THE CONTINUING PROFESSIONAL DEVELOPMENT PROGRAMME

Fundamentals CPD

What is a smart building?

By Joe McClelland

Smart buildings use Internet of Things (IoT) devices—sensors, software, online connectivity—to monitor various building characteristics, analyse the data, and generate insights around usage patterns and trends that can be used to optimise the building's environment and operations. While smart technology gives you greater control over your building, Smart building technology is much more than just advanced "command and control" mechanisms (like your Building Management System, or BMS).

To get a clear picture of what smart building technology is, let's look at an example comparing it to a traditional BMS. A BMS can be programmed to turn on and off the building's Heating, Ventilation and Air Conditioning (HVAC) system at specific times daily based on predefined temperature levels. Smart building technology gives you more control over how you operate your HVAC. For instance, it can direct your BMS to turn the HVAC on and off as needed throughout the day, by measuring carbon dioxide (CO_2) levels in real time. If CO_2 levels are in line with building guidelines, the system automatically reduces the outside air intake. If CO_2 levels are approaching the limit, it brings in additional outside air. Smart building analytics platforms can also factor in data from utility companies and weather data along with your building's HVAC operating data to help you strategise about ways to reduce operating costs. Having this degree of control over your HVAC system means you save energy and costs, while still maintaining a comfortable environment for occupants.

Potential customers commonly ask if smart building technology will replace their BMS (which we know was a hefty investment); the answer is NO. Smart building systems work in conjunction with a BMS, allowing you to understand your building by monitoring building functions in real time, analysing building data, and automating operations more strategically so you can fully optimise your operations.

With the advent of technology, buildings which were once solely meant to provide shelter, are now capable of doing more for us. Thanks to technological advances and new connections between various kinds of software and hardware, smart buildings allow for more convenience, customisation, reduced waste and lower overhead costs than was ever thought possible.

What resources are in use

At their core, smart buildings use wireless connections that record and share information about the building's functions (such as water use, heating and other utilities) to streamline their use. This information allows users to better see when and what resources are in use, control them remotely, and even automate processes.

A core component of every smart building is their use of sensors to gather data. This means they might track when a room is in use, at what times lights are turned on and off, which areas of the building receive the most traffic, and what the average temperature is.

The data collected by smart buildings is of high value, as it gives building managers great insight into what resources are underutilised or wasted. It can help them see which spaces are unused, which lights are kept on and which entrances create opportunity for security breaches.

This information is used to automate processes from heating to lighting to security. Users can adjust settings so that, for example, the heat is turned off on the weekend, lights are motion activated or doors lock automatically.

Finally, data is shared with users so that action can be taken remotely in cases where it is necessary. In many smart buildings, users who forget to lock up or turn off lights and even appliances can do so at the click of a button remotely. They may even be able to use their smart building interface to get directions to a certain part of the building or to an open parking spot.

A human-centred approach to design is at the core of smart buildings of the future. From the moment people step inside until the moment they leave, future Smart buildings will have the capability to determine the percentage of the workforce inside the building at any given time and automatically adjust the settings of its facilities according to their feedback and needs – from WiFi connections,

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lighting, electricity, heating, ventilation and air conditioning, placing people at the centre.

However, smart buildings are not simply about the use of integrated technology to create reactive environments – they are also about people, and how people will use these structures now and in the future.

The global smart building market size is expected to gain momentum by reaching $265.37bn by 2028 while exhibiting a growth rate of 21.6 per cent between 2021 to 2028. In its report titled "Smart Building Market, 2021-2028," Fortune Business Insights mentions that the market stood at $57.30bn in 2020.

Smart buildings are fast becoming the norm across the globe. According to Mordor Intelligence, the smart building market is expected to record a compound annual growth rate of over 23 per cent over the period of 2020 – 2024. Increasingly, sophisticated smart cities are in development by nations around the world to improve efficiency, reduce operating costs and make life easier for residents and business owners.

Rethink business models

In 2020, the availability of IoT-enabled smart building solutions that employ connected sensors will continue to influence how smart building vendors rethink their business models to take full advantage of this technology. That being said, smart buildings present a set of unique challenges that building managers also have to keep in mind when implementing a solution, like the need to penetrate dense building materials. Because of that, long-range and low-power capabilities have become essential to ensure sensors do their intended job like detecting danger, optimising utility usage and improving the safety and convenience of everyday living.

Today, many new start-ups are leveraging the proliferation of the internet of things, machine learning and energy savings solutions to bring about massive innovation to the smart building arena.

Technologists, architects, engineers and builders are aiming to increase the number of smart buildings constructed and the number of older buildings retrofitted with automation and control technologies.

Smart buildings bring together various building-wide systems—such as HVAC, lighting, alarms, and security—into a single IT managed network infrastructure. It often uses foundational technology such as Power over Ethernet (PoE) to accomplish this convergence.

