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Indoor air quality (IAQ) and indoor environment quality (IEQ) are now more important than ever as businesses look to cost-save and increase productivity.

Breath of fresh air

When staffing represents as much as 90 per cent of a business's operating costs, even marginal improvements in productivity and absentee rates can represent significant savings. **Sean McGowan** explores the role of indoor air quality (IAQ) and indoor environment quality (IEQ) with Tony Arnel, global director of sustainability at NDY; David Jarratt, associate director and sustainability practice lead Australia and New Zealand for AECOM; Gary Whatling, M.AIRAH, Manager (NSW/ACT) for A.G. Coombs Advisory; and Frank Roberson, communications manager for NABERS.

Ecolibrium: How has the pursuit for improved IAQ and IEQ changed over the past few years? Has it become a bigger area of emphasis for HVAC designers?

Tony Arnel: We now have clear evidence that good IEQ delivers a range of positive outcomes for building occupants.

One research project, driven by Harvard University, examined the impact of green buildings on brain function and found that employees' cognitive performance scores were higher in green building environments with enhanced ventilation compared to a conventional building.

This is just one example of the growing body of evidence. It's no surprise then, that the market for IEQ products, technologies and skills is booming, and that it is becoming a bigger area of emphasis for the HVAC industry.

Gary Whatling: For most design engineers, this aspect of HVAC design has probably been influenced recently more by the considerations required for building rating systems. While AS/NZS1668.2 has consistently provided the fundamental guidance on minimum outside air-flow rates and locations of air intakes and discharges, increasing effort has been applied more to achieving the ratings rather than fundamental considerations of IAQ.

David Jarratt: With \$8.7 billion spent on healthcare globally, our built environment plays a significant role, both internally and externally, to unlocking the human potential – especially in a



“ Air quality gets less attention because it’s not as tangible ”

knowledge-based economy that we are currently experiencing in Australia.

My experience working with a vast array of HVAC designers is that while there is greater knowledge within the industry regarding case studies that have shown a financial advantage in improved IAQ, we are still a little way off in the design of developments, especially where the end user is not actively involved in design decisions.

Frank Roberson: The pursuit of good air quality and good indoor environment quality has certainly increased over the past few years. It’s been driven by a number of factors. Society on the whole has become more health conscious, research findings continue to show

links between good IEQ and health and productivity, and the introduction of the WELL building standard has generated a lot of interest and discussion.

I don’t know that it has become a bigger area of concern for HVAC designers, as good air quality has always been a concern for them. The difference now is that other professionals are making it a priority and are willing to invest in achieving it.

As well as that, technology is now allowing building managers to access higher quantities of quality data across numerous indicators of IEQ performance more cheaply than ever before. That means that HVAC systems are getting the attention they need throughout the life cycle – and not just at the design stage.

Ecolibrium: Have these terms, and their impact on occupant comfort and productivity, become more widely understood by the industry?

Whatling: In general terms, probably not. With the focus on achieving the rating systems point scores, less attention has been paid to the fundamentals around comfort and productivity.

For some time, the major property owners and leading property managers have carried out IAQ/IEQ testing in their PCA Premium and A-Grade properties, but many have chosen not to share this with their tenants or the market.

We are now seeing more of the blue-chip global and Australian corporate occupiers of these properties ask for disclosure of these results, and we are seeing this in the increase of formal NABERS IE ratings. You would hope that this is likely to help the development of a better understanding of the connection between IEQ and productivity.

Jarratt: There is a general acceptance that having an environment that focuses on improved IAQ benefits occupant comfort and productivity; however, there is still more education required when it comes to the finer details. For instance, at what point does reducing outdoor air rates diminish the productivity of the space, and to what point does allowing increased levels of CO₂ affect performance?

Roberson: There have been some great studies in this area over the past few years that have been widely circulated

throughout the property and HVAC&R industries. They have done a lot to improve awareness and understanding of IEQ and its impact on occupant comfort and productivity.

If we’re talking about the wider property industry, while there’s definitely been a lot of discussion and media coverage dedicated to comfort and productivity, I don’t know how much of this has been focused on air quality and IEQ. The WELL building standard, for example, covers a lot more than air quality, and from discussions I have had with people, the areas that interest occupants the most are those that they have most control over: food, exercise and so on.

Air quality gets less attention because it’s not as tangible. If the air quality is good and people leave the office feeling fresh at the end of the day, they go home thinking about other things – not about the quality of the air. IEQ is often only something you notice when it’s bad. You notice the absence of something, rather than its presence.

Arnel: The acronym itself may not be well understood, but the rapid acceleration of the healthy building movement in Australia and globally, is undoubtedly a response to this growing evidence base. We are seeing everyone from building owners to tenants talk about the importance of built environments that support health and wellbeing, and obviously good IEQ is a vital component of that.

