Keeping Educational Facilities Balanced

Improved energy use can compromise indoor air quality. Improved air quality can compromise acoustics. Poor space utilization can compromise energy savings efforts. The list goes on and on. How can a district strike a balance between so many conflicting facility features?

- **Awareness:** Be aware of facility features and improvements that can compromise other features.
- **Objective Monitoring:** Establish an empirical system of monitoring major facility systems and features.
- **Balance:** Overall ratings in monitoring categories should be consistent. Allowing one category to fall behind the others will result in facility imbalance.

Awareness

Be aware of facility features/improvement that can compromise other features. The following are some common facility features and improvement efforts that can compromise each other. The "solutions" are stated from the perspective of monitoring existing facilities. The following should also be considered in the design phase.

Acoustics can compromise IAQ

A common strategy for reducing reverberation is the use of sound absorptive materials such as acoustical wall panels, carpet, and acoustical ceiling tile. These absorptive materials also can harbor moisture and contaminants, which can compromise IAQ.

Solution: monitor reverberation, CO2, humidity, particulates, and allergens.

Reducing HVAC background noise can compromise IAQ

Duct liner that reduces background noise can promote growth of allergens and harbor contaminants. Lowering fan speed to reduce background noise can reduce air movement, which can compromise IAQ.

Solution: monitor noise levels, CO2, particulates, and allergens.

Improving IAQ can compromise acoustics

Two common strategies to improve air quality are to increase air circulation and minimize sound absorptive materials. The result is often a lot of hard surfaces and high levels of air movement. This can result in high reverberation and background noise.

Solution: monitor reverberation, noise levels, CO2, particulates, and allergens.

Day lighting can compromise safety

In regions subject to hurricanes and tornados, extensive windows can compromise safety. Occupants should have areas of refuge from projectiles and flying glass. Susceptibility to blast impact should also be considered.

Solution: monitor day lighting, safety items related to high wind and blast events.

Improving energy use can compromise IAQ

Reducing air changes, reducing air flow, shutting off HVAC systems in off hours, etc. can compromise IAQ by reducing air movement and introduction of fresh air.

Solution: monitor energy use, CO2, *temperature control, humidity, particulates, and allergens.*

Improving energy use can compromise light levels

Reducing artificial light levels to save energy can result in inadequate light levels (light levels associated with learning).

Solution: monitor light levels and energy use.

Natural ventilation can compromise IAQ

Without proper filtration and humidity control, natural ventilation can introduce excessive humidity and contaminants to the interior.

Solution: monitor CO2, humidity, particulates, and allergens.

Maintenance emphasis can compromise educational program

Ongoing facility planning efforts often focus on operating cost, energy use, and renewal. Too much focus on operating cost, without appropriate monitoring of educational program support, can result in a deterioration of program support.

Solution: monitor operating cost, program support.

Improving technology can compromise IEQ

Technology equipment can increase background noise, add heat load, and create contaminants.

Solution: monitor technology components, particulates, background noise, and temperature control.

Low grade air filters can compromise air filtration

The utilization of low grade air filters can compromise filtration, IAQ, and HVAC equipment operation.

Solution: monitor energy use, CO2, humidity, particulates, and allergens.

Space utilization can compromise energy use

Even the most efficient energy use per square foot can be offset by poor space utilization.

Solution: monitor energy use and space utilization.

Objective Monitoring

Implement metrics based on empirical methods. Avoid subjective condition rating systems (poor/fair/good or conditions ratings of 1-5, etc.). Evaluations should be performed by independent, qualified individuals, and by the same team of individuals to ensure consistency. Ratings in each category should be based on percentage of criteria met.

Accessibility: Based on American's with Disabilities Act facility criteria.

Indoor Environment Quality: Based on scientific measurement of conditions. This should include actual measurements of IAQ including CO2, particulates, allergens, humidity, temperature, VOC's, etc. Light levels and background noise levels should also be measured.

Moisture Control: Excessive moisture is a major cause of IAQ problems and building systems failure, and should be monitored. Monitoring based on humidity, visual observation, and criteria for common moisture accumulation areas.

Operating Cost: Based on comparison of energy use, water use, custodian staffing, maintenance staffing, and overall operating cost/sf to benchmarks.

Program Support: Based on benchmarks related to supporting the educational program including adequate spaces for programs, technology systems, equipment, etc.

Safety: Based on compliance with safety standard such as NFPA Life Safety Code criteria. It is important that the standard be a commonly recognized standard that is clearly articulated.

Security: Based on compliance with security standard such as National Clearinghouse of Educational Facilities (NCEF) Mitigating Hazards in School Facilities. Several states have developed guidelines for school facilities. Links to many of the state standards can be found on the NCEF web site.

Space Utilization: Based on adequacy of individual educational spaces, support space adequacy, extra-curricular space adequacy, overall space utilization, and gross-to-net space ratios.

Systems Age/Condition: Based on the age and condition of major facility systems. Comparison of system actual age to normal life should be monitored. Condition assessments should be used to confirm relationship of actual age to normal life. Rating based on number of systems well within normal life.

Balance

Facilities should be monitored on two levels. First on a macro level by monitoring general benchmarks of major facility categories (figure 1). Macro monitoring ensures a balance of overall facility conditions and improvement efforts. Micro monitoring includes specific system/feature monitoring. An example of macro vs. micro monitoring is monitoring monthly energy use per sq.ft. (macro) vs. real time energy use monitoring with an energy management system (micro).

