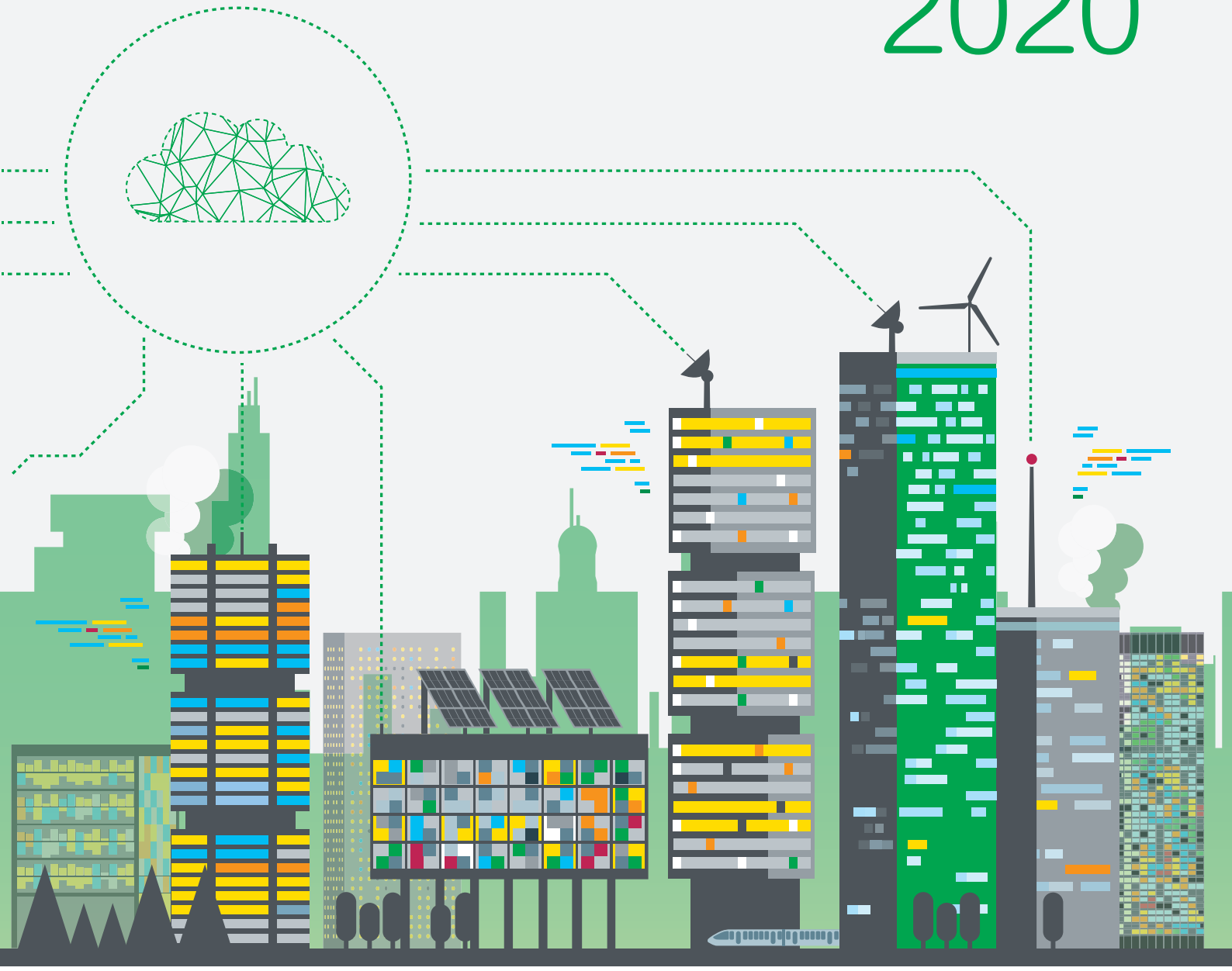
Smart Working

Smart Buildings and the Future of Work

2020



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1. Introduction

The way companies work has been transformed over the past decade as a confluence of new ideas, technological innovation, new generational cohorts of workers, and major shocks to the system such as the global banking crash and coronavirus crisis has upended longstanding approaches to work and the workplace. Traditional models of workplace design that focused on cost reduction and efficiency are today being rapidly superseded by more dynamic, agile models that are designed to increase health, well-being, and an unprecedented level of flexibility for remote working.

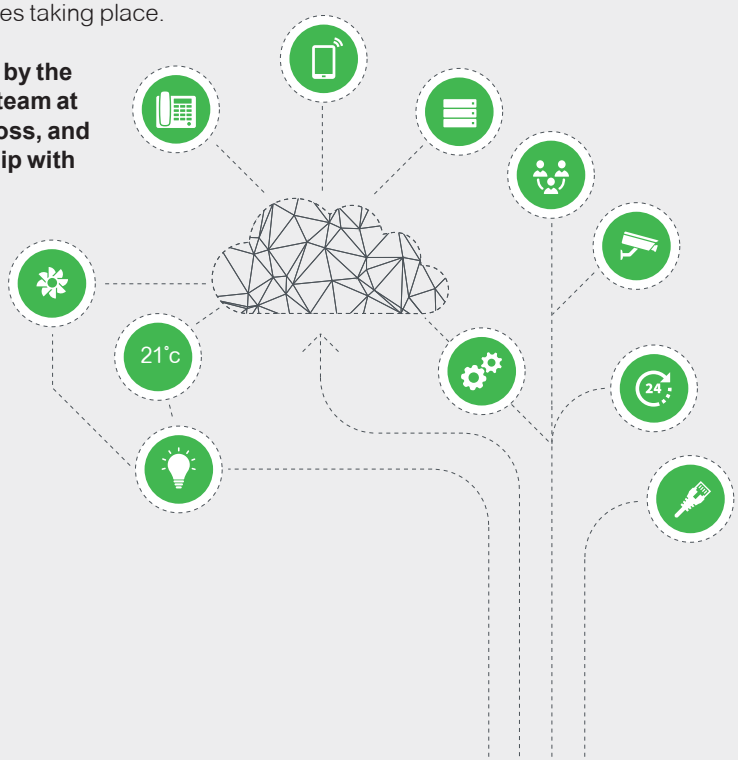
As the role of the workplace changes, so do the kinds of buildings that companies look to locate in. More mindful of the benefits that particular buildings offer, firms are increasingly discerning about the kinds of sites they select. For most companies, buildings need to provide more than the traditional lease – they need to help organisations keep their workforce safe, support business aims, retain talent, provide amenities and energise and inspire their staff.