Ecolibrium: Has the broader property industry got its head around the energy cost of improved IAQ versus the cost savings that productivity and wellbeing improvements bring?

Roberson: This is starting to change, as the property industry understands that good IAQ is strongly linked to good building management, which in turn helps manage costs. Our research shows that there is a strong positive correlation between NABERS Energy and NABERS Indoor Environment ratings, demonstrating that well-managed buildings tend to be both energy-efficient and more in tune with occupant comfort and satisfaction.

Jarratt: There are many case studies that identify the overall cost savings; however, it is my perception that people making decisions don’t believe that the figures



Gary Whatling, M.AIRAH



David Jarratt



Frank Roberson



Tony Arnel

materialise into reality. Therefore the more data and case studies, and the more educated tenants become, the greater the pressure that can be mounted to ensure strategies that have a strong focus on indoor air and environment quality can be delivered to market.

Many studies have estimated the value of improved productivity at approximately \$250/m²/year value to a tenant, when taking the cost of absenteeism and the cost of replacing staff, among others, into account. This figure dwarfs energy costs by a factor of greater than 20 times.

These savings are significant and shouldn't be taken as a bonus – they need to be taken into consideration when business cases are established for new and existing buildings.

Arnel: Buildings are complex and there will always be trade-offs when project teams are juggling energy-efficiency imperatives alongside the need to deliver good-quality indoor environments. The secret is to keep sharing our successes, implementing incremental improvements and expanding our thinking about return on our investment in sustainability. This will ensure more people understand that IEQ is a powerful way to keep businesses in the black.

Whatling: I don't think there is a general awareness that this is an issue for anyone other than the mechanical services designer. Very few building design briefings include reference to IAQ in any context other than building ratings.

That said, it is now pretty much a given that new commercial buildings will be designed and built to meet Green Star criteria, with clear IAQ/IEQ requirements. Most of the major owners of existing property track IAQ in one way or another.

Additionally, with the effective use of demand-based outside air intake control using CO₂ sensors, and carefully tuned HVAC systems, higher outside air rates, when required, need not always be at the cost of energy efficiency.

Ecolibrium: What weight is now placed on IAQ and IEQ by the various rating systems available?

Arnel: Australia's rating systems have always addressed IEQ. The IEQ category in the Green Star building rating tools has driven improvements in air quality, lighting and thermal comfort, while discouraging the use of harmful chemicals and off-gassing materials.

Other benchmarks include the WELL Building Standard, which focuses on seven areas of health and wellness: air, water, nourishment, light, fitness, comfort and mind.

Whatling: IAQ considerations are a relatively modest part of the overall Green Star rating, and again a relatively small aspect in a NABERS Energy rating context.

I represented AIRAH during the recent review of the NABERS IE tool. The NABERS team worked very hard on the update of this tool to satisfy the needs and wishes of the many stakeholders at the table. With the arrival of the new NABERS IE tool, ratings are now more consistent and straightforward. For some owners, a NABERS IE rating each year is already business-as-usual, and this contributes to well over 10 per cent of their Green Star Performance rating score.

Hopefully this will encourage more occupiers to request base-building IEQ ratings from owners.

Jarratt: In regards to NABERS, it can be observed that the number of premises

THE GROWTH IN NABERS IE

According to Francis Roberson, interest in the role of IAQ and IEQ on productivity and wellbeing in buildings is reflected in the demand for NABERS Indoor Environment (IE) ratings.

Last financial year saw the number of NABERS IE ratings rise by more than 40 per cent, and Roberson expects this financial year to be a "record breaker".

In the period from 2008 to 2015, 100 buildings received a NABERS IEQ rating. But since the tool was reviewed, improved and relaunched as NABERS IE in 2015, the number of buildings to have already received a rating totals 57.

"We think it's the natural next step for buildings wanting to differentiate themselves in the marketplace," he says. "With more businesses offering remote working opportunities and flexible working arrangements, spaces that meet the needs of tenants and . . . are of the highest standard will attract employees to come into the office."

‘ It’s no surprise then, that the market for IEQ products, technologies and skills is booming ’

currently advertised as rated under the IE tool is significantly smaller than the number of ratings targeting a NABERS Energy.

This difference can be attributed to two main areas. The first is the mandatory disclosure of energy performance of office buildings and space looking to sell

and lease. The second is that building owners are reluctant to benchmark the performance of the quality of the indoor environment for fear of tenant backlash.

In saying this, an important step in improving the performance of anything in the built environment is to benchmark the performance, identify areas of weak performance and implement strategies for improvement, and then benchmark again to demonstrate improvement.

