Indoor Environmental Quality + Workplace Environment
DEED Minnesota Multi-Purpose Stadium (aka US Bank Stadium)
Minneapolis, MN

June 2018, Minneapolis, MN
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 DEED Minnesota Multi-Purpose Stadium (aka US Bank Stadium) 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 July 2016. 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 November 2017.

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 US Bank Stadium is located at 401 Chicago Avenue, Minneapolis, MN. The building (see Figure 1) is an 8-story (including two levels below grade), 1,761,117 square foot building that is home for the Minnesota Vikings Football and Minnesota Golden Gophers Baseball, and host of numerous sports, entertainment, and civic events. It also is home to building facilities and operational staff. To support staff, the workplace includes office and conference space, totaling approximately 27,874 square feet; this is the area that is being evaluated by building staff and was the focus of this study.

Figure 1. US Bank Stadium. (Photo courtesy of US Bank Stadium)

3.2 Project Team

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

Owner	Minnesota Sports Facilities Authority
Architect	HKS, Studio Five Architects
Mechanical and Electrical Engineer	ME Engineers
Interior Designer	HKS
Acoustical Consultant	Wrightson, Johnson, Haddon & Williams, Inc.

Lighting Designer	Schuler & Shook, Ephesus Lighting
Landscape Architect	Oslund & Associates
Commissioning Agent	Questions and Solutions Engineering
General Contractor	Mortenson Construction
Facilities Manager	US Bank Stadium

3.3 Description of Respondents

This survey was administered to 90 employees with workspace in the facility during November 2017. The response rate to the questionnaire was approximately 54%. Of those responding, 60% were male and 40% were female. The mean age of respondents was 36 years, with a range from 23-55 years of age.

The US Bank Stadium was completed and ready for operation in July 2016. Since that time, 13% of the respondents reported that they worked at the US Bank Stadium for more than two years, 76% of the respondents reported that they worked at the US Bank Stadium facility for 1-2 years, and 11% of the respondents spent less than one year at this facility. Relating to hours worked during a typical week at the US Bank Stadium, 96% of the employees reported they spend 40+ hours a week in the facility and 4% spend 30-40 hours a week at the US Bank Stadium.

Relating to the time employees spend per week in their primary workspace, 33% of the employees reported they spend more than 75% of their weekly time in their primary workspace; over 48% spend 51-75% of their time in their primary workspace; 15% spend 25-50% of their time in their primary workspace; and 4% 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.

The US Bank Stadium is a workplace with private offices; enclosed shared offices; workstations (cubicles) with low partitions, desk(s) in an open area, and benching (i.e., long table, ability to plug in, shared) serving as primary workspaces. Nearly 24% of employees indicated that their primary workspaces were located within 15 feet of an exterior window, nearly 74% of the employees were not within 15 feet of an exterior window, and 2% were not sure how far they were from an exterior window.

4.0 Findings and Discussion

4.1 US Bank Stadium Facility (Site, Building, and Interior): Overall Satisfaction, Work Performance, and Health

Employees responded to questions concerning the US Bank Stadium 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 US Bank Stadium facility - overall satisfaction, work performance, and health

Overall	Mean	SD	N	Interpretation
Satisfaction	5.16	1.27	49	Satisfied
Work Performance	4.53	1.36	49	Enhanced
Health	4.47	1.37	49	Neither Hindered nor Enhanced