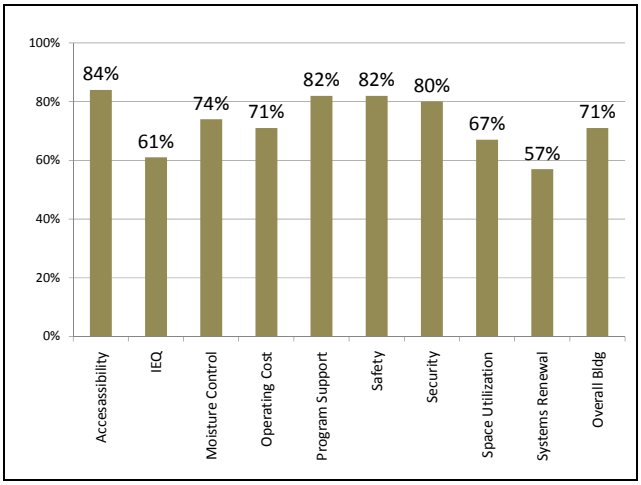

Figure 1 – Macro monitoring of major building categories

Macro monitoring should be done of all categories to ensure balanced facilities. If macro monitoring identifies inefficiencies or problems in one category, then micro monitoring should be considered for that category. It is common for a district to focus efforts on micro monitoring of one category (energy, IAQ, etc) while ignoring other categories. The result can be facility imbalance, inefficiencies, and unnecessary expenses.

The Cost of Not Balancing

Ongoing monitoring typically requires independent consultants. However, the cost of not balancing facilities can far exceed monitoring costs. The following are examples of facility value improvement that can be identified by monitoring. The examples are based on a 25,000 student district. Why 25,000 students? Roughly half of Texas public school students are in districts larger than 25K (and half in districts with <25K)[1]. Calculations and benchmarks used to determine potential value are available upon request.

Attendance rates: Robust research indicates attendance is associated with facility conditions[4]. Based on average funding per student in Texas, the value of just 0.5% attendance associated with improved facility condition is $634,000.

Cost due to increased teacher absenteeism: Research indicates an association of poor facility conditions and increased teacher absenteeism[5]. The result can be elevated substitute costs. Estimates of the potential financial impact of facility condition on absenteeism (thus substitute costs) are as high as 15%. Reducing the average annual district substitute cost by 5% would save $98,000.

Major environmental event: Minor environmental events (small mold growth or other contaminants) are common in school facilities. Minor environmental events, if not identified and corrected promptly, can evolve to a major environmental event. Routine IAQ monitoring can reduce the likelihood of major environmental events (wide spread mold or other contaminants). The cost of one major environmental event including remediation, consulting fees, replacement of contaminated building materials, and temporary space costs can be $280,000.

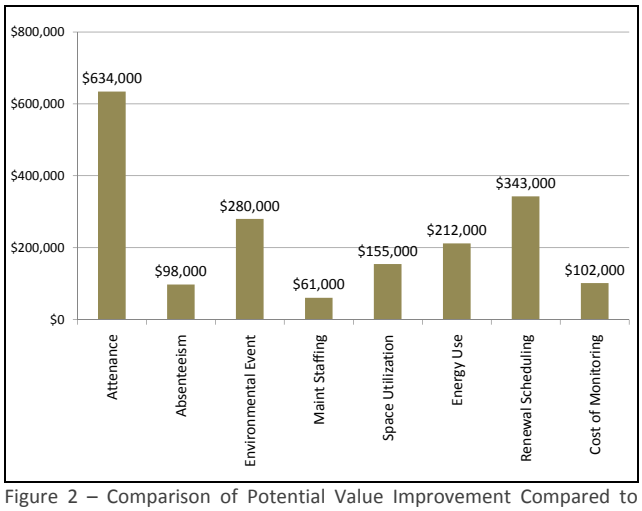

Figure 2 – Comparison of Potential Value Improvement Compared to Monitoring Cost (annually).

Maintenance Staffing Alignment: As facility needs and conditions change, custodian and maintenance staffing should be adjusted to ensure the best value. Misalignment often occurs when facilities are added or renovated and M&O staffing[2] is not adjusted accordingly. Improving staffing alignment by 1% can result in $61,000 annual savings.

Space Utilization: It is common to focus value improvement efforts on energy use, M&O, etc. Even the best cost savings efforts can be offset by poor space utilization. Every sq.ft. saved is one less sq.ft. to heat, cool, and maintain. Improving space utilization just 1% can result in $155,000 annual savings.

Energy Use: The strategies and benefits of saving energy are well documented. Detailed energy use monitoring can identify areas of specific savings opportunities. Improving energy use by 5% can result in $212,000 annual savings.

Renewal Scheduling: Improper scheduling of building systems replacement can result in additional costs due to extended high maintenance costs, escalating replacement cost, and higher operating cost. Assuming 20% of the systems in a district will be in need of replacement[3] in the next 5 years, the annual cost of improper replacement scheduling could cost up to $343,000.

Cost of Monitoring: The cost of comprehensive facility monitoring, if done by one consulting firm, is estimated at 3 cents per sq.ft. of building space. For a 25,000 student district, the cost is an estimated $102,000 annually.

References

[1] Texas Education Agency "Pocket Edition 2007-2008 Texas Public School Statistics", 2008.

[2] AS&U Magazine "37th Annual Maintenance and Operations Cost Study", April 2008.

[3] U.S. General Accounting Office "Condition of America's Public Schools", 1999.

[4] National Academy of Sciences "Green Schools, Attributes for Health and Learning", 2008.

[5] "Estimation of Facility Impact on Teacher Absenteeism", Monte Hunter, November 2008.

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