Roberson: NABERS is a holistic building performance rating system. We measure energy and water efficiency, waste management and IEQ. With that said, each aspect of sustainability is rated with a distinct tool that gives a separate star rating, so you can know if improvements in one area have come at the expense of another.

That’s why I believe occupants should be demanding an IE rating alongside their Energy rating – to ensure that they are getting the whole picture. No one wants to work in a building that is very

energy-efficient at the expense of their comfort. Doing these ratings in tandem ensures tenants are leasing spaces that are both efficient and that foster productivity.

In terms of other ratings systems, on a global scale the Global Real Estate Sustainability Benchmark (GRESB) is putting a lot more emphasis on health and wellbeing. As of last year, if property owners get three or more NABERS ratings, as part of a NABERS multi-rating certificate, they can access another 10 points in the GRESB Survey.

Ecolibrium: How are IAQ and IEQ now being measured? What benchmarks are commonly used?

Whatling: I’m a big fan of the NABERS team and the tools. The consistent way in which the NABERS suite of tools is applied gives our industry in Australia a big advantage over overseas property markets. Just consider what the energy tool has done for energy efficiency in Australian property.

FEATURE

Roberson: In a NABERS IE rating, our assessors will measure various aspects of air quality such as ventilation effectiveness, particulate matter (PM10), formaldehyde, total volatile organic compounds (VOCs) and carbon monoxide (CO). They do so by taking space measurements on site, in various locations within the building.

Air quality is just one aspect of overall IEQ though, including other aspects such as thermal comfort, acoustic comfort, lighting and office layout.

Importantly, the NABERS IE tool takes physical measurements from the space, but also measures the occupants' perception of their workspace through occupant satisfaction surveys. The two combined provide a powerful analytical tool that can identify issues and help building managers understand where to focus their attention.

Jarratt: There are rating tools and technical measuring devices that are enabling the commercialisation of

IAQ and IEQ; however, organisations should be looking at how their business is operating when making decisions to either improve the indoor environment of the existing facility or when they move to new facilities.

People take sick leave for a vast array of reasons but a major contributor is the spread of illness throughout the indoor environment. Therefore, businesses can benchmark sick leave, compare it to industry averages and work with their consultants or facility management teams to understand how their HVAC system can work better for them and unlock the human potential of the people who are using the facilities.

Ecolibrium: [How is technology making measurement easier and more accurate?](#)

Whatling: The new NABERS IE tool gives property credits for the automated sampling of some IEQ parameters over an extended period. And the availability

and ease of incorporation into a BMCS of sensors such as CO₂ certainly makes the inclusion of moderately sophisticated control philosophies a much simpler decision to justify.

Our Building Technology team have managed alterations to a number of BMCS recently to incorporate the inclusion of IAQ measurement technology to support both ongoing NABERS IE and Green Star Performance rating requirements.

There is a need to obtain calibration or maintenance certificates for all sensors from which data is used during the rating period, as well as BMS sensor installation diagrams on the floor levels tested during the rating. For the selected sample floors, you must ensure the data is robust, that these floors are not subject to a lease expiry part-way through the year, and for the BMCS team to set critical alarms should these levels go out of set-point balance.

Arnel: Technological advancement is pushing the IEQ agenda.

I'm inspired by the work of the University of Sydney's Professor Richard de Dear, who leads the IEQ Lab. It aims to provide a scientific approach with specific technology that can inform decision-making about building performance.

The IEQ Lab assesses a range of environmental factors – temperature, humidity, ventilation rates, air quality and movement, daylight and artificial lighting, acoustics and particulate levels – to enable building owners to identify weak spots and determine pathways to improve them.

Jarratt: There are a range of bespoke sensors being developed to identify IEQ issues relating to indoor environment performance; however, ensuring that these are accurate by comparing measurements to those being read by the BMS will ensure the validity of any additional measuring devices being employed to diagnose the performance of the existing building stock.

Roberson: The progress in sensor technology and building management systems has been fantastic for everyone who operates buildings. We're now able to collect a much wider spectrum of building data, in real time, with more granularity than ever before and for less cost.

The SAMBA unit developed by the University of Sydney tracks all of the NABERS IE measurements in real time and is small enough to sit unnoticed on your desk, while a helpful dashboard allows you to monitor these results remotely.

Ecolibrium: What are we doing, as an industry, with all this data? How can it be used to improve both new and existing buildings?

Roberson: After NABERS Energy ratings were introduced to the market, they served as a feedback loop for architects and designers to understand and evaluate which features were working

to achieve energy efficiency and which weren't. This feedback allowed buildings to be built better and also created an incentive for well-designed buildings to be commissioned well.

