Measuring *the* ROI *of* IAQ

Building owners may be missing out on a building's most lucrative payback.

By Thomas J. Kelly

Over the last decade, indoor air quality (IAQ) has been a widely debated and publicized topic, drawing the attention of many businesses, industries, and governmental agencies. In that same time span, building occupants have become increasingly concerned and vocal about the overall quality of the air they breathe in the workplace.

While many solutions have been developed to address IAQ issues, many building owners and facilities managers have not been quick to take advantage of them. The issue is generally addressed on a reactive basis. Occupant complaints or, even worse, a lawsuit or loss of tenants often serve as the primary drivers behind IAQ initiatives.

Seldom is an investment in IAQ considered on the same basis as other capital investments — which is to ask, "What kind of financial return can be expected from the expenditure?" Yet, surprising to many facilities professionals, there can be a fiscal return on investment (ROI) made to improve IAQ, and it can be calculated in advance.

What's even more surprising is that the payback, which entails things like productivity gains made by occupants, can actually eclipse payback on investments made for other types of improvements, such as energy efficiency.

An Extensive Problem

The U.S. Environmental Protection Agency (EPA), Washington, D.C., estimates that one-third of the 4.5 million commercial buildings in the United States offer less than acceptable air quality, and ranks IAQ among the five most important environmental issues. The National Energy Management Institute (NEMI), Alexandria, VA, has reported that as much as 80 percent of commercial buildings do not consistently achieve compliance with engineering standards developed for acceptable indoor air, with consequences for 55 million workers.

By NEMI's estimate, IAQ problems cost the economy upwards of $63 billion a year in lost productivity and increased healthcare costs. IAQ problems contribute to absenteeism, reduced employee output, lowered employee morale, increased workers' compensation claims, medical expenses, union grievances, and legal expenses.

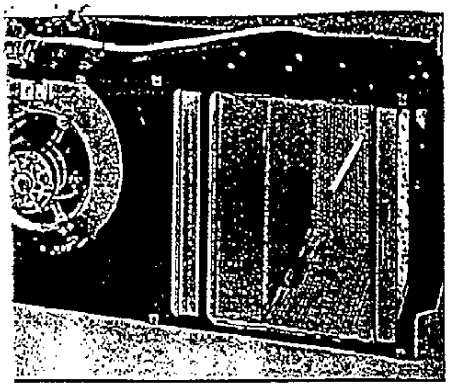
NEMI calculated that by making well-designed and time-tested improvements to buildings or mechanical systems, IAQ-caused productivity losses could be eliminated. Collectively, such an effort would require a one-time investment of $87.9 billion and annual maintenance costs of $4.8 billion, but it would provide an economic payback in less than two years, resulting in a total life-cycle benefit of $774 billion. Potential annual benefits in the office, education, and healthcare markets are shown in *Annual Productivity Benefits* (page 53).

The challenge for today's professionals is how to apply those principles to a single building or building complex.

Calculating the Savings

Calculating the potential savings for an IAQ program is really not difficult, and can be demonstrated using a spreadsheet. *Productivity Economic Analysis — Cost to Employer* (page 53) shows one such example. Here, a 20,000-square-foot building is occupied by 125 employees, resulting in an occupational density of 160 square feet per person. This is within Atlanta-based American Society of Heating, Refrigerating, and Air-conditioning Engineers' (ASHRAE's) average occupancy density for commercial buildings, which ranges from 75 to 200 square feet per person. Combined rent, utilities, and taxes provide an annual operating cost of $20 per square foot.

Next, the average employee cost is factored into the building operating cost. In this case, the hourly pay and benefits amount to $15.60, or $31,200 per person, annually. Multiplied by the number of individuals in the building, this results in an annual employee cost of $3.9 million. This is divided by the occupational density figure, resulting in an annual cost of $195 per person, per square foot. Put in those terms, it



Air purification systems, such as this 31RX series offered by Carrier, use high-efficiency filtration to capture particulates, activated carbon to trap odors, and ultraviolet light sterilization to kill germs.

air motion, background sound, and lighting. By tracking the number of claims handled by the employees, researchers concluded that productivity increased 2.8 percent after the workstations were installed.

