

# Ecolibrium

**The art  
of smart**  
Buildings that think and adapt.

**AIRAH**





# The art of smart

We first saw the “smart” moniker applied to mobile phones, then to televisions and now to cars. But what does it mean in the built environment? **Sean McGowan** explores the issues with a panel of industry leaders, including Arup head of digital services Australasia, Greg Stone; Wood & Grieve Engineers mechanical section manager and principal Angus Grant, M.AIRAH; and NDY associate director and controls group manager Jonathan Clarke, M.AIRAH.

**Ecolibrium:** How should we define a smart building? And moreover, what makes a building smart?

**Stone:** The word smart has become overloaded in the last few years to the point where it can mean anything the marketers want it to.

I don't think of smart buildings as a binary thing – either smart or not. It is progressive based on the extent of smarts infused into the building or precinct.

Cars have followed a similar path where some smarts were added progressively over time – air bags that protected you, assisted braking that prevented skid, then computer-assisted cornering and so on, up to fully autonomous driving vehicles that are on the cusp of prime time. But the next step will then be on the vehicle proactively responding to the driver's needs without being asked.



The Edge building in Amsterdam is said to be a good working example of seamless integration and sustainable building design.

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Smarter buildings are seamlessly integrating in addition to conventional BMS, multiple building systems such as power and power generation, lighting, fire protection, security and access control, maintenance and facility management functions across common converged network platforms to allow data sharing, collection and use for operational decision making to support the needs of its occupants.

**Clarke:** It's an interesting question and one I've been asking for some time. Up until about 18 months ago, my answer would have suggested an integrated BMCS, energy management and possibly the introduction of analytics.

However, since my visit to Silicon Valley this year and having spent some time facilitating digital workshops with various clients also asking the same questions, I have come to realise that there is so much more to a smart building.

So my explanation is this. It is a building that understands its occupants' flow and locations, that learns and adapts to provide the optimum environmental conditions while balancing minimal energy and maximum comfort, with connectivity to create an online community providing additional services for occupants and new revenue streams for owners.

**Ecolibrium** Are smart buildings – or elements of – just part of best practice design now, or are they a step beyond?

**Clarke:** Currently, there are no standards for best-practice smart buildings; however, we are seeing a trend of using an integrated communications network (ICN) that hosts the building services systems for new buildings.

The challenges with adding a technology layer to a building are associated with breaking tradition for cost, procurement strategy, up-time quality of service and ongoing maintenance – all additional risks to building owners and operators.

An ICN needs managing, and this has an associated cost, adding to the operational expenditure. Owners are looking to reduce costs, and therefore a business case needs to be provided to clearly identify the advantages of an ICN. From what we are seeing in the market, smart buildings are on the agenda but usually one step beyond the budget.

Buildings have seen automated aspects of building control systems improve over the years too. HVAC for improved energy efficiency etc, and we are getting BIM as the basis for virtual modelling of real-time data in environments, but true smarts come when the building responds to human beings in more human ways. This means identity and access systems that know who occupants are, and allow or prevent entry without the need for a key card. It means tenants and occupants being able to use shared or third spaces in a building and have their encrypted wireless connections simply follow them from their office seamlessly.

It also understands what a user requires without the user having to train it or manually intervene.

**Grant:** Everyone has their own unique definition, as it is a developing concept. But to me it's a flexible, adaptive and intuitive building that seamlessly responds to the needs of its occupants, managers and owners.

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Smart systems in buildings have been with us for many years and they continue to evolve. Building management systems (BMS) for controlling and interfacing with the building's HVAC systems and other stand-alone controlled systems is business as usual.



Greg Stone



Angus Grant, M.AIRAH



Jonathan Clarke, M.AIRAH

**Stone:** Smarts that play into the building automation or best-practice energy control are now becoming baseline and expected. Most BMS providers have or are incorporating this into their wares.

But those that play into the more human-centred aspects I referred to earlier are very much nascent.

**Grant:** We are seeing more and more change in this space. Digital disruption and the Internet of Things (IoT) are changing our lives and the way we do business. It stands to reason that this will significantly impact building design as its users are challenged in this changing environment.

What is best practice now will soon be commonplace. We are seeing many examples of buildings around the world and in Australia that are adopting new technologies and approaches to integration of building systems and elements. The extent of and demand for connectivity is driving this seamless integration push.

So while full or seamless integration of all systems is not standard or best practice yet, it is coming.