The data that's now becoming available through NABERS IE and the many developments in real-time monitoring equipment are shining a spotlight on IEQ. This will lead to a similar understanding and transformation for comfort and amenity that we saw from the introduction of NABERS Energy back in the early 2000s.

Jarratt: Understanding all data available is paramount to being able to diagnose performance issues. This is where data loggers will be a crucial component to identify and connect what is happening within the space and inform the user and the facility management team on how to address potential issues within a tenancy. People need facts, and they need facts that are relevant to them, how they work and how they conduct business.



Whatling: The one advantage of using the BMCS to acquire IAQ/IEQ related data, as opposed to a stand-alone data gathering tool, is that the information acquired is available for use immediately in real-time by the BMCS to improve its ability to manage and modulate the HVAC system to provide optimum internal conditions.

Arnel: There are many variables that make IEQ notoriously difficult to measure. What happens when someone puts on a jumper, changes the position of their screen in relation to the light, or opens a window? This can make it very hard to put a dollar value on productivity improvements.

But quantifying the benefits of good IEQ is the Holy Grail, and for good reason. The World Green Building Council's *Health, Wellbeing and Productivity in Offices* report suggests productivity improvements of between 8 and 11 per cent as a result of better air quality alone.

These aggregate figures may mean little to business decision-makers, but when they can see that their building's air quality is poor – and that improving ventilation alone can deliver a significant productivity improvement – it makes the case for investment in more energy-efficient buildings with good IEQ a no-brainer.

Ecolibrium: Where does activity-based working (AWB) sit in all of this? What does the data say about its impact on IEQ? Do occupants like it, or merely tolerate it?

Arnel: AWB is just part of the current movement around healthy, sustainable buildings. Until recently, buildings have been seen as cost centres and not enablers of human productivity. But as corporate leaders get more information on how a range of factors – from agile working to biophilic design – can boost productivity,

they can draw correlations between building quality, employee performance and health costs. And they can make decisions accordingly.

Jarratt: AWB plays an active role. As the workspace does not just constitute the typical work desk in a small cubicle with a PC and a desk phone anymore, people are looking for variety, and if something is not working for them, they will evolve and adapt.

There are mixed reactions to AWB. However, just as businesses become redundant if they don't embrace the change that is happening outside the walls of the office, staff also need to be adaptable.

Roberson: We have seen early indications that ABW may have a neutral or slightly positive effect on the perception of IEQ. But again, and like most things in life, it greatly depends on how this is designed and implemented.

Thoughtful environments that are designed to maximise not just the headcount per square metre but also carefully consider how to make spaces work better for people, can be very successful. In these spaces we would expect to see happier occupants and therefore better IEQ performance.

In terms of NABERS, office layout is a key component of a tenancy and the whole-building NABERS IE rating, and therefore occupants who are more satisfied with all aspects of their surroundings are going to score higher on this component leading to an improved NABERS IE rating.

Whatling: In the CBD where rents are higher, ABW appears to be a very attractive leasing and cost-saving proposition. It appears to have taken a real hold, with many new commercial buildings and refits incorporating this space-planning approach.

Whether occupants like it or not is a very subjective thing. Having worked in an AWB office over a number of years in the past, I didn't enjoy the experience at all. For me, the potential benefits of improved collaboration didn't outweigh the cramped, noisy and impersonal environment.

As a building services specialist, we see that while AWB floors are not normally overcrowded, they generally reach or come close to their maximum design occupancy for most of the time. When compared to traditional fitouts, AWB floors can be seen to drive the outside air rates on CO₂ sensors, and drive cooling calls on zone AHUs due to their higher occupancies. AWB floors often have the peak noise levels when the NABERS IE tool assessment takes place.

Ecolibrium: Will the focus on IAQ and IEQ continue to grow, and who will be driving it?

Jarratt: The trend is going to continue to grow. Businesses are becoming more educated, savvier and are demanding spaces that can enhance their competitive advantage. We have seen the banking sector invest in high indoor environment quality spaces – now the consultancy management sector is following suit. Everyone is looking for an advantage.

Whatling: We are likely to see the general focus on IAQ and IEQ continue to grow. It seems to be emerging as a significant issue for property owners in retaining and attracting tenants and more generally for tenants in retaining staff. We now have great tools to help measure and deliver improved internal conditions.

I suspect that there may be a plateau in this aspect in new-build designs; however, the upgrading of old building stock should be the field of opportunity for savvy building owners and their designers.

Arnel: When energy costs account for just 1 per cent of a company's expenditure, it's hard to get the boss or the board excited about investing in improvements to a building's energy efficiency.

But when staff costs equate to around 90 per cent of a company's total operating budget, anything that delivers even a small productivity uptick gets their attention. For this reason, IEQ will continue to rise up the boardroom agenda. ■