Smart buildings do all of these things, and more. Leveraging cutting-edge technologies, such as the Internet of Things, Big Data and intelligent software, smart buildings enhance the experience of occupants, create more desirable places to work and, critically, help companies to manage people and workflow. In a smart building, building systems sustain optimal levels of performance, helping to make them highly energy efficient; the experience of building users is personalised to their individual preferences; and real-time data is captured on the performance of the building and its work spaces – essential in the post-pandemic world in which we now exist.

This report sets out the advantages that smart buildings offer to occupiers and developers of commercial real estate in a post-covid world. It identifies key technological enablers and shows how smart buildings will transform work, the workplace and the urban landscape over the next few years. Furthermore, it lays out a set of practical steps that developers can follow to realise the vision for smart buildings and begin drawing occupants away from home-based work and back to the office.

In the aftermath of the coronavirus pandemic, the emergence of smart buildings is set to fundamentally reshape the way office complexes are designed, built and operated. This report shows how developers can position themselves to benefit from the changes taking place.

This report was written by the workplace technology team at UnWork led by Philip Ross, and developed in partnership with Schneider Electric.



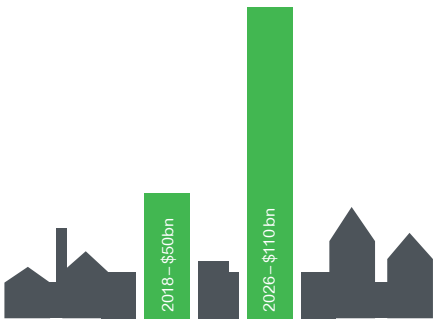
2. Executive Summary

Major advancements in storage, aggregation and analysis of data in the built environment have ushered in a new frontier in building design and operation, prompting unprecedented levels of efficiency and a human-centric experience that is intuitive, seamless and personalised for all.

On top of this, the way buildings are used by occupiers is being transformed as competitive pressures and new ways of working create demands for different types of space. Increasingly, companies are looking to locate to buildings that are flexible and adaptive, that help them attract the best talent, that offer an excellent user experience and that are simple and efficient to run.

Enter the smart building. Smart buildings are those that utilise cutting-edge technology to enhance the experience of occupants, sustain optimal levels of performance and reduce the costs of building operations. In a smart building, different technology systems work together through open IoT platforms to make the building highly efficient, flexible and a more desirable place to work; they leverage advanced digital infrastructure to enable an array of different hardware devices to capture data as a single interconnected ecosystem.

But this is no new phenomena, the smart building market has expanded rapidly in recent years, surpassing the $50bn mark in 2018 and is predicted to reach $109.48bn by 2026. [1]



The smart building market reached a value of $50 billion in 2018. By 2026, this figure is projected to reach $110 billion.

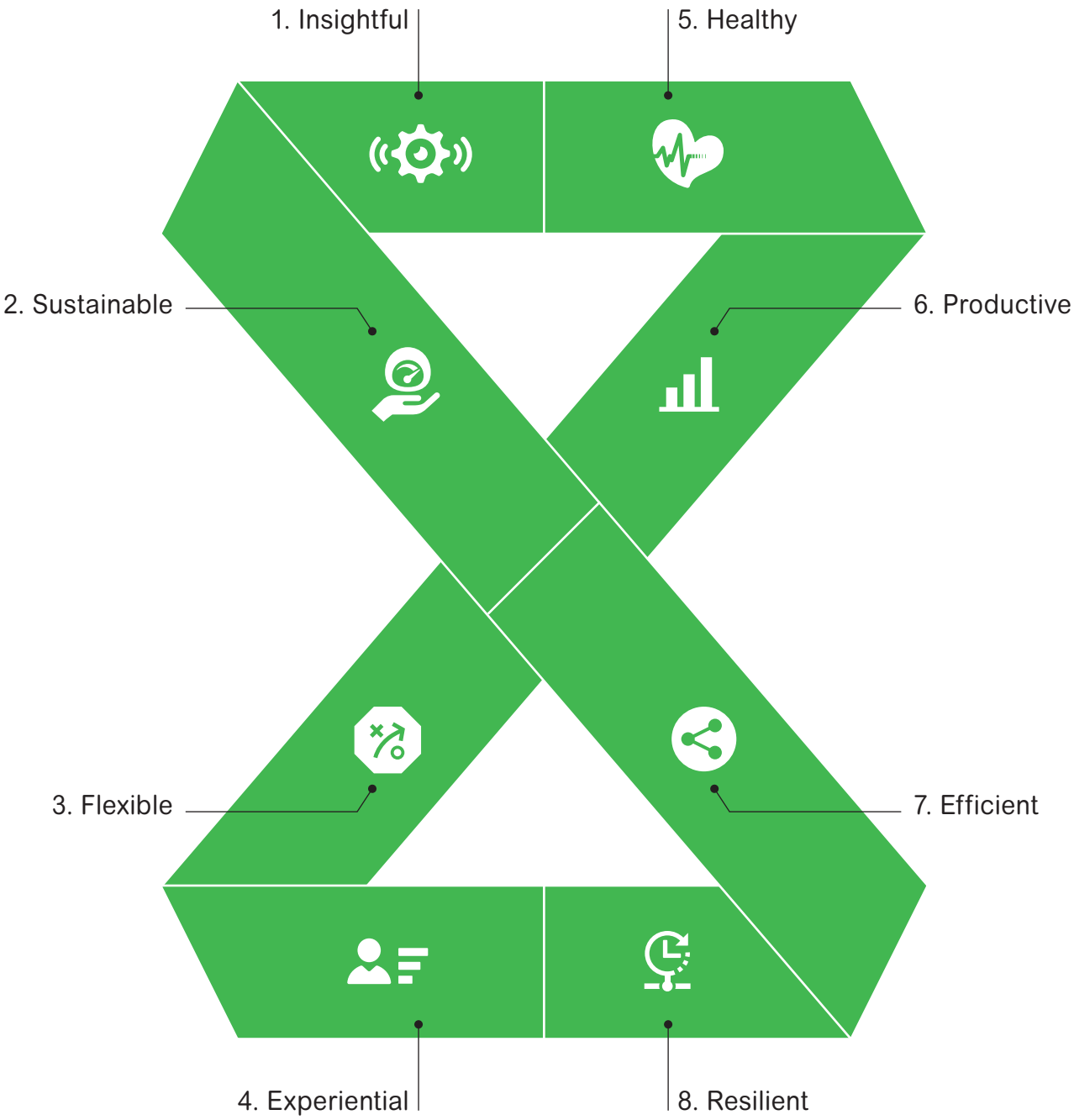
Assessing Building Intelligence: The Activ8 Model of Smart Buildings

While occupiers and developers While occupiers and developers of commercial real estate are increasingly aware of smart buildings, understandings and definitions of the different aspects of building intelligence differ widely. This report sets out a new, outcome-orientated model for assessing how smart a building truly is.