**Ecolibrium:** Can you offer any good working examples of smart buildings?

**Grant:** To me, one of the best examples is a building called The Edge in Amsterdam, Netherlands. It is a good working example of seamless integration and sustainable building design. And it's not touted as the world's greenest building without good reason.

Power over Ethernet (PoE) lighting, façade and roof PV panels, rain-water harvesting in an office building environment and geothermal heating systems are a few examples.

The systems are by no means perfect and without fault. However, the vision of the developer and their continued focus on producing smarter buildings is commendable.

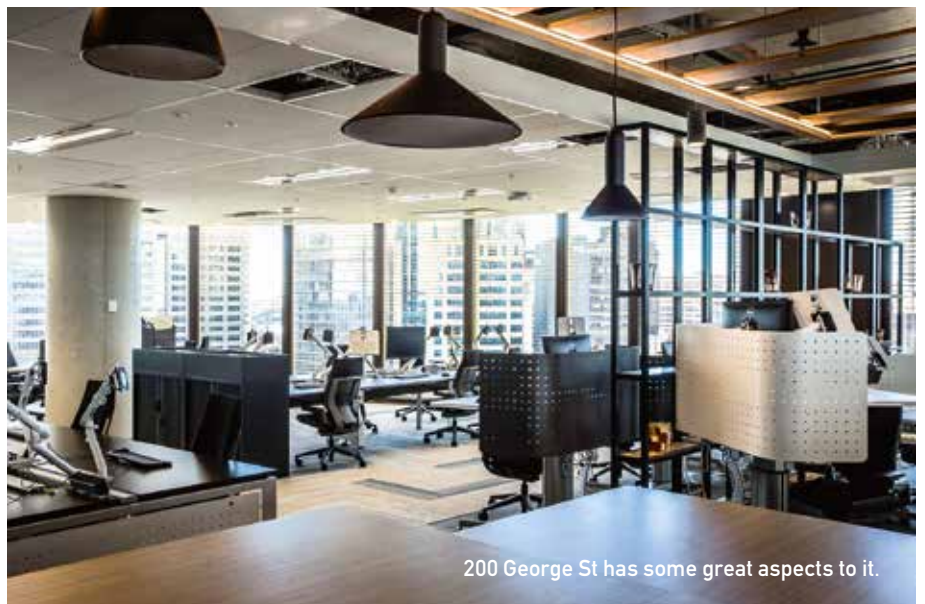
**Clarke:** The Edge is the "smartest building in the world" according to Bloomberg, but a smart building means different things to different people, and therefore finding a good working example is a challenge.

Unfortunately, most smart building projects start out as a great idea until the budgets come in. Another challenge

is finding experienced contractors to deliver one. A smart building will cross all building services disciplines, and the integration of these requires a specific skill set. There are not many contractors with this.

**Stone:** Mirvac's 200 George Street in Sydney has some great aspects, as does Lendlease's Barangaroo towers. While everyone points to The Edge, actual use by tenants of some of the innovations has been less than successful, and the way the technology was wired up means it is quite inflexible to future change.

I don't see any real examples of smart buildings of the type I indicated earlier, that are more human-centred in their focus rather than simply energy efficient.



200 George St has some great aspects to it.

“The industry is in a technical revolution and we are at the start of a very exciting journey”

Arup is, however, currently working on three major smart buildings/precincts in Australia, two in Singapore and one in the UK that incorporate this fundamentally new human-centred approach to smarts.

**Ecolibrium** What are some of the challenges in designing smart buildings? Are technologies already “smart ready”, or are some lagging behind?

**Grant:** The challenges in designing smart buildings are varied. Challenging preconceived ideas and the tendency to fall back into, “We’ve always done it this way, why change?” thinking. This applies to building owners, designers, contractors and suppliers.

Cost is the greatest obstacle in delivering truly smart buildings. The development of technology across all systems and experience in fully integrating systems are still a challenge.

**Stone:** The first challenge is to clearly understand and define exactly which stakeholder experiences hold the most value. Then these experiences must be mapped to the technologies that are required to power them, and then they must be choreographed in a modular way to support changing end-user requirements.

This means a lot of “joining up” of systems will be required, and some of these are not easy to interoperate with.

Traditional building systems, in particular, tend to be vertically integrated stacks with little desire for openness and lifts etc., represent some of the worst cases. This will change as project requirements and the specifications for these systems start to preclude vendors’ closed systems.