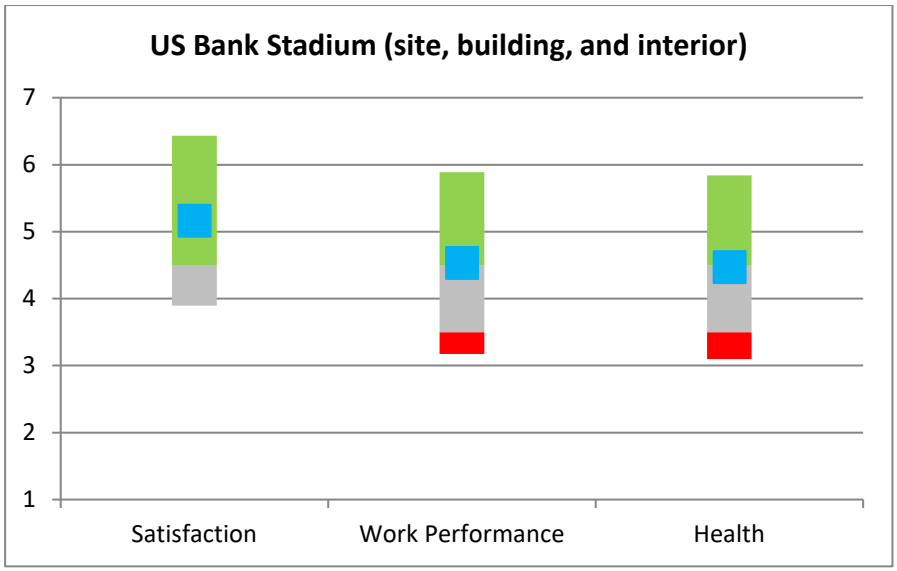

Figure 2. US Bank Stadium facility - overall satisfaction, work performance, and health

Results indicate that employees were **satisfied (M = 5.16)** with the physical environment of the US Bank Stadium facility (building, site, and interior) and reported that their overall work performance was **enhanced (M = 4.53)** by the facility. Employees reported that their overall health was **neither hindered nor enhanced (M = 4.47)** 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. US Bank Stadium primary workspace – overall satisfaction, work performance and health

Overall	Mean	SD	N	Interpretation
Satisfaction	4.12	1.64	49	Neither Dissatisfied nor Satisfied
Work Performance	4.12	1.56	49	Neither Hindered nor Enhanced
Health	4.18	1.21	49	Neither Hindered nor Enhanced

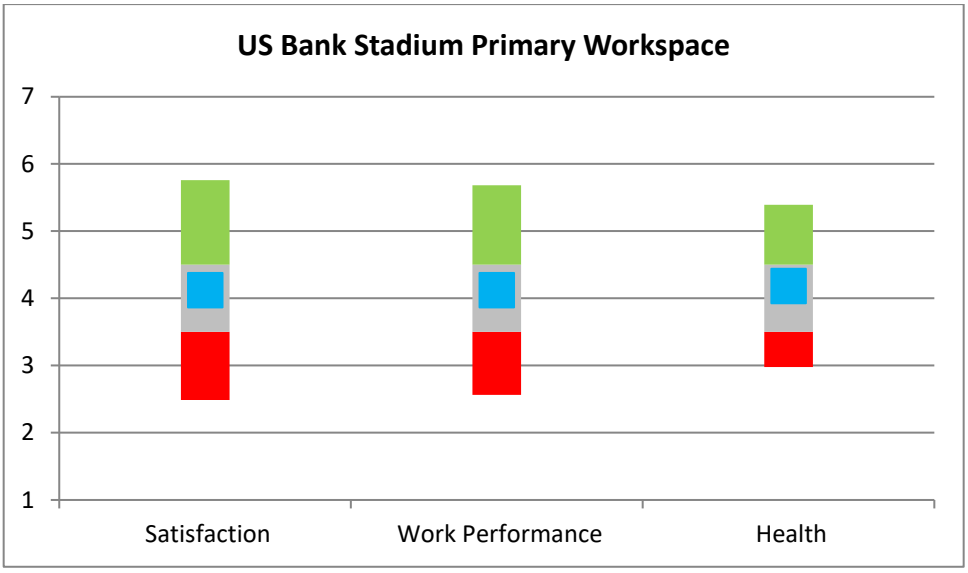

Figure 3. US Bank Stadium primary workspace - overall satisfaction, work performance, and health