Here are a few specific ways connected IoT solutions will continue to drive the growth of smart buildings.

Energy costs are rapidly increasing, and environmental issues continue to be a major concern, so there is increasing pressure on building managers to provide more energy-saving solutions within their facilities. For example, by using sensors, smart thermostats can now monitor indoor and outdoor air temperature, humidity and the presence of people in a room. This data can then be used to smartly control the HVAC systems inside buildings so that they can cool or heat rooms only when necessary. Smart meters also enable more precise monitoring of energy consumption throughout a building, while using smart electric plugs allows tenants to detect high-energy devices and take appropriate actions to reduce their consumption.

Internet devices also make it easy for building managers to implement an easy and economical energy-saving smart building system. Designed to support robust, long-range wireless communications, these devices can connect energy management systems with smart thermostats, lighting controls, smart outlets and other energy-aware devices.

Dynamic glazing for windows can be installed in commercial offices and high-rise residential buildings. Users can make any window to go from bright to dark and dynamically adjust for privacy, glare, and energy control. Current 'smart glass' alternatives are expensive and depend on electricity or phase changing materials. The latest technology is user controlled, requires no power or phase changing materials, and is a lower cost alternative to smart glass.

Living green walls can be scaled for any size project and function. They act as natural insulators by reducing heat transfer from the exterior of buildings to save energy costs and reduce noise pollution. Living walls, sometimes called green walls or vertical gardens, increase commercial and residential property values for smart building owners with an average expected increase in value of 4 per cent.

IoT platform for the smart building marketplace can use existing PoE cables to transform structures into smart, agile buildings on which any solution and device can be added. These are real-time solutions to convert static building systems into genuinely IoT-enabled and dynamic platforms in a range of applications. This is due to easy retrofit plug and play models that can then be deployed in any existing system.

Smart facilities management platforms use core building information, building systems, and sensor data in combination with a machine learning engine for smart buildings. These are cloud-based, mobile first, and location-aware, which helps building owners, operators and facilities managers improve building performance by delivering detailed operations and maintenance information about building components ranging from the major mechanical and electrical systems down to the wall and floor finishes.

The management of storm water run-off from snow and rain is becoming a critical issue as our cement footprint continues to increase with the development of new buildings. A management and transportation system uses a permeable pavement with a patented arched reservoir to maximise on-site storm water capacity. The technology is being deployed in exterior commercial real estate properties and helipads on top of commercial building roofs in hospitals and other locations.

Advanced tankless water heaters for commercial applications allow building owners to conserve space by eliminating the need for redundant heaters/boilers and reducing or eliminating the need for storage tanks. They can operate 40 per cent more efficiently compared with traditional heating methods. The technology enables commercial properties to dramatically minimise the cost of water heating.

Detect malfunctions

Vibration and ultrasonic sensors enable smartphones to detect machine malfunctions before they happen. The technology uses smart sensors to monitor machines and create algorithms that can identify imminent failures to enable building managers to conduct real-time analysis of their facilities. The sensors can then be attached to equipment such as commercial refrigerators or industrial scale heaters to record vibrations and ultrasonic sound and upload to a cloud service, where it is analysed to make predictions about the health of a machine. Technicians can then use the company's mobile app to view the status of a machine and any alerts to indicate in advance that something may be going wrong with it.

Live customer service video kiosks, with video displays, and other digital signage devices, allow two-way or one-way video interaction with customers. Businesses who previously had to choose between leaving their entrance lobby unmanaged or paying a full-time employee to manage the lobby and greet guests, can use this high-tech option to take back control of the lobby at a fraction of the cost. The technology uses motion detection to see when visitors enter the building and then greets visitors with a friendly video message and invites them to touch the name of the person or department they are there to meet, using the company directory shown on the touchscreen. The visitor and employee use two-way video so both employee and visitor can communicate face to face.

Footpath generators can harness energy from pedestrian foot traffic. This is a commercial flooring tile solution that converts wasted kinetic energy from footsteps into renewable electricity designed for use in high foot-traffic areas. The generated renewable electricity can be stored in lithium polymer batteries and used to power low-wattage, off-grid applications like street lighting, displays, speakers, alarms, signs, and advertising.

Smart building products in the energy management controls industry constantly scan the external environment, in order to identify customer needs, anticipate competitive actions and identify technological changes which will provide new market opportunities or technological advancements including the Internet of Things (IoT).

Many facilities use preventative maintenance to ensure equipment is running correctly. This usually involves routine inspections and making assumptions about the status of the equipment and how often it is used. Connected sensor technology takes this concept to the next level by providing a more granular level of insight on the technology maintaining a smart building, including equipment temperature, power and sound. An example of this is the monitoring of ventilation fan motors which typically operate for 24 hours a day in a commercial building. Different mechanical harmonics are identified as they age, and, by using internet-based sensors and a modem, the health of the motor and its life cycle position can determine when a problem appears to be developing so maintenance can be scheduled at the most convenient time before a bigger problem emerges.