The Activ8 model details eight outcomes that can be used to understand the benefits of building intelligence.

1. **Insightful.** Smart buildings provide actionable insights into how a building is operating. In a smart building, real-time data is reported and used to inform decisions on building operations. Portfolio managers can see their operations across the globe and compare performance, giving them actionable insight on how to drive efficiencies and improvements.
2. **Sustainable.** Smart buildings enable facilities managers to easily monitor and control the performance of the buildings against their sustainability strategies. Combined with appropriate supply and demand energy management strategies, many smart buildings are even net-positive, creating more energy than they consume.
3. **Flexible.** Smart buildings are better able to accommodate agile, dynamic models of work, such as activity- based working, by allowing spaces to be easily re-configured. This enables the workplace to adapt to technological advances and changing business requirements - such as the need for employees to socially distance themselves from one another more easily.
4. **Experiential.** Office users have greater control over their environment in a smart building, allowing them to tailor comfort levels to their personal preference using their mobile devices.
5. **Healthy.** Smart buildings monitor health-related factors like CO2 levels, VoC, noise levels and humidity, notifying stakeholders when an alarm is triggered. Some of these can even be autonomously adjusted, measuring well-being and helping to reduce the costs of sickness absenteeism.
6. **Productive.** Smart buildings facilitate better, more effective use of space and environments to prompt better engagement from staff, in turn boosting their productivity.
7. **Efficient.** Smart buildings meet the needs of their stakeholders in a hyper-efficient way and transform a company's real estate into an enabler of business growth.
8. **Resilient.** In a smart building, all systems within a building, including the electrical distribution system, are flexible enough to react in near-real time to the complex set of conditions. They adapt to constantly changing needs and expectations of occupants, ensuring longevity and resilience to threats.

Together, the components of the Activ8 model represent a set of criteria for developers and occupiers to use when designing, specifying and procuring smart building technology.



The Smart Advantage

This report demonstrates that a smart building offers considerable advantages over a conventional one for developers, landlords and occupiers of commercial real estate.

Smart Assets
In a smart building, intelligent energy management solutions can be deployed to optimise the performance of building systems and carefully manage energy consumption, enabling smart buildings to achieve high levels of energy efficiency. Onsite energy production, advanced analytics software and new types of intelligent building materials even allow some smart buildings to be net suppliers of energy to national grids, rather than mere consumers.

Huge volumes of data produced by building systems and sensors can be analysed by smart building software to provide actionable intelligence on building performance. Building managers are then better able to make informed decisions on the operations of a building, or schedule pre-configured outcomes based on their desired model of operation. The continual monitoring of data produced by building systems also enables advanced detection and diagnostics of faults, and allows a building to sustain a high level of performance across its entire lifecycle.

Advanced security technologies, like facial recognition, touch-free technology and video analytics, can be easily integrated into a smart building to ensure the safety of building occupants and users. These sorts of technologies can then work alongside other building systems to deliver a more holistic concept of security. For example, upon identifying an intruder, a smart building can redirect security cameras, engage control systems to prevent building access and direct security personnel to the threat.

Smart Workplaces
For businesses, there are considerable strategic advantages to working in a smart building, including better business performance, improved workforce wellbeing and a better working experience for their employees.

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Data captured by a range of workplace sensors can report the occupancy of workplaces in real time, measure how effectively the space is being used and enable better decision-making by heads of real estate and facilities managers.

Moreover, new analytics techniques are being pioneered that can correlate data captured in work environments with overall business performance. 'Social physics', the practice of using vast datasets from smartphones, wearables and workplace sensors to gauge how people interact and share ideas, has been used to demonstrate the effectiveness of workplace design on individual performance, speed to market and sales growth.

Workplace sensors in a smart building can also be used by companies to measure their organisational health, while also giving office users greater control over their working environment. Data on indoor air quality, light and noise levels and levels of physical activity can all be assessed by smart building sensors, which companies can use to make positive interventions that improve health and wellbeing outcomes.

Smart Buildings, Smart Cities

Smart buildings are the enabler of smart cities, cities that use data to generate and realise efficiencies in the provision of services; Smart buildings engineered to use energy more efficiently, for example, can generate vast savings in the running of urban infrastructure.

A multitude of technologies has been deployed as part of efforts to create smart cities. In Singapore, IoT and other technologies have been deployed to ease the flow of congestion, monitor the workings of streetlights and measure the cleanliness of public places. In China, spending on the government's expansive smart cities programme is expected to reach $16 billion by 2024.[2]

Real estate developers can play a leading role in the creation of smart cities. At the EUREF Campus in Berlin for example, home to more than 150 enterprises and 3,500 workers each day, developers consolidated 5.5 hectares of office buildings and amenity space onto a single BMS system and smart microgrid, saving over 100 tons of CO2 since 2013 and meeting the German government's 2050 climate targets 30 years early. Creating clusters of smart buildings that can exchange information between each other in this way will expedite the creation of smart cities and allow developers to redevelop the urban landscape.

Delivering a smart building – Seven Steps to Achieve Smart

1 **Choose smart from the start.** Smart buildings with the best outcomes are born from conception. If you want to make your existing building smart, look to vendor partners who have open platforms and easy-to-install sensors to enable simple connectivity.

2 **Procure smart and challenge the status quo.** Identify experts that can help sell your concept to key stakeholders and work with your consultants to drive smart choices of technology, gain cost certainty and keep your chosen solutions on track.

3 **Don't forget the basics.** Power demand and supply, an iBMS and resilient building systems that interconnect can save time, manage risk, deliver cost efficiency and lifecycle value. The most commercially attractive buildings are those with built-in resiliency where systems are constantly open for updates and improvements.

4 **Be as smart as your building needs to be.** Focus on the technologies and base build inclusions that deliver maximised tangible benefits while still delivering the required concept of operation.

5 **Dealing with data.** Focus on the data that is needed for reporting – efficiency, business improvement and performance – and ensure that your technology partner or integrator is aligned to this.

6 **Don't rule out your lifecycle.** Understand the relationship between CapEx and OpEx choices. Smart decisions at the base build stage of projects will open the door to smart facilities maintenance further down the line, pushing cost savings while driving ROI and system optimisation.