Results indicate that employees were **neither dissatisfied nor satisfied (M = 4.12)** with their primary workspace, their overall work performance was **neither hindered nor enhanced (M = 4.12)** by their primary workspace, and their overall health was **neither hindered nor enhanced (M = 4.18)** 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. US Bank Stadium 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 technology**	**5.02**	**1.56**	**47**	**Satisfied**
2	Access to electric outlets	4.76	1.56	46	Satisfied
3	Amount of electric light	4.72	1.48	47	Satisfied
4	**Overall vibration and movement**	**4.70**	**1.49**	**47**	**Satisfied**
5	Air velocity (drafty or stagnant)	4.55	1.48	47	Satisfied
6	Humidity (dry or moist)	4.53	1.47	47	Satisfied
7	**Overall electric lighting conditions**	**4.40**	**1.53**	**47**	**Neither S or D**
8	**Overall cleaning and maintenance**	**4.40**	**1.58**	**47**	**Neither S or D**
9	**Overall furnishings**	**4.37**	**1.66**	**46**	**Neither S or D**
10	**Overall appearance (aesthetics)**	**4.35**	**1.63**	**46**	**Neither S or D**
11	Function of furnishings	4.34	1.67	47	Neither S or D
12	Ability to hear desired sounds	4.28	1.54	47	Neither S or D
13	**Overall indoor air quality**	**4.13**	**1.80**	**46**	**Neither S or D**
14	**Overall thermal conditions**	**4.02**	**1.82**	**47**	**Neither S or D**
15	Adjustability of furnishings	4.00	1.85	47	Neither S or D
16	Temperature (hot or cold)	3.96	1.79	47	Neither S or D
17	**Overall acoustic quality**	**3.87**	**1.76**	**47**	**Neither S or D**
18	Adjustability of thermal conditions	3.77	1.81	47	Neither S or D
19	Adjustability of task lighting	3.74	1.74	47	Neither S or D
20	Adjustability of task lighting	3.53	1.89	47	Neither S or D
21	Ability to limit undesired sounds	3.38	1.64	47	Dissatisfied
22	**Overall privacy (sound and visual privacy)**	**3.26**	**1.80**	**47**	**Dissatisfied**
23	**Overall daylighting conditions**	**3.23**	**1.94**	**47**	**Dissatisfied**
24	Amount of daylighting	2.93	1.96	46	Dissatisfied
25	**Overall view conditions**	**2.85**	**1.68**	**46**	**Dissatisfied**
26	Adjustability of daylighting	2.66	1.70	47	Dissatisfied

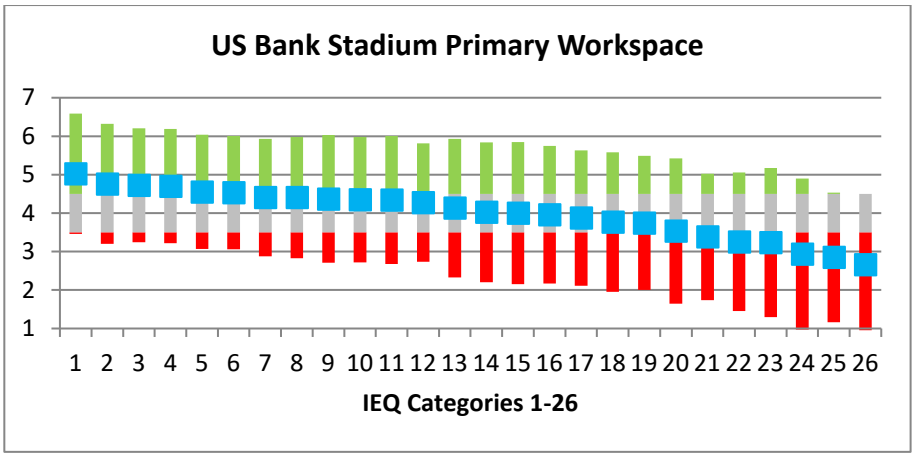

Figure 4. US Bank Stadium primary workspace - satisfaction with IEQ criteria (IEQ 1-26 refer to Table 3)

Results indicate that employees were **satisfied** with six (6) of the IEQ criteria in their primary workspaces, i.e., means at or above 4.50. Employees were **neither satisfied nor dissatisfied** with 14 IEQ criteria, ranging from a mean of 3.53 (adjustability of task lighting) to 4.40 (Overall electric lighting conditions). Employees were **dissatisfied** with six (6) of the IEQ criteria, ranging from a mean of 2.66 (adjustability of daylighting) to 3.38 (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 US Bank Stadium is **4.13**, which falls near the mid-point of neither dissatisfied nor satisfied range, below the satisfied range (4.50-7.00)**.**