**Clarke:** Connectivity and accessible data are both key towards creating “smart”. There has been an industry push over the last decade to standardise communications standards to make integration an easier task to achieve. But there is still a lot of room for improvement to get to pure plug and play.

Wireless sensor technology has vastly improved and costs are falling, so we see this becoming business as usual. Lighting systems have been behind the curve for a number of years but we are starting to see some very innovative solutions coming through.

The industry is in a technical revolution and we are at the start of a very exciting journey. At NDY, we are exploring all trends of automation – from the early stages of conceptual design to FM operations. And so far, it’s been quite a trip.

**Ecolibrium:** From an HVAC&R perspective, what advantages does being smart offer?

**Stone:** The advantages have been focused on energy efficiency and green status, which is important but now a baseline expectation. The focus now is more human – it is on wellness because that impacts productivity for commercial tenant employees. This means HVAC needs to integrate with a variety of other systems now to deliver this rather than just try and be optimised for basic comfort or energy efficiency.

**Clarke:** There are benefits, or advantages, in integrating services to share data. Having the ability to optimise building performance using intelligence is the way forward. However, an arsenal of technology in a building will not provide smart HVAC control strategies without flexibility in the mechanical infrastructure – such as zoning, sensor types and locations, and plant selection adding to costs and delivery timeframes.

**Grant:** Great environments for the building occupants are an important driver, and the HVAC systems have a key role to play in that. Real and instantaneous data from multiple system sources that becomes available in smart buildings will inform how the systems are operated and controlled. This has a direct bearing on the HVAC system performance and energy consumption.

COVER FEATURE

**Ecolibrium: How can the industry take better advantage of the opportunities presented by smart building design?**

**Grant:** By taking the lead in integration and challenging current norms.

As an industry, we must be bold enough – especially when cost pressure is brought to bear on a project – to implement creative solutions that challenge the current norms and ways of doing things. Smart buildings present opportunity to be creative, which is key to the development of our industry.

In addition, greater openness and integration of system platforms will be required to realise opportunities presented with smart building design.

**Stone:** Very simply, these vendors must realise that they can't now lock in their proprietary technologies, and must now participate with many other technologies to deliver better outcomes for developers, tenants and other stakeholders.

They can actually step up to opening up their systems using well-documented, comprehensive Application Programming Interfaces (APIs) via common, lightweight open standards to access them. It's really that simple.

**Clarke:** The industry needs to look beyond the current supply chain and investigate the world market for smarts.

Equipment should come to site semi-installed with preconfigured controls as a package. This will cut installation and commissioning time, which are typical pinch points on any project. Packaged plant rooms are big in Europe, and having spent many years there as

a systems integrator, this really does provide benefits to the project timeline.

A smart building should not just be about technology. We need to be smart about the procurement, delivery and ongoing maintenance of the building using technology to provide the data that we are blind to.

**Ecolibrium: What is the relationship between smart buildings and rating tools, whether it's Green Star, NABERS, LEED, WELL or others?**

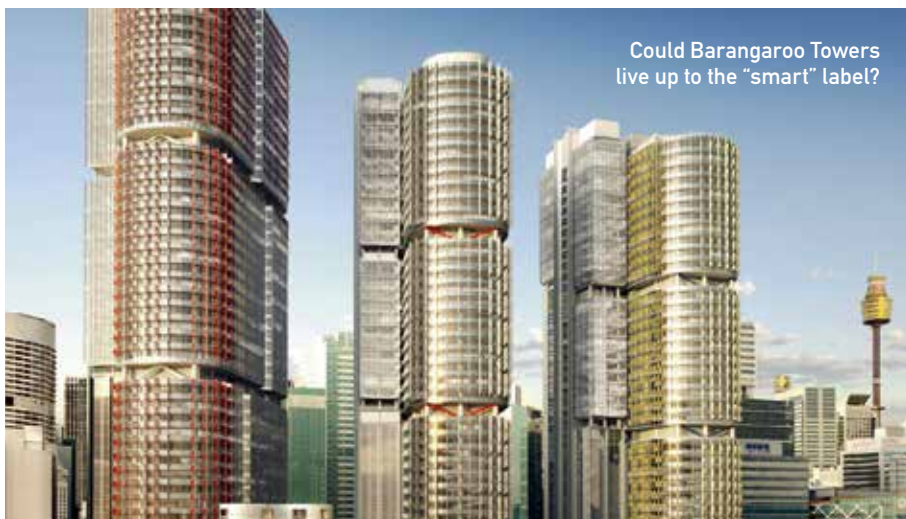
**Stone:** We see the ratings as natural outcomes of creating a more liveable, flexible and user-centric development, whereas I think much of the focus to date has been on achieving the rating.