7 **Choose a strong smart partner.** Developers should seek to partner with global players that manage risk and reward equally and have well documented experience in smart infrastructure. Providers that forge leading alliances with other technology players and work regularly with the contractual chain in partnerships can be pivotal to a successful deployment.

3. The Changing Role of Corporate Real Estate

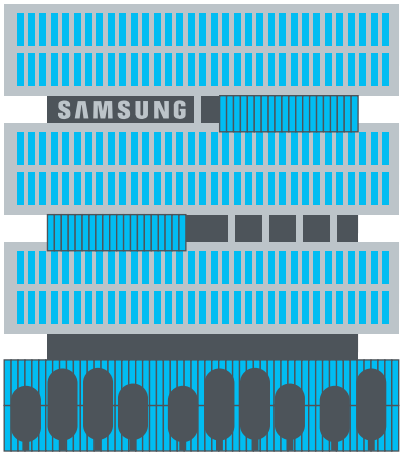
The way businesses use their office space has transformed in recent years. Whereas in the past firms tended to look at their real estate as an intractable though necessary cost of doing business, they now appreciate how investing in their workplaces can support business aims - and help them adapt to the toughest external challenges

3.1 The Workplace of the Future

By providing employees with the right environment, tools and facilities to work more productively whatever the changing external conditions, a company's work environment can become a catalyst for innovation and growth. As more companies have realised this, they have started to put more thought into the design of their work environments. Traditional models of workplace design that attempt to pack as many desks into an office as possible are being superseded by more dynamic, agile models that focus on collaboration, wellbeing and knowledge sharing.

Activity-Based Working (ABW) is an approach to office design in which employees do not 'own' a desk, but make a transition between a number of different settings for work according to the tasks they are doing. As employees are not tied to any particular space in an ABW environment, there are more opportunities for staff to interact and mingle – although post-pandemic social distancing rules will influence how these interactions are managed safely.

In some cases, entire buildings have been designed around creating staff encounters that might lead to the development of new ideas. For example, Samsung, for its North American HQ in San Jose, worked with architect NBBJ to create a workplace that would encourage collaboration between employees. Building 20, a facility on



Facebook's Menlo Park campus in California, is another office where employees can meet and interact in one large contiguous space. The collaborative intent behind these large office schemes remains relevant despite restrictions and concerns around Covid-19, although it is likely that social engagements will be more tightly managed and curated in the future.

Similarly, a trend for companies with multiple business units is to co-locate them in fewer locations to encourage collaboration and break down silos. Specialist incubator and accelerator spaces, where employees can work on new projects and ideas alongside start-ups, partner companies and outside experts are becoming more common.

3.1.1 Treating People with Care

Firms are increasingly aware of the role their workplaces play in attracting and retaining the best people. Use of office design to send signals about treating people with care and respect is part of that equation, especially in the aftermath of the pandemic. According to data from Oxford Economics, the average cost of replacing an employee is around £30,000, with most of this due to lost output while the new employee is brought up to speed.[3] Taking into account the value of a leaving employee's knowledge, reputation and relationship with clients, some studies put the total cost of losing an employee at 1.5 times an annual salary.[4] Many companies now view investments in the quality of their workplaces as a cost-effective way of retaining top talent.

The increasing interconnectedness between talent and workplace strategies has made companies more discerning about the locations they select. While low-cost, out-of-town office locations were once seen as an effective way of controlling real estate costs, they are now being shunned in favour of central business districts and urban talent hotspots that allow employers to tap into deeper pools of talent. Innovation districts are emerging in cities with a high concentration of young tech talent and a vibrant ecosystem of start-up businesses. Identifying and securing space in these sorts of locations is becoming vital to sourcing top talent.

3.1.2 Wellness and Amenities

Competition for the right talent will remain intense despite the economic fallout from Covid-19, as growth in the global labour market slows down. Between 2015 and 2030, the world's working age demographic will only grow at half the pace it did between 2000 and 2015.[5] In the UK and other developed economies, despite rising unemployment in the general working population, demand for specialist talent – such as in the technology sector – will outstrip the growth in supply. This will not only drive the costs of talent up, but also lead companies to invest further in their workplaces so they can appeal to the best people.

Tech has responded to talent shortages by kitting out their workplaces with gyms, wellness and fitness centres, as well as game and music rooms. These types of spaces could become standard features of offices in other sectors. Across the board, there will be an emphasis on creating environments that maximise the output of staff. Wellness initiatives that reduce employee ill-health can significantly increase business performance. Health and wellbeing will be higher than ever on the workforce agenda post-Covid-19. According to estimates by PwC, absence through sickness costs UK businesses £29 billion per year.[6] We can expect more access to natural light, improved air quality, better sanitisation of work settings, safe food consumption; and socially distanced movement around the building in the post-pandemic era.

Supporting this increased focus on employee wellbeing is the WELL Building Standard, a certification that rates buildings on seven different criteria related to health and wellbeing, including indoor air quality, access to natural light and how much a building's design encourages physical activity.[7] As wellness becomes an even greater factor to large occupiers, WELL and similar accreditation bodies are likely to incorporate important factors related to limiting the spread of infection to occupiers' selection criteria for new sites.

3.1.3 Agile Workplaces and Flexible Real Estate

As companies increase the share of their footprints in cities and invest more in creating spaces that inspire and energise their employees, they will have to find innovative ways to secure the most value from their workplaces. Models of workplace design based on non-assigned seating, such as ABW, allow companies to unlock significant space savings by freeing up under- occupied space while also providing office users a choice of settings from which to work. By overturning the idea that every employee 'owns' a desk, even when they are not in the office, firms are able to create highly efficient offices and better manage the costs of locating closer to the centre of cities.

Flexible locations, such as coworking spaces and serviced offices, are also becoming an increasingly important part of real estate strategies as companies look to scale their space commitments more dynamically according to changing business needs, rather than locking themselves into long leases. In the post-Covid-19 environment, many corporates will turn to the flexible space market as part of an office-as-a-service model that offers higher design and safety standards to keep the virus at bay and provide for greater flexibility.

Companies are increasingly aware of the competitive advantages that can be secured from adopting a well-considered workplace and real estate strategy. This shift has changed the types of work environments firms create, and the kinds of buildings to which they opt to locate. The office was previously considered a dumb container for work, with people commuting to buildings where they spend most of their day behind a desk. Now these assumptions are being challenged. Remote working is a growing part of the workplace mix post-pandemic and buildings are becoming fluid workplaces, with agile work driving a more efficient use of space, higher productivity and better performance.

