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# The Internet of Things

Seemingly everything with an on and off button is now either connected to the internet, or soon will be. In fact, such is the speed at which devices are being connected that some forecast a whopping 100 billion devices will be connected worldwide by 2020. As **Sean McGowan** reports, connectivity has arrived.

Despite its relative new-found popularity, the term “the Internet of Things” (or IoT) was actually coined in 1999 as the internet age was still in its relative infancy.

Back then, it referred to the potential global connection of devices using radio frequency identification (RFID) – the same technology still used in items such as e-passports, vehicle toll tags and public transport passes, to name just a few.

British entrepreneur Kevin Ashton saw RFID technology and the IoT as a method by which items, or people, could be identified and catalogued by computer.

Yet almost 20 years on, the modern concept of the IoT is significantly greater in scope, with the potential to impact many facets (some might argue every facet) of our lives. It does this through the interneting, or connection, of billions of physical devices via the

internet, such that they are able to communicate, share data and ultimately influence each other.

In the context of the built environment, and more specifically the commercial property sector, the prevalence of building management systems (BMS) means we’ve been using the basic principles of the IoT for many years.

“If you think about it, every BMS or any other control system is a connected set of devices that shares data and influences the behaviour of other devices in their own mini IoT ecosystem,” says BUENO managing director, Leon Wurfel, Affil.AIRAH.

“But in the last few years, with the advent of open protocols and more open engineering frameworks, macro IoT layers have been added to the built



environment. Firstly by converging the systems on individual sites and then by converging the systems and data flows across portfolios of buildings.”

For many in this space, the IoT offers the promise of innovation, optimisation and performance management of buildings based on reliable, measured and factual evidence.

And if this sounds like the same promises being made around big data, you’re dead right. The two are inextricably linked.

“In our view, IoT is the enabler of big data,” says Sharmila Tsourdalakis, chief information officer at GPT Group.

“The challenge is to take this tsunami of data, millions of data points across our portfolio . . . and move it up the information hierarchy. We need

to move from big data to big information, big knowledge and big wisdom. That’s the open challenge.”

Then of course, there’s building information modelling, or BIM.

Its evolution – and that of information exchange standards such as COBie (Construction Operations Building Information Exchange) and Project Haystack (the standard for building operational IoT data) – offers an important framework to link objects across all building elements.

“With BIM we can create a validated data repository that seamlessly progresses from design through to construction and then into operation,” says Con Bafitis, director of facilities and asset management services at AECOM.

“With the addition of a big data platform, integration is possible – producing reports to measure and drive key performance indicators.”

## FULFILLING POTENTIAL

Despite the countless number of devices already installed in buildings, we are not yet using them to their full potential. The promise of the IoT is that this potential is unlocked, and that the cost of business will ultimately be reduced.

In the meantime, however, Bafitis says the built environment will continue to operate in a reactive mode.

“Usually a problem arises, we then gather data and then apply a solution,” he says.

As well as the inherent costs of working in this way, the hidden costs associated with having key building functions “down” can mount up – such as lifts being out of order, surgical theatres closed or air conditioning acting up, resulting in lost productivity and revenue.

But by making the most of what the IoT offers, such costly events could be avoided in the future.

“In a smart building, predictive analytics are embedded and life-cycle can be accurately predicted so there are no budgetary surprises,” Bafitis says. “Rather than maintenance staff attending at regular intervals hoping to find a fault, they can instead attend a site when required with the parts needed, because the fault has already been diagnosed.”

“We need to move from big data to big information, big knowledge and big wisdom.”

## TAPPING INTO VALUE

Value in commercial property is directly linked to the productivity of space and productivity in the space.

According to Tsourdalakis, productivity of space is driven through space utility – using every square metre for the best and highest use. Productivity within the space, particularly commercial office space, is subject to a range of wellness and comfort criteria.

“The IoT offers the potential for fact-based or evidence-based decisions to be made on the optimum performance of services in a building,” she says.

For instance, Tsourdalakis says many buildings have electronic taps installed in bathrooms as a water-saving device. But what if data taken in real time from these taps was used to schedule cleaning based on usage, rather than a fixed schedule?

“That’s the value-add enabled by a smart tap,” she says, “connected to communications and presenting information in a way that can be understood and used effectively by the facilities team.”

## BUSINESS AS USUAL

While the IoT can provide value improvements, the real value will only be unlocked once businesses treat it as an integral part of their business processes, as opposed to being a bolt-on to business-as-usual.

Wurfel says the IoT can provide improvements to the value returned in three key areas of the built environment.



Con Bafitis



Peter Greaves



Chris King, M.AIRAH



Sharmila Tsourdalakis



Leon Wurfel, Affil.AIRAH

The first is in analytics and fault detection, by using algorithms to automatically mine datasets and look for faults and optimisation opportunities.