This example also illustrates that there can be more to the solution than upgrades to the HVAC system. IAQ is just one component, albeit a key one, of the overall indoor environmental quality (IEQ). IEQ is affected by many things — including acoustics, lighting, temperature, humidity, air circulation, and composition of the air in terms of its level of carbon dioxide, dust, particulates, mold, and microbes.

Solutions Abound

The solutions available for tackling IAQ issues could fill an entire series of articles, but generally come down to three approaches:

1. Keeping indoor air pollutants out of the building through source control.
2. Dilution by controlling the mix of outdoor and indoor air being circulated.
3. Filtration to trap or kill contaminants.

New weapons against airborne contaminants include filtration systems that use a combination of activated charcoal, high-efficiency particulate air filters, and ultraviolet light to capture and destroy particulates and microbials.

Because of the complexities involved in solving IAQ and sick building issues, facilities professionals should work with a consulting engineer to conduct an IAQ assessment. Many consulting engineers are now specializing in IAQ and are capable of providing a more comprehensive picture of the ROI gains to be made dependent on a range of solutions deployed in compliance with building codes and various applicable standards, such as those offered by ASHRAE.

The Cost of Doing Nothing

One might legitimately argue that the economic benefits portrayed in the previous models are only of consequence if the occupant owns the building. What benefit is there, really, to the owner who leases the building to another company or multiple tenants?

Building owners have a major stake in the success of the building; that is, how many tenants move in (occupancy rate) and perhaps just as important, how long tenants stay. Presently, office building construction is on the rise, and today's emphasis on good IAQ in new facilities puts pressure on owners of existing offices to upgrade.

According to BOMA, the No. 1 reason tenants move out of a building is due to issues with HVAC systems. If a tenant moves out of a building, there are many costs the building owner will incur, such as lost rent, renovation and refurbishment costs, reletting costs, and utilities that continue to be paid, even when the building is not occupied.

Economic Analysis — Building Owner Losses Due to Move (pictured below) provides a scenario for the building owner. In this case, the cost of lost rent, utilities, advertising, and concessions to attract a new tenant add up to $283,333. The economic return on making the $100,000 investment in IAQ to keep the tenant is 283 percent, with a payback achieved in less than six months.

Make IAQ a Priority

People don't want to spend money on mechanical systems unless they are forced to because of obsolescence, failure, or tenant complaints.

But the adage "An ounce of prevention is worth a pound of cure" should really be the approach to IAQ. It is far cheaper to solve problems before they result in tenant complaints or lawsuits. And, the benefits will be less tenant turnover and a building that — because of its higher quality — is more prestigious and may command higher rent than other facilities in a community. Tenants will benefit from improved employee productivity and probably improved operating costs, because any upgrade to an HVAC system today will also likely result in energy savings.

In many respects, IAQ is an issue that is still "out there" to a lot of people who don't see the potential benefits of improved worker comfort, health, and productivity. But in the 1950s, the same could have been said about air-conditioning. Back then, people didn't recognize that air-conditioning could be a great productivity booster in an office setting. Times have changed.

It won't be long before businesses take for granted that IAQ, like air-conditioning, has an impact on productivity. But, until then, a little economic modeling can do the job ■

Economic Analysis: Building Owner Losses Due to Move

required to re-lease facility after tenant moves (months):		4
Cost of lost rent:		$100,000
Cost of utilities while vacant:		$13,333
rising cost to attract new tenant:		$0
deling/refurbishment costs:	1 ($/sq. ft.)	$20,000
ssions to attract new tenant:		
Months free rent:	6 months	$150,000
(OR) Reduced rent:	0 % for 0 months	$0
Moving Cost to Building Owner:		$283,333
HVAC system upgrade if tenant does not move		283%
Payback Period (years)		0.35

This worksheet considers costs to the building owner if a tenant decides to relocate to a new facility. Shaded cells are user-selected variables. According to a BOMA survey, the leading reason tenants relocate from one building to another is due to inadequate HVAC systems. If the tenant does not move, there is a tremendous cost savings to be realized.

becomes evident that the cost per employee per square foot is 10 times the operating cost.

In this model, the ratio of employee cost to energy cost, on a square-foot basis, is 98 to one. So, although achieving energy savings is certainly important, there is potential for a much larger financial payback if you can impact employee costs, even in a small way.