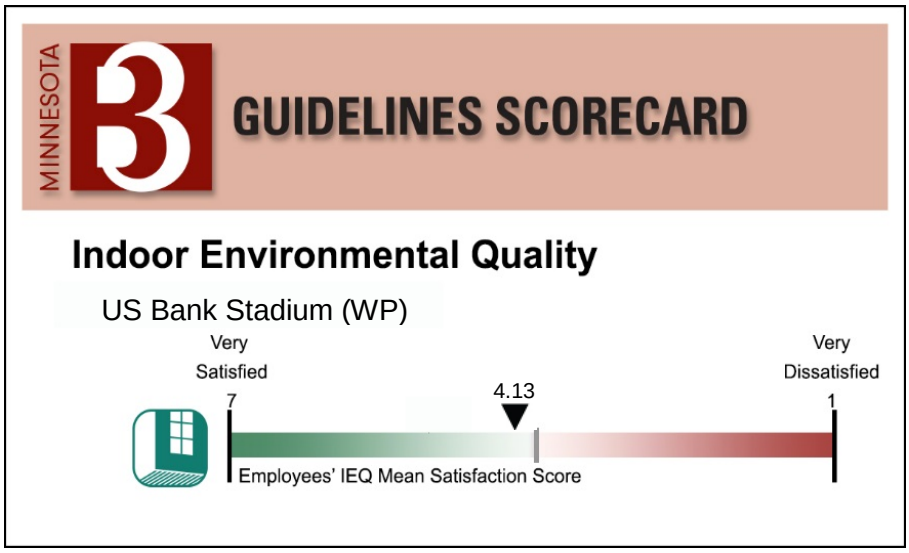

Figure 5. US Bank Stadium primary workspace - IEQ Satisfaction Score

As shown in Table 3, satisfaction with Overall technology and Overall vibration and movement were the categories with the highest satisfaction means (4.70 or higher), but could not pull the IEQ Satisfaction Score in a positive direction as the majority (7) of the mean scores were in the neutral range, with scores between 4.40 (Overall electric lighting conditions) and 3.87 (Overall acoustic quality). The remaining three mean scores out of 12 category-level criteria of 3.50 or below (i.e., 3.26, 3.23, and 2.85) also 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 US Bank Stadium (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 US Bank Stadium facility

US Bank Stadium (site, building, and interior)	Mean	SD	N	Interpretation
Overall physical activity (walking, stair use, etc.)	5.51	1.42	45	Enhanced

Results indicate that employees felt that US Bank Stadium **enhanced (M = 5.51)** their physical activities (walking, stair use, etc.).

5.2 Commuting Practices

US Bank Stadium is in downtown Minneapolis and is located is located between Chicago and 11th Avenues and 4th and 6th Streets. Access is available via Interstate 35W. Public transportation is accommodated by bus or from an adjacent light rail station and dedicated biking lanes connect the stadium with the surrounding downtown area. Public 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 US Bank Stadium 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 – US Bank Stadium Primary mode of transportation

Primary Mode of Transportation (N=46)	**Drive Alone (or w/children <16)**	**Public Transit**
Commuting to US Bank Stadium	93%	7%

Related to primary modes of transportation, 93% of employees drive alone (or with children under 16) and the remaining 7% use public transportation. No employees used carpool or vanpool with others, walking, biking, or other modes of transportation.

Table 6. Commuting Practices – US Bank Stadium Commuting distance traveled

Miles Traveled (N=46)	**0-5**	**6-15**	**16-30**	**31-45**
Home-to-US Bank Stadium (One-way)	22%	39%	35%	4%

Results indicate that 22% of employees commuted 0-5 miles one-way between home and the US Bank Stadium, followed by 39% who commute 6-15 miles, 35% who commute 16-30 miles, and 4% who commute between 31-45 miles to the US Bank Stadium facility. These are one-way miles.