Access to real-time data is one of the biggest benefits of deploying a smart building solution because it allows business managers to visualise improvements around the structure and make actionable decisions. For example:

- smart sensors in buildings make

everyone safer by monitoring and reporting a wide range of issues, including fire alarms, office air quality, dangerous chemical detection for industrial buildings and structural integrity;

Real-time occupancy, geolocation and foot traffic data can be used to identify spatial usage patterns, allowing space efficiency optimization and reconfiguring offices and retail location layout based on real usage data.

Occupants can be equipped with badges to control access, but this also provides presence information. Building managers can use this information to detect intrusion and identify open entry points that should be closed, and remote control allows them to keep a close eye on their building without setting foot on site.

Some of the characteristics of smart buildings are:

Buildings of the future will not only be designed for us but also get to know us

People-centric – buildings of the future, designed to function for the people who will use them. As the needs and expectations of people continuously change, the way we design, and construct buildings must follow. However, we need to ask:

- what will people use these buildings for?;
- how will these buildings make them comfortable, happy and productive?; and
- if today's workforce values mobility, flexibility and connectivity around the work place, how should the design of these buildings address these needs?

Flexible – disruption is moving at an exponential rate, continuously affecting and changing business needs, models, landscapes, and the use of buildings. To address disruption, smart buildings of the future should be designed with flexibility in mind. Gone will be the days that buildings are designed as rigid structures that are built for one purpose and cannot be changed. In the future, smart structures and spaces will be adaptable without significant building modification: with walls that can be moved easily and essential engineering services that can be effortlessly altered and re-connected in new ways.

Invisible – technologies should be embedded to a building seamlessly. It should just work, no explanations needed. The goal for smart buildings is to self-manage, learn, anticipate, and adapt on its own, without the need for the intervention or recognition of its users. Room temperatures, lighting, shading, energy and water utilisation can all be easily and automatically adjusted based on sensors and monitors.

Sustainable – the impact of climate change and rapid population growth to our natural resources is endangering the future of human kind, making sustainability one of the key priorities when designing buildings of the future. Thanks to advanced technologies, smart buildings can exist off the grid and develop self-sustaining ecosystems, enabling them to produce energy and collect and treat water on site.

Learning – buildings of the future will not only be designed for us, but they will also get to know us. Every sensor, automation and monitor installed in these buildings will be integrated into a main building management system which can capture every movement within the building and enable the building to automatically modify its settings and continuously self-tune.

The resistance against digital transformation usually stems down from one thing: cost. Technology can be expensive, and in today's highly competitive global market, businesses want a guarantee that their investments will pay off, financially. However, the return on investment (RoI) for buildings of the future are not always financial. It is far more three dimensional in its approach and understanding the bottom-line benefits will be the key.

The company's vision

Value starts at the design phase. Building designs should reflect the business' needs, today and tomorrow. The first step in proving the value of innovations brought by buildings of the future is understanding the company's vision, needs and future requirements. Design will be defined by the building's function and role in the business, not aesthetics.

A new investment equation. A smart building's RoI is not only measured by financial gains. It requires a more robust, holistic and full-bodied evaluation of ROI, which will include energy savings, tax incentives, and non-financial benefits such as improved employee productivity and wellbeing. While these non-monetary benefits may not be quantified by numbers and financial gains, they carry an invaluable and real return on the business' investment.

Invest for the long-term payoffs. Investing in buildings of the future means designing for the future. Buildings that are designed for an organisation's short-term plans may end up being outdated and inefficient. Taking a long-term view, on the other hand, leads to designing with the future and flexibility in mind.

Given that in future buildings will be assembled, not constructed, buildings of the future will be designed to be easily modified. This will allow for quicker reintegration of engineering systems, increasing not only the user experience of the structure, but the value of the building going forward.

Wireless plays a key role in smart building development and technology, but fibre is still king in terms of keeping disparate technologies connected to the web and, increasingly, to each other for whole-building systems optimisation. Wireless is an incredible convenience but is still showing its limitations with interference and reliability.

On the hospitality side, smart buildings are incorporating 4K video on-demand, access control, energy management and occupancy control, and they are integrating those features through a central dashboard and controls. The key is to avoid redundancy.

From wiring to networks to HVAC, smart building infrastructure is most easily installed during construction. However, the larger opportunity is to bring smart building systems to existing buildings, which is where Wi-Fi comes in.