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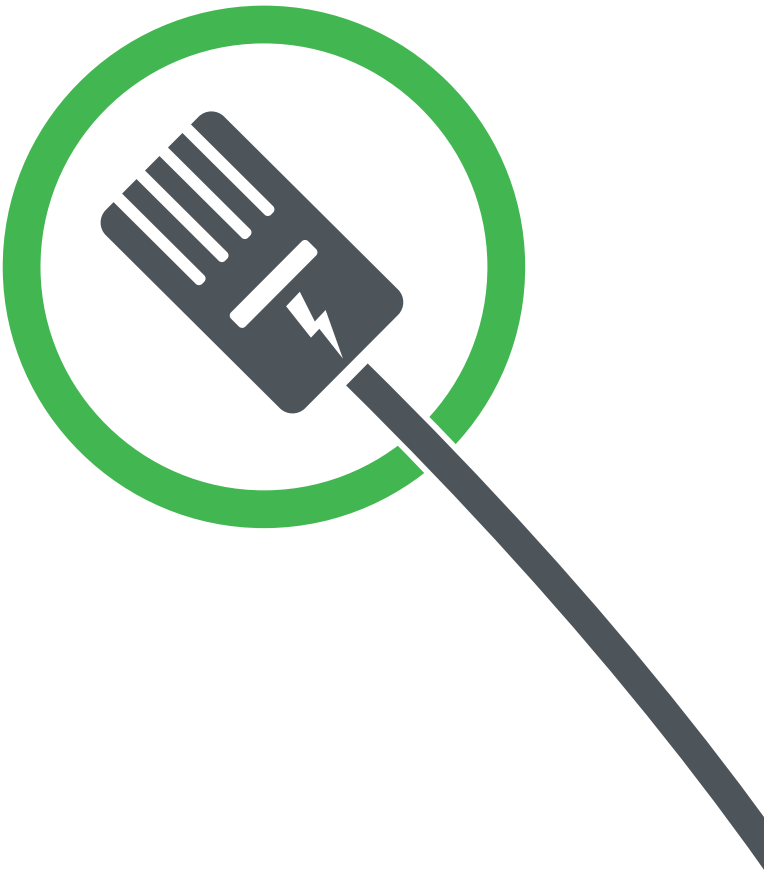

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What is a Smart Building?

Smart Building Technologies

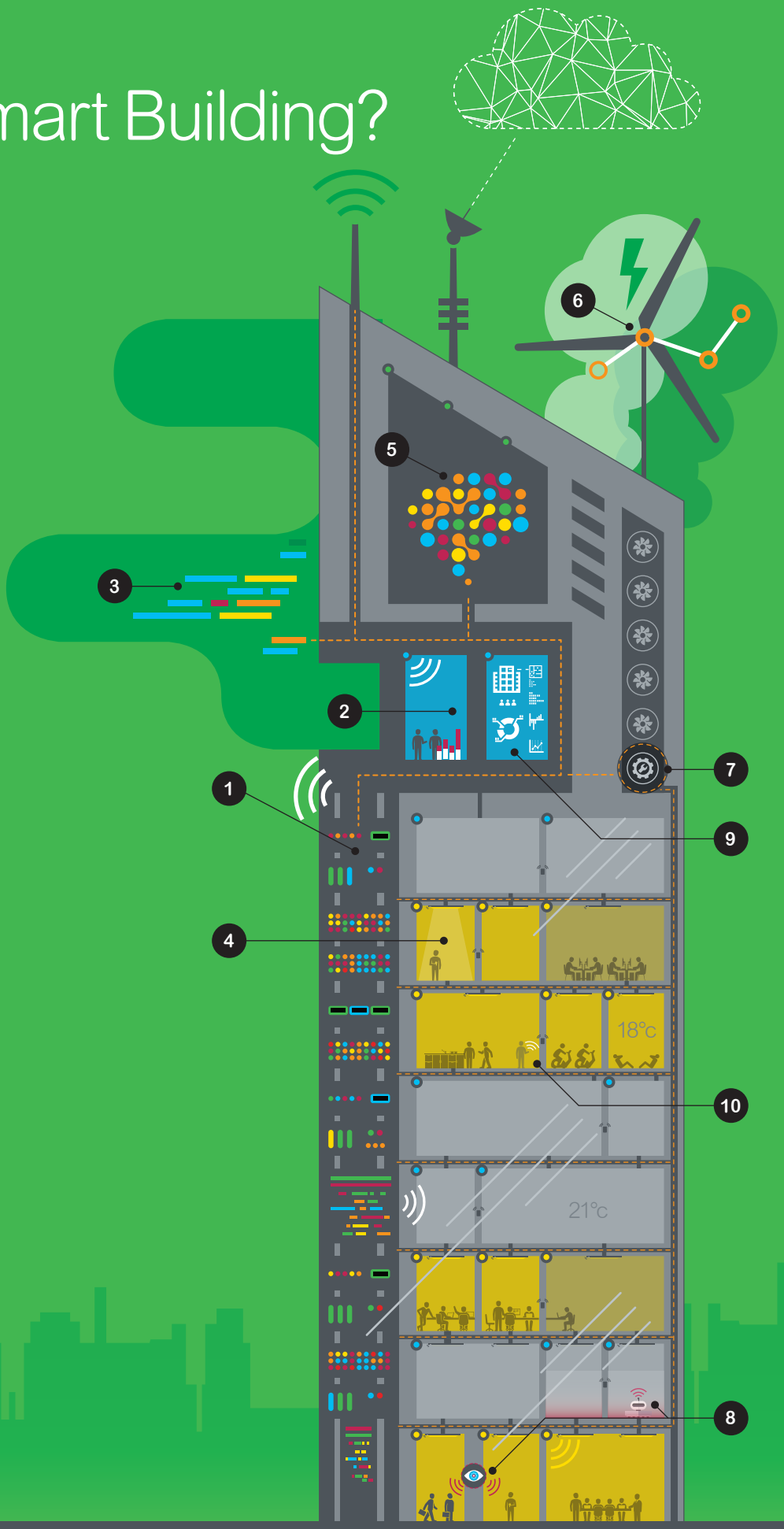
1. **The Internet of Things (IoT).** Thousands of sensors and other connected devices are embedded into the fabric of the building and exchanging information over the Internet.

2. **Predictive Analytics.** Using data from IoT devices, intelligent software forecasts how the building and its different systems will perform throughout their lifecycles.