If IAQ problems are negatively impacting productivity by a conservative 1.5 percent, due to poor thermal comfort or absenteeism resulting from sick days, then the lost productivity for the building can be quantified at $2.93/person/year. Note that this amount is 50 percent more than the energy cost for the building.

In this particular model, the IAQ solution is found in upgrades budgeted at $5 per square foot, or $100,000. Based on this, and the anticipated employee-cost savings, the payback period is about 20 months.

Annual Productivity Benefits

Building Type	Wellness Category	Total Number of Workers (U.S.)	Productivity Increase Per Worker	Total Benefits ($Millions, U.S.)
Office	1 Healthy	7,222,800	$0	$0
	2 Generally Healthy	10,000,800	$617	$6,165.5
	3 Unhealthy, Problem Unknown	5,278,200	$1,439	$7,592.7
	4 Unhealthy, Problem Known	3,333,600	$1,439	$4,795.4
	5 Sick Building Syndrome, Building-Related Illness	1,944,600	$2,466	$4,795.4
Education	1 Healthy	720,400	$0	$0
	2 Generally Healthy	1,440,800	$762	$1,098.5
	3 Unhealthy, Problem Unknown	2,521,400	$1,779	$4,485.4
	4 Unhealthy, Problem Known	1,440,800	$1,779	$2,563.1
	5 Sick Building Syndrome, Building-Related Illness	1,080,600	$3,050	$3,295.4
Healthcare	1 Healthy	845,000	$0	$0
	2 Generally Healthy	1,690,000	$807	$1,363.1
	3 Unhealthy, Problem Unknown	845,000	$1,882	$1,590.3
	4 Unhealthy, Problem Known	422,500	$1,882	$795.2
	5 Sick Building Syndrome, Building-Related Illness	422,500	$3,226	$1,363.1

NEMI estimates of potential productivity benefits to be gained by IAQ investments.

How Real is the Deal?

In NEMI's *Productivity and Indoor Environmental Quality Study*, it is stated that even in "generally healthy" buildings, a 1.5-percent productivity gain is possible, and in "sick" buildings a six-percent gain is achievable. NEMI considers the 1.5-percent figure to be conservative, saying gains of five to 10 percent are possible.

Washington D.C.-based Building Owners and Managers Association (BOMA) International conducted a 1988 study that indicated a significantly higher ROI is possible from IAQ improvements. One-quarter of the 400 executives involved with space planning and use who were polled identified heating, ventilating, and air-conditioning (HVAC) systems as the No. 1 operating, management, or design problem. Respondents said an average productivity gain of 18 percent would be realized if the HVAC system problems were eliminated.

Although the ROI suggested by the BOMA poll is subjective, more concrete studies have been performed at various companies to measure the impact of workplace environment changes. At one insurance company, for example, workstations were installed, allowing for individual worker control of temperature,

continued

Productivity Economic Analysis – Cost to Employer

Building Area (sq. ft.):	20,000	Productivity Loss Due to Poor Thermal Comfort, Absenteeism, Etc. (%)	1.5
Number of Employees:	125		
Avg. Occupancy Density (# sq. ft/person):	160	Cost of Lost Productivity: ($/sq. ft./person/yr.)	$2.93
Building Operating Costs:		Total Building	$58,500.00
Rent ($/sq. ft./yr.)	$15.00		
Utilities ($/sq. ft./yr.)	$2.00	Total IAQ Upgrade Cost	$100,000.00
Taxes ($/sq. ft./yr.)	$3.00		
Total ($/sq. ft./yr.)	$20.00	IAQ Upgrade Cost ($/sq. ft.)	$5.00
Total Annual	$400,000.00		
Salary Costs:		ROI of HVAC Upgrade Cost	59%
Hourly Pay:	$12.00	Simple Payback Period (years)	1.71
Benefits (+30%)	$3.60		
Total Hourly	$15.60		
Total Annual (per person)	$31,200.00		
Total Annual	$3,900,000.00		
($/sq. ft./person/yr.)	$195.00		
Ratio of: Salary to Bldg. Oper. Cost	10		
Salary to Annual Energy Cost	98		

This spreadsheet computes the return on investment (ROI) and Simple Payback Period for the cost of upgrading an HVAC system. The cells with shaded backgrounds are input fields. All other numbers are calculated values and cannot be changed.