Organisations are looking increasingly into wireless technologies and putting infrastructure into the cloud as much as possible for storage and data management. Wireless technologies are also the key to making the built environment of 'dumb buildings' more smart because we don't have to open up the floors and the walls to update infrastructure." For new buildings, too, wireless can minimise the volume of copper wire installation, keeping costs down.

More research and product development around the intersection of occupants' biometric data is needed to provide enhanced smart building operations. By using sensors to detect and trigger the control of lighting and thermal comfort, researchers are finding ways to increase productivity in office buildings and reduce stress in hospitals and other environments by mimicking circadian rhythms.

In a parallel to machine learning, smart buildings may eventually become smart enough to diagnose and repair structural and system damage without human intervention.

Researchers are investigating new sensing technologies for buildings to output data on structural integrity. Among them is a new computational model developed by researchers at the Massachusetts Institute of Technology to measure structural damage and stress after a seismic event. The researchers outfitted the 21-storey, I.M. Pei-designed MIT Green Building with 36 accelerometers to track how the building responds to ambient vibrations.

Regardless of where — and how soon — technology leads the development and optimisation of smart buildings, providing building occupants with better information on energy management and other installed smart systems is integral to advancing the smart building ethos. Equally important to maintaining the efficacy of smart buildings is the behaviour of building occupants.

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ENTRY FORM

Please mark your answers below by placing a cross in the box. Don't forget that some questions might have more than one correct answer. You may find it helpful to mark the answers in pencil first before filling in the final answers in ink. Once you have completed the answer sheet, return it to the address below. Photocopies are acceptable.

Questions

1. What is the significance of potential energy savings from the application of smart building technologies?
- ☐ Energy savings are marginal with few opportunities available.
- ☐ Energy savings opportunities are pivotal as UK buildings use around 27 per cent of energy annually.
- ☐ Energy savings potential from Smart Buildings in UK is small and insignificant.
- ☐ Energy savings potential is zero as they would be too expensive to achieve.

2. By 2028 he potential future global market size for smart buildings is estimated to reach:
- ☐ $83bn?
- ☐ $54bn?
- ☐ $265bn?
- ☐ $120bn?

3. Smart buildings are just an advanced command and control system.
- ☐ They do not integrate directly with BMS installations.
- ☐ They require exiting BMS installations to be upgraded or replaced.
- ☐ Smart building technology does not add any notable advantages over a BMS.
- ☐ Smart building technology well with BMS and adds value and many additional features.

4. The installation of smart building technology can be disruptive and extended installation time requirements can outweigh the financial benefits.
- ☐ The installation of multiple sensors adds significant cost and installation time.
- ☐ The use of wireless and IoT technology to connect remote sensors ensures that cost, disruption and installation time are kept to a minimum.
- ☐ Payback times are too long to make smart building investment attractive.
- ☐ Project costs are too high to make smart building investment attractive.

5. Additional data collected by smart building technology is not particularly useful.
- ☐ Smart building Internet devices and data make it easier for building managers to implement energy savings.
- ☐ Smart building Internet devices and data collection over complicate building management operations.
- ☐ Smart building data does not offer any advantage or add any value over BMS.
- ☐ Most of the data gathered by smart building sensors is of little use for delivering energy savings.

6. Smart building systems are not very effective from an operational viewpoint.
- ☐ The additional data management required disrupts existing BMS processes.
- ☐ Smart building data does not add any value to building operations.
- ☐ Smart building data adds significant value to building operations.
- ☐ Smart building data adds only marginal value to building operations.

7. Data collected from smart building systems have no added value over BMS installations.
- ☐ Additional data granularity and features allow smart building technology to add significant value from learning and adjusting operations that provide continual improvement.
- ☐ Additional data and processing from a smart building installation will slow down BMS operations.
- ☐ BMS and smart building systems do not synchronise particularly well.
- ☐ Smart building systems disrupt BMS operations and can compromise existing energy savings gained from BMS.

8. The smart building global market is estimated to grow between 2021 and 2028 by.
- ☐ 33.3 per cent.
- ☐ 54.1 per cent
- ☐ 21.6 per cent
- ☐ 10.7 per cent

9. Smart building systems are only suitable for installation in new building projects.
- ☐ Smart building IoT and wireless sensors and systems cannot function properly in older buildings with more dense structures.
- ☐ Smart building IoT and wireless sensors and systems will function well in older buildings, with careful planning and positioning of equipment.
- ☐ Older buildings are not suitable for retrofit smart building systems adoption.
- ☐ Smart building systems are only effective in modern lightweight buildings.

10. Smart building technology is not future proof.
- ☐ Smart building technology will not replace BMS installations.
- ☐ BMS installations are more suitable for delivering energy savings.
- ☐ Smart building technology integration with BMS will continue to grow.
- ☐ Smart building technology integration with BMS will not continue to grow.

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MARK THROWER Managing Editor

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