3. **Open Standards Architecture.** All connected devices are speaking the same language, allowing them to 'talk' to each other and exchange information.

4. **App-enabled Building Services.** The mobile phone is the pivot in a smart building; occupants can control their environment, book amenities and access wayfinding all through a mobile app.

5. **Intelligent Building Management System (iBMS).** Functioning like the building's brain, the iBMS connects to all systems and devices and then takes informed decisions to improve the building's operations.



A Smart Asset

6. **Sustainable Buildings.** By carefully monitoring the usage of electricity and water, the building optimises the performance of its different systems and is highly energy efficient.

7. **Actionable Intelligence.** Intelligent software monitoring the performance of every building device detects faults, schedules maintenance and sustains optimal levels of performance.

8. **Smarter Security.** Technologies like robotics, video analytics and advanced access controls keep building users safe.

A Smart Workplace

9. **Data in the Workplace.** Data on the occupancy of different workspaces is captured and reported in real time, enabling the building's manager to identify spaces where an intervention is needed.

10. **Getting Smart About Wellness.** Sensors and wearables report on how the working environment is supporting the wellbeing and productivity of building users.

11. **Enhancing Employee Experience.** Using an app, building users are able to locate colleagues, control their environment and access building information.

4. The Smart Building

As the role of corporate real estate changes, the types of buildings that companies occupy are changing too. A greater appreciation of the contribution that the workplace can make to business success has made firms more discerning about the kinds of sites they select, and more mindful of the benefits that particular buildings offer.

Increasingly, occupiers are opting for buildings that provide more than the traditional lease, create a human-centric experience, improve efficiency and are simple and efficient to run.

Enter the smart building. Smart buildings are those in which different technology systems work together to reduce the costs of operations and enhance the experience of occupants. Smart buildings are more efficient, flexible and adaptive, making them more attractive and desirable places to work. In contrast to earlier notions of the 'intelligent building' that arose in the 1980s and focused on narrow concepts of operations, today's smart buildings deliver far greater benefits and a complete concept of operations for developers, landlords and occupiers of commercial real estate.

Rising interest in smart buildings from occupiers and developers of commercial real estate space has seen investment in the space reach $7.0 (£5.8) billion in 2015. By 2019, IDC forecasts that spending on smart buildings will exceed $17.4 (£14.4) billion.[8]

4.1 The Activ8 Model of Smart Buildings

In the interviews conducted as part of this research, there was no single or consistent definition or criteria as to what constitutes a smart building. However, there was a general recognition that assessments of a building's smartness should be done by examining the benefits it produces for its landlords and tenants.

This report sets out a new, outcome-orientated model for assessing building intelligence. The Activ8 model details eight outcomes that developers and occupiers of commercial real estate can use to understand the benefits of smart buildings.

1. **Insightful.** Smart buildings provide actionable insights into how a building is operating. In a smart building, real-time data is reported and used to inform decisions on building operations. Portfolio managers can see their operations across the globe and compare performance, giving them actionable insight on how to drive efficiencies and improvements.

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5. **Healthy.** Smart buildings monitor health-related factors like CO2 levels, VoC, noise levels and humidity, notifying stakeholders when an alarm is triggered. Some of these can even be autonomously adjusted, measuring well-being to reduce the costs of absenteeism due to illness.

6. **Productive.** Smart buildings facilitate better, more effective use of space and environments to prompt better engagement from staff, in turn boosting their productivity.

7. **Efficient.** Smart buildings meet the needs of their stakeholders in a hyper-efficient way and transform a company's real estate into an enabler of business growth.

8. **Resilient.** In a smart building, all systems within a building, including the electrical distribution system, are flexible enough to react in near-real time to the complex set of condition. They adapt to constantly changing needs and expectations of occupants, ensuring longevity and resilience to threats.

Together, the components of the Activ8 model represent a set of criteria for developers and occupiers to use when designing, specifying and procuring smart building technology.

4.2 The Technological Enablers of Smart Buildings

Leveraging the latest technology is essential to realising the Activ8 benefits set out above. Emerging technologies, such as IoT, the next generation of intelligent Building Management Systems (iBMS) and new device protocols, are fundamentally changing how buildings are designed, built and operated. As a technology consultant at a major engineering firm we spoke to as part of this research said, "the technology has overtaken our expectations – creating use cases for smart buildings that we hadn't previously imagined." Developers of real estate need to understand these technologies and what impact they will have on workplaces and buildings.

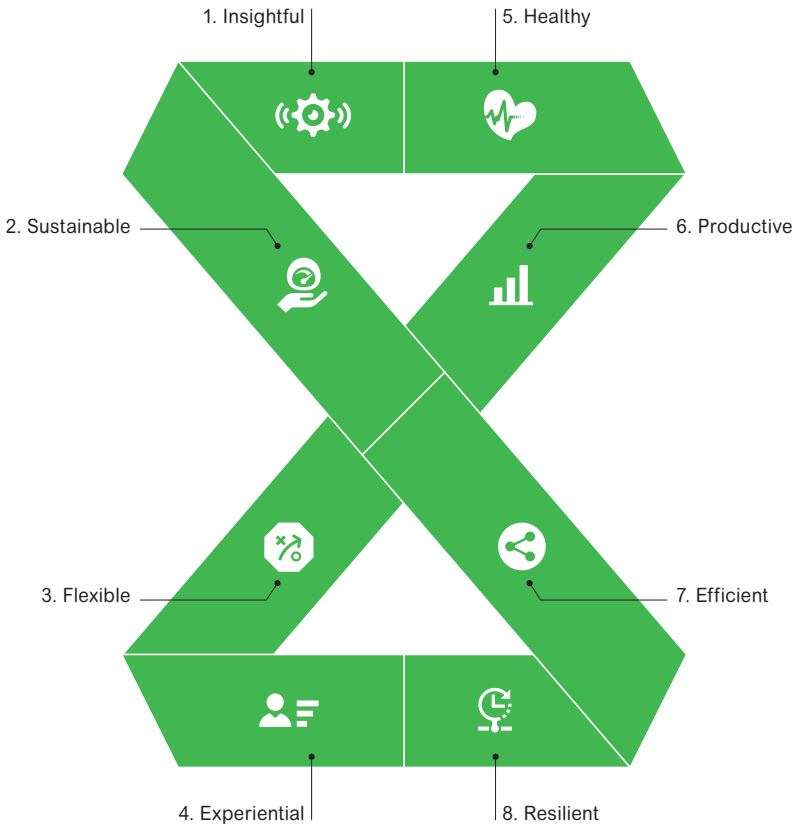
4.2.1 The Internet of Things

IoT is the term used to describe a world in which devices are sensor- enabled, connected and able to share information about their current state and environment over the Internet. Sensors in cars, oil pipes, energy meters and wearable devices are all part of the expanding IoT ecosystem, which already connects billions of devices. At the end of 2018, there were an estimated 22 billion internet of things (IoT) connected devices in use around the world with forecasts suggesting that by 2030 this number will swell to over 50 billion.[9]

IoT devices are being used by businesses to automate decisionmaking, increase efficiency and reduce operating costs. General Electric is using sensors to remotely monitor the performance of its jet engines allowing the firm to detect and deal with minor faults before they become major ones. In buildings, similar sensors for managing the performance of building systems are starting to be installed.

