63)**; they found the facility **enhanced** their work performance **(M = 4.84)** and **enhanced** their health **(M = 4.68)**. Similar results were reported when employees were asked these same questions about their primary workspaces (workstations, etc.). They reported **satisfaction (M = 4.82)** with their primary workspaces, that their work performance was **enhanced (M = 4.58)**, and their health was **enhanced (M = 4.55)** by their primary workspace. As the range of scores was from 1-7, facility scores showed a moderate level of satisfaction and enhancement; whereas, ratings of workplace performance and health relative to the primary workspace resulted in a satisfaction level near the low end of that range (i.e., satisfaction score range is 4.51-7.00).

Most of the survey questions related to employees' satisfaction with the IEQ criteria in their primary workspaces (private office, workstations, etc.). Employees' responses showed they were **satisfied** with the 17 of the 26 IEQ criteria. The mean satisfaction scores ranged from **4.59** (adjustability of task lighting) to **5.62** (Overall cleaning and maintenance). Again, this shows a moderate positive level of **satisfaction**. Employees responded **neither dissatisfied nor satisfied** to seven (7) IEQ criteria. Those mean satisfaction scores ranged from **3.69** (adjustability of thermal conditions) to **4.36** (adjustability of task lighting). Employees were dissatisfied with the remaining two (2) IEQ criteria, **3.22** (Overall privacy, sound and visual) and **3.47** (ability to limit undesired sounds).

From employees' responses, an IEQ Score was developed and shows respondents' satisfaction with the majority IEQ of all category level criteria. For the MCM, the IEQ Satisfaction Score was **4.74**. This score reflects the influence of the moderate satisfaction level of 7 of the 12 categories, the neither satisfied nor dissatisfied level of 4 of the 12 categories, and dissatisfied level scores for one of the 12 categories. Finally, employees reported that the MCM **enhanced (5.53)** 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 'neither dissatisfied nor satisfied' or dissatisfied scores. However, the rest of the criteria would benefit from some attention as well. The following 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 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 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.

6.2 Recommendations

Several 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 the applicable version of ASHRAE Standard 55, or Human Factors Design Handbook (see B3 Guidelines). For additional information, consider reviewing Human Factors and Ergonomics Design Handbook, Third Edition (2016), by Barry Tillman, published by McGraw-Hill, NY.

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. The MCM employees raised very few specific concerns about the following themes: acoustics and privacy, electric lighting, daylighting and view conditions; and thermal conditions. These qualitative responses appear as if the employees are a bit dissatisfied with some features; however, it does not mean they represent the overall sentiment from employees. However, the comments do give insight into specific issues that could be addressed by building management. The comments from the employees are provided below.

Overall Positive/Negative

- Love the space!
- I believe we need offices for certain levels of management.
- The colors are bright and cheerful. I think the environment promotes good feeling and energy.
- Overall, I think the building is very nice and well-maintained.
- I was concerned about moving to an open office environment, but I really like it. I am able to talk to my co-workers more easily, and I really like my workstation.
- Most of the "adjustability" questions I ranked 4 because there isn't really any adjustability, but that isn't necessarily negative.
- I think we could make a few improvements in terms of accessibility.
- I work in the Volunteer Services office where there is no daylight, no view, no privacy, no task lighting, no adjustability for the workspace except for my chair.
- Many of the items I marked as Very Dissatisfied are because I do not have access to them in my work space.
- It is a bit frustrating to have new equipment break and then have to wait around for weeks to get it fixed because it's under warranty.
- Many of the factors that I am dissatisfied with are typical of an office environment (temperature, lighting, etc.).

Acoustics and Privacy

- Noisy and distracting. Odd mechanical noises. Chatter.
- There is a draft noise in one of the vents that sounds like wind sweeping "over the tundra" that has been here since we moved back.
- The noise level doesn't really bother me.
- We [Volunteer Office] don't have the option to limit undesired sounds either - we can't close the door because we need to make sure the office is accessible to everyone and the break room door also needs to be open to ensure accessibility so we hear all museum and break room sounds in addition to the noise in our office. I am not looking forward to the musical instruments as part of museum experience because that will be an additional impact on the noise we can hear.
- It's [the conditions] difficult because it's part of the job to be available to our volunteers and we want to create a welcoming environment for them, but there are constant interruptions and any time we need privacy or quiet time to concentrate we have to leave our desk for either a quiet room or the standing workstation, which may or may not be available. Anyone can see my full computer screen by being in the room (or even standing near the doorway) and anyone can listen to my phone conversations. I've adapted to these things over time, but I definitely would

not choose any of this arrangement if I had the choice. A privacy filter for my computer screen would be helpful and my ideal workstation would have a standing adjustable desk.
- Both spring time periods there have been instances where there has been an air gushing sound on the west side of the admin space which is where my desk is. It's annoying and distracting.

Electric Lighting, Daylighting, and View Conditions

- I only wish there was more control of overhead electric lighting. I am here on weekends and the motion sensors shutting on and off can be distracting.
- It would be nice if the motion sensors on the lighting were a little bit more sensitive.
- I'm extremely thankful for the windows. The question about what's outside of the windows is really difficult to controlled.
- We do not have access to daylight or task lighting

Thermal Conditions

- The meeting spaces are warm, the office/workspaces are cooler and feel even cooler after a meeting. There's definitely a draftiness and a constant sound of air moving around in the space.
- Air does not move, I have a fan on my desk that is going all day when I am at my desk.
- I am generally cold so I wear layers and don't expect the office environment to reflect my body temperature.

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).