The second is integrated sequencing.

“Data from traditionally siloed systems can be used to augment the operation and control sequences of other systems,” Wurfel says.

And the third is business intelligence.

“Smart data scientist-types can ask more detailed questions about the behaviour of systems and study how they interact with the world – and people – around them,” Wurfel says.

“IoT has the potential to simplify and improve the quality of many operational workflows in the property industry. But we won’t be at ‘peak IoT’ until we start seeing it firmly embedded in the business-as-usual.”

## PASSING ON PROPRIETARY

Getting the most out of the IoT relies on open protocols and engineering frameworks so that data from any connected device can be widely shared.

GPT Group is therefore breaking down the barriers between various proprietary software-based systems across its portfolio.

By doing so, both the company and its customers can enjoy the benefits of using correlated data that informs how they can continue to drive productivity in commercial property.

“We’ve been trialling some new analytics tools that draw on BMS data while our energy-management capabilities are enhanced by being able to view energy sub-meter data through the same portal as single-line diagrams and asset registers,” says Tsourdalakis.

“Combining this information with weather data allows daily comparison of energy performance. The strategy creates a knowledge portal that drives energy performance, reduces our key person dependencies, and assists in the induction of new staff members to any asset.”

She says data liberated from the captivity of the BMS system can be shared among a building’s management team with great success.

“Giving people access, or even better, directly sending performance information to relevant personnel, empowers them to act to ensure optimal outcomes,” says Tsourdalakis.

“In the past we struggled to provide energy performance information to asset teams once a month – now they can see it daily, and know if the building is performing as expected. Then they’ll learn exactly what roles they can play in having a building perform to target and can be far more proactive in their work activities.”

To make the most of IoT open protocols, collaboration in the true spirit of an open system and data sharing is required.

“The days of protecting corporate interests at the expense of the client are old school,” says Bafitis. “The value proposition, particularly for BMS, has shifted.”

## BUILDING BLOCKS

For the majority of buildings in operation, many of the building blocks are already in place for IoT. They simply lack a vendor-agnostic solution.

According to Bafitis, it makes sense that buildings leverage from the significant investments in systems and applications that are already in place.

“A vendor-agnostic solution is therefore required that blends together an optimised technology stack where data can be integrated,” he says.

The addition of what he calls an Integration Hub provides a big data view across all systems using existing systems to gather and analyse data trends.

“IoT enables data analytics to be more real-time and more effective,” he says. “Models can be self-learning. The data can be collected, stored and then used for multiple analytical solutions instead of being locked up in an on-premise, siloed application that typically has limited analytics capability.”

To this end, Bafitis says advanced IoT platforms allow data scientists and engineers to model in various tools and then compile them into executable analytics engines to provide meaningful “natural language” insights in building operation and maintenance practices.

## ALERT FATIGUE

One of the conundrums of the IoT is the efficiency (or inefficiency) and unintended consequences of connecting almost every device with an on/off button.

Although it is still too early to evaluate the cost-versus-value equation, many of the opportunities that may be unlocked as a consequence of the IoT are yet to be identified nor perhaps imagined.

“What is an efficient and high-value IoT-inspired solution today may look very different to the IoT-inspired solutions five years from now,” says Wurfel.

But one of the short-term risks associated with having almost every device and piece of equipment connected is alert fatigue. It’s why Chris King, M.AIRAH, responsible for business development with Envizi, takes a philosophically different approach.

“Our clients tell us they don’t want to be bombarded with alerts, which is a natural by-product of connecting every last device in a building,” King says. “They do not like being confronted with hundreds of non-critical alerts that require time to interrogate and triage. This is time that facility managers simply do not have, as their main focus is on keeping their building running and tenants satisfied.

“We help clients focus on the things that matter, by analysing and prioritising alerts for high-energy-consuming items like HVAC equipment that really make a difference to energy consumption.”

## EVOLVING DATA ANALYTICS

The IoT enables a new suite of data analytics by allowing datasets to be layered with machine-generated data from many different systems.

This means signs and symptoms in one system might reveal unknown information about the behaviour of a superficially unrelated system.

And for Wurfel, this is an exciting area to explore.

“There are many experts out there who can fault-find within their native systems by using engineering first principles,” he says.

“However, there are no industry-standard first principles that might tell us what HVAC data will predict vertical transport failure, for example – though signs of pressurisation issues spring to mind. Nor how IAQ sensor data can validate the performance of higher-cost, low-VOC materials immediately post fitout and during the defects liability period.

“There is a huge opportunity in this area to generate new knowledge that is, to this point, undiscovered.”

## THE THREAT OF AI

While data analytics are emerging around occupation, utilisation and energy consumption, the future of the IoT will see the adoption of artificial intelligence (AI) and machine learning.