Combined with faster connectivity and advances in cloud computing, IoT has the potential to transform how businesses operate. By 2025, The McKinsey Global Institute forecasts that applications of IoT technologies will have an economic impact worth potentially $11 trillion to the global economy.[10]

The installation of connected devices in buildings is one of the key applications of IoT technology. Sensors that detect the presence of a person, light levels and humidity are already being installed in new developments. The Edge, a 40,000m2 office building in Amsterdam, is by many accounts the world's smartest building. 28,000 sensors track the movement of people through the building.[11] The office buildings of the near future will have hundreds of thousands of sensors installed, monitoring everything from the performance of individual light fittings to the health and wellbeing of employees.



4.2.2 The Internet of Things and Predictive Analytics

The real promise of IoT is that data captured by connected devices could be used to not just report the performance of various devices and information about their environment, but accurately forecast conditions into the future. Using data from sensors, for example, a smart building can begin to create a picture of common occupancy trends within an office to then make predictive decisions about demand-based energy usage.

Growing volumes of data from IoT sensors are expediting the development of new types of computing that will further transform building operations. Neural networks, for instance, are an emerging technology that use networks of interconnected processing units arranged to mimic the makeup of the human brain. Software running on a neural network can identify patterns and trends in large sets of historical data to learn to anticipate future events. By analysing data from building sensors, and combining this with external data, specialist neural software could predict how many building users will be present on a given day and optimise services accordingly.

DeepMind, a company specialising in applications of neural networks that was acquired by Google announced that it had implemented a world-first cloud control system to automate the cooling of datacentres through delegating power management to its neural network.[12] Elsewhere, IBM Watson, IBM's cognitive artificial intelligence system, is now being used in the real estate industry to analyse vast sets of data to improve building operations. IBM has partnered with facilities services provider ISS to enable Watson to analyse data from millions of sensors installed in ISS-managed buildings. ISS will be able to use this data to optimise its services and understand how people are using its sites [13] enabling software to understand and respond to commands spoken in natural language. As this technology improves it will enable the rise of virtual concierges in buildings that users can interact with as they do today with Apple's Siri or Google's Assistant. The Schneider Engage Enterprise App is already transforming the employee experience through services such as smart parking, room booking and comfort control.

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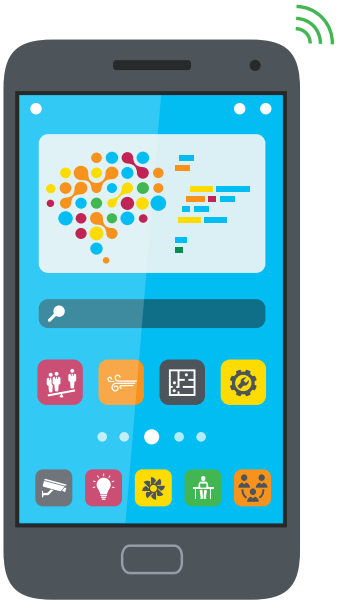


4.2.3 Intelligent Building Management Systems

Smart buildings are powered by the next generation of iBMS. In many of today's office buildings, existing BMS only support the operation of critical plant systems. All other systems, such as those controlling lighting, security and safety, are regulated by their own subset of controllers, supervisor panels and applications, each with their own support networks.

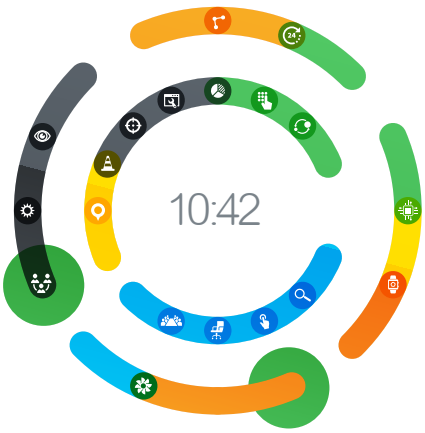
An iBMS, by contrast, connects to all building systems and services over an Internet Protocol (IP) network. This allows an iBMS to function like the operating system of a building, with data from individual systems and devices transmitted back to the iBMS. Using this data, an iBMS can make informed decisions and actions that improve the operation of the building. Data from occupancy sensors, for instance, could be fed into an iBMS to allow it to identify vacant parts of the building where ventilation and lighting systems can be turned off.

Operational efficiencies generated by the iBMS can significantly reduce running costs in areas such as utility consumption, management overhead and building adaptations. Furthermore, iBMS control software provides a simple, visual solution that brings all building systems together on one user interface, allowing building managers to monitor, adjust and reconfigure lighting, security, HVAC, elevator, power and other building system devices as needed.

4.2.4 Open Standards Architecture

One of the major inhibitors to the adoption of smart building technology has been the lack of interoperability between different building systems. Currently the makers of these building control systems have begun to adopt open protocols, such as LonWorks or ASHRAE's open-source BACnet, that allow all systems to communicate in a common protocol language. These common protocol languages define the arrangements under which devices and systems interact and communicate with each other.

Open protocol systems can be programmed by asset managers to preconfigure certain outcomes, ('if system x does this, then system y should take the output data and process it in this way'). For example, if a security system were to identify an intruder, the iBMS could be programmed to redirect cameras, engage control systems to prevent access to parts of the building and direct security personnel to the threat. One key advantage of open standards architecture and open protocol systems is that they enable the integration of new devices, IoT sensors and systems, as long as these devices also communicate using an open protocol language. A building that adopts open architecture standards is, therefore, effectively 'future-proofed', as new functions and devices can be easily installed when enabling technologies are developed. Furthermore, open standards enable the use of powerful software solutions that can link data from multiple locations to drive efficiency across an entire real estate portfolio.