Table 7. Commuting practices – US Bank Stadium location and alternative commuting behaviors

Alternative Commuting	Mean	SD	N
Ability to commute in alternative ways	4.33	1.79	46

Results indicate that location of the US Bank Stadium **neither hindered nor enhanced (M = 4.33)** 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 the US Bank Stadium at approximately 17 months after it was first occupied. This US Bank Stadium facility is used as a multi-purpose stadium for sports, entertainment, and civic events and houses building facilities and operational staff who support those activities. This survey reports responses from employees and their satisfaction with the physical environment of the facility and their primary workspace. Results indicate that 100% of employees spend more than 30 hours per week in the US Bank Stadium facility, and approximately 81% of employees spend more than 50% of their time at the US Bank Stadium 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 = 5.16)** and they found the facility **enhanced** their work performance **(M = 4.53)** Employees determined that the facility neither hindered nor **enhanced** their health (**M = 4.47**). In addition, results that were not as positive were reported when employees were asked these same questions about their primary workspaces (private office, shared office, workstations, etc.). They reported **neither dissatisfaction nor satisfaction (M = 4.12)** with their primary workspaces, that their work performance was **neither hindered nor enhanced (M = 4.12)**, and their health was **neither hindered nor enhanced** (**M = 4.18)** by their primary workspace. As the range of scores was from 1-7, scores showed a neutral level of satisfaction and enhancement.

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 six (6) of the 26 IEQ criteria. The mean satisfaction scores ranged from **4.53** (humidity) to **5.02** (Overall technology). Again, this shows a moderate positive level of **satisfaction**. Employees responded **neither dissatisfied nor satisfied** to 14 IEQ criteria. The mean satisfaction scores ranged from **3.53** (adjustability of task lighting) to **4.40** (Overall electric lighting conditions). Furthermore, employees were **dissatisfied** with six (6) of the IEQ criteria, with mean scores ranging from **2.66** (adjustability of daylighting) to **3.38** (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 US Bank Stadium, the IEQ Satisfaction Score was **4.13**. This score reflects the influence of the neutral (i.e., neither satisfied nor dissatisfied) satisfaction level of 7 of the 12 categories as well as the dissatisfied level of 3 of the 12 categories. Only two (2) of the IEQ category scores were in the satisfied range. Finally, employees reported that the US Bank Stadium

enhanced (5.51) 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' and 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 US Bank Stadium employees raised very few specific concerns about the following themes: acoustics and privacy, amenities, cleaning and maintenance, daylighting, indoor air quality, and thermal conditions. These qualitative responses appear as if the employees are 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 Negative

- There always seems to be construction going on outside US Bank Stadium. Lifts to fix panels are left on property on Vikings game day which looks terrible.
- Those cheap temporary fences around the building don't look inviting at all to the public/fans.
- We have almost no control over anything air, temperature, or light related.

Acoustics and Privacy

- The sound environment is here is not good. If you have an event in a club, there is constant noise interruption and issues with sound bleed.
- The noise from the dock—especially the Air Quality Ductwork is loud. We joke about working under the deck of an aircraft carrier during flight operations.

Amenities

- No exterior window.
- This is a warehouse environment on level-2.
- Should have plumbing/restroom in our office areas. No sinks or coffee/break area.
- Need more storage spaces.
- We have a concrete floor and no ceiling in our office.

Cleaning and Maintenance

- Super dirty.
- We have had items break and not be fixed for an extended period of time.
- Maintenance and cleaning crews come in during work hours and a few times have vacuumed during work hours.

Daylighting

- There are windows close but from offices so the windows do not provide any outside lighting.
- For a building with so much glass, we have almost zero in our office. The people with offices have little slivers of window.
- The windows look onto the dock.

Indoor Air Quality (IAQ)

- We get exhaust fumes sometimes in the Ticket Office from big machines outside working on the roof/exterior walls.

Thermal Conditions

- We have thermostats on the wall that they don't let us have access to.
- The temperature is a real issue. If you are here outside of the usual 9am-5pm work day, then the temperature will be either one extreme or the other. It makes it really uncomfortable and hard to get work done.
- Building is kept very hot in the summer, to save on costs, but it makes it a very uncomfortable place to work.
- We don't have heat and any heat that is generated rises out of our work space.

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).