“Data analytics could be carried out by machines,” says Peter Greaves, global electrical leader with Aurecon.

“As artificial intelligence increases, the amount of data will not be a big issue, as the future machines will be self-learning.”

But this can and will create some complex issues that will need to be overcome.

“I have heard this being compared to nuclear weapons and the threat that they pose,” he says.

## FINDING TRACTION

Already, the IoT is finding traction in many sectors but the health sector may be leading the charge.

According to Bafitis, the integration of complex systems such as nurse call, security and patient entertainment with BIM, CMMS (computerised management and maintenance system) and building services, as well as medical imaging and medical records, has moved to a new level.

“The ICT (information and communications technology) design and implementation needs many levels of security and redundancy, and in many ways our learnings here are made available to the broader industry,” he says.

Also, key infrastructure facilities with long-term corporate objectives are using an IoT approach to life-cycle management. These include airports and data centres where expansion is ongoing, and data plays a role in developing business cases and budgets.

And despite the perception that the IoT is for new commercial smart buildings only, IoT-type principles are finding traction in incumbent systems.

“Where there is a wealth of data and connectivity potential within existing systems that is not being tapped, then it is much better to use the data that is already there instead of a system to generate the same data in parallel,” says Wurfel.

“We are only seeing the dedicated IoT systems, outside of incumbent IoT systems, being adopted in a small amount of cases, but this will definitely grow over time.”

To this end, device renewal within existing buildings represents an opportunity for owners of this building stock to establish an IoT network of devices.

## THE DIGITAL NATIVES

Those born in the era of the internet will likely adapt more readily to the new wave of information management than those born before them.

Tsourdalakis says the opportunity of applying business intelligence techniques to building operations is a challenge, and the building industry will be competing for the right people who have the insights required to make the best use of the IoT.

“Managing changes and operations team members, including service contractors that prefer to exist in the old reactive world instead of being part of the proactive world where superior productivity of commercial property is second nature, presents a challenge,” she says.

“We suspect the digital natives – those who don’t know of a world before the internet – will be far more engaged in sourcing evidence and facts for decision making.”

## SECURING THE SPACE

As networks become more converged over time in the built environment, and information technology and operational technology begin sharing the same infrastructure, security in the age of the IoT has become a concern.

“The security of the whole network will be limited by the lowest common denominator,” says Wurfel.

“However, security is a broader concern outside of the individual properties, where poorly secured IoT devices can be leveraged into crippling DDOS (distributed denial-of-service) attacks by malicious groups. In this instance, the IoT devices themselves create a market-wide threat.”

As the levels of connection increase, the task of ensuring security across all building systems increases. This includes essential services that, if left open, can present a significant risk to the safety of building services and occupants.

And while thorough due diligence will be required to ensure new, exploitable vulnerabilities are not introduced in the built environment, the push toward cloud-based processing means cyber security is a much broader challenge for all.

## INFLUENCING DESIGN

As comfort is a precursor to occupant productivity and the productivity of businesses, the HVAC industry is uniquely placed to leverage the power of the IoT to better inform design.

All stakeholders in the HVAC industry can use the IoT as a tool to create better spaces and ultimately better buildings.

“Designers can use IoT to gather real performance data from existing buildings to better inform designs for better performance, reliability and efficiency,” says Tsourdalakis.

“Installers can use IoT to document the finished system so that it can be optimised and maintained at peak efficiency from the earliest opportunity, and maintainers can identify and use lead indicators to ensure performance can be maintained and enhanced consistently.”

## IMPROVING PERFORMANCE

While many technologies in the HVAC industry are already IoT ready, a great deal of work can still be done to improve performance and data management – especially in the space of building automation.

“We still use standard software libraries to stay competitive and keep costs down, but this stifles innovation and system intelligence,” says Bafitis.

If we want to build smart buildings, he says the industry should move beyond temperature-based algorithms and include both energy-based and condition-based algorithms.

“Take a floating set-point as a basic example, which was commonplace in pneumatic systems. Speaking generally, most new buildings are not programmed to have a floating set-point capability allowing for seasonal adjustment, yet

savings of up to 10 per cent can be made by including this algorithm.

“Similarly the system can be self-diagnostic. If a VAV box damper opens, there should be a corresponding change in velocity. Or if a valve opens, the supply temperature should change.

“By monitoring performance envelopes for these devices, we could raise the alarm that maintenance is required, and then service that device or arrive with the spare parts and fix it in one session.”

Similarly, Bafitis says the industry should be taking advantage of the mobility that wi-fi technology offers by moving sensors into problem areas to resolve issues, and then relocating them to the next priority area cost-effectively.

“We talk a lot about smart devices, but we are not using them to their full potential,” he says. “There is plenty of opportunity to create meaningful data within new and existing systems.” ■