4.3 Smart Buildings – A Day in the Life

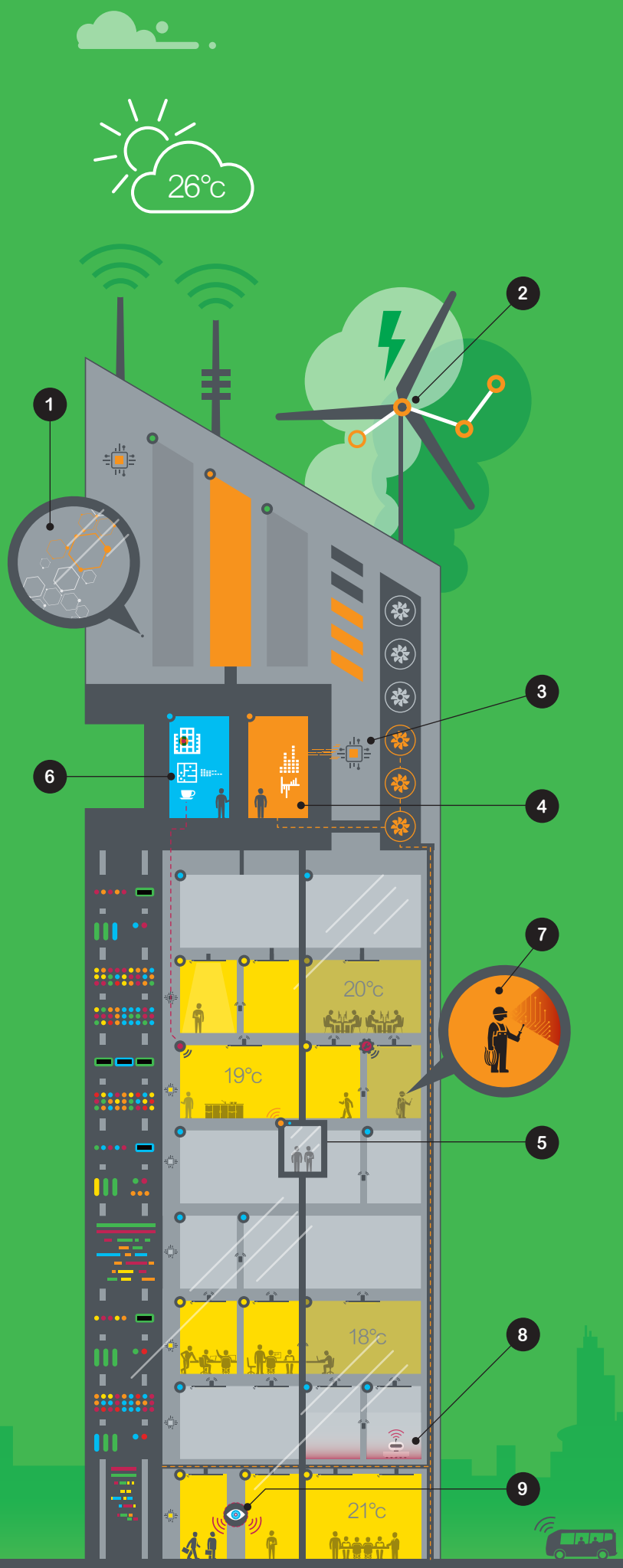
As new applications of smart building systems and IoT technologies are developed, the advantages that smart buildings offer over conventional ones are growing in number. Investing in smart building technologies offers a number of benefits for building users, occupiers and landlords.

Building Users. When users arrive at a smart building, facial recognition technology means they do not have to use entry cards to access the building. Security systems recognise them and open the access gates automatically, this can further integrate with employee calendars to prompt the destination control elevator to take the occupant to the correct floor without interaction, this makes the entire entry process touchless. Services, such as booking a meeting space, ordering lunch or locating colleagues working in other parts of the building, are all available through a smartphone application Through analysing corporate databases, the building also knows what employees are working on, alerting users that colleagues or specialists in their network are working nearby.

Heads of Real Estate. Access to real time data from the various building data points provides CRE professionals with unprecedented insight into how the building is performing. Live data on space occupancy, carbon usage, amenity demand and fault detection can all feed into advanced analytical models, such as the digital twin, to utilise machine learning and predictive analytics for maximised efficiencies. This data can be stored and analysed alongside external data such as the weather, commute information and local news events to spot patterns that streamline the occupants working day. Data on the wellness and physical activity of employees captured from wearables and sensors in the office furniture provides a comprehensive measure of organisational health, helping to reduce the costs of sick days and absenteeism. All this data can be displayed back to occupants and CRE leaders in the form of digital dashboards, ensuring the workplace is always data-led.

Building Owners. Data from the building allows owners to compare the performance of their buildings against one another and against corporate objectives. Smart technologies that enable buildings to be net contributors of energy, rather than consumers, positively contribute to occupiers' sustainability goals. By providing real-time reports on occupancy, the building gives owners informed insight so they can adapt their strategy based on the evolution of the real estate requirements.

Building Management. Tactical and operational decisions on the operation of the building are automated by the machine learning capabilities of the iBMS, taking the guess work out of the decision making process and limiting the scope for human error. By analysing data provided by individual building systems and sensors, the iBMS optimises the workings of the building to reduce operating expenditure, minimise carbon usage and enhance the experience of occupants. Advanced cause and effect modelling means the building can respond dynamically to changes in usage. The performance of every individual device is carefully monitored and controlled by the iBMS, allowing it to identify any issues and automatically schedule maintenance before an issue leads to downtime.



A Smart Asset

1. **Smart Materials.** Technologies like bio-reactive facades and nanotechnology make the building much stronger and energy efficient.

2. **Power Generation.** Onsite energy production makes the building a net contributor of energy to the national grid, rather than merely a consumer.

3. **Environmental Sensors.** Sensors measure levels of ambient light and adjust the building's lighting levels accordingly.

4. **Energy Management.** Software analyses and predicts the consumption and costs of energy, and then optimises the performance of the HVAC systems to increase efficiency.

5. **Connected Lifts.** Sensors measure the motor temperature, shaft alignment, cab speed and door functioning of the building's lifts, helping to identify when maintenance might be needed.

6. **Intelligent FM.** Sensors highlight to the building manager when bathrooms need cleaning, coffee machines need refilling, or lightbulbs need changing.

7. **Smart Servicing.** Service personnel use Augmented Reality (AR) to access information on faulty equipment concealed behind building fixtures.

8. **Robotics.** Robot security guards patrol the building at night to locate potential intruders.