**Clarke:** Although being smart can provide very useful data and the ability to be sustainable, we have seen more intelligent buildings tip the balance and burn energy as analytics pick up poor-performing plant, leading to an energy increase.

However, as they say, if it's not measured it can't be managed, so having the data and intel will ultimately help with energy control.

**Grant:** To me, rating tools and systems have, to date, purely been a metric. A mere box-ticking exercise. A building can be smart without aspiring to achieve a rating with a particular tool.

Smart buildings deal with elements well beyond what these rating tools measure. The more holistic approach tools, such as the WELL Building Standard can drive creative design that is focused on the wellbeing of its occupants.



Could Barangaroo Towers live up to the "smart" label?

“ A building that can think for itself and adapt to suit the occupants and operators is the ultimate challenge ”

**Ecolibrium:** So what is the relationship between smart buildings and the electricity grid, and how does it differ to standard buildings?

**Grant:** Smart buildings often adapt on-site power generation in varying forms. The use of PV and gas-driven micro-turbines provide the ability to either fully, or in a reduced form, to supplement the building’s power supply from the grid.

The ability to feed back into the grid then becomes a reality when it makes sense to do so. Standard buildings might have a limited back-up power capability but not much more, so there is a big difference.

**Clarke:** If a building understands its demands and operating profile, it can predict what power it needs and when. This, along with analytics and the ability to monitor the energy suppliers, can get the best deals in the market. This can dramatically cut operating costs, which is a great selling point for the building and its occupants. And it generates another revenue stream for the owners – as we are seeing with some buildings becoming embedded suppliers of power.

Again, it is all about connectivity.

**Stone:** Naturally, a smarter building will contain the ability to manage energy more efficiently and even generate a positive balance at times, so making this available to others via the grid is an option.

However, we would argue that the energy component of a building represents a tiny portion of the overall value of the development and its use by stakeholders. Compare a tenant’s energy bill, for instance, with their human capital cost and the implications

for getting even small, incremental improvements in the latter.

Improving productivity for a tenant’s employees supports higher rents, which supports a higher valuation in a way that energy efficiency improvement can’t match. This is why we are seeing a shift in focus now.

**Ecolibrium:** And finally, without budget or time constraints what would you do and why?

**Grant:** I can’t recall a client saying to me that there are no budget or time constraints on a project. But ultimately, all that we do will have to stand up to the scrutiny of our clients and peers in the industry. So doing smart for the sake of smart will never fly.

Purely from a selfish perspective though, I would put a sensor on or in everything and have time to achieve seamless integration. And seeing as though we have no constraints, also having the opportunity to measure the real performance for the first two years of a building’s life to understand the interactions between a smart building and their occupants.

This will provide the best feedback loop to creative engineering design.

**Clarke:** Although having a blank cheque and calendar to work with, I don’t think a technology-for-technology’s sake approach would be of any benefit.

We are sometimes limited by the available products in Australia, and having the ability to widen this spectrum would be an advantage, as there are some really cool products out there.

Smart sensors for temperature humidity, CO<sub>2</sub>, occupancy and location tracking would be great to accurately measure and control environmental zones.

These zones would be modular, and have the ability to be transformed into different configurations, providing the occupancy a flexible and diverse workspace it needs.

Tenants are requesting control over their spaces – a bit like a hotel room. However, this could have a major impact on energy and also make an interesting debate on what the best temperature in a meeting room is. Notwithstanding this, some level of interaction between occupants and space could be facilitated if the boundaries are set and understood. For instance, if 50 per cent of tenants want cooler and 50 per cent want warmer, the net result might not impact on increased energy. Having an analytics engine with the ability to understand the building operation and make decisions to change parameters would be a move forward.

A building that can think for itself and adapt to suit the occupants and operators is the ultimate challenge. Bring it on!

**Stone:** Even with those constraints, we counsel developers to undertake at least the early phases of a digital master-planning exercise to enable a sound business plan to be assembled for activating their development as smart.

We also suggest this happens as early as possible so that the implications – both positive and negative – for contracts, project process, tenant marketing and cost can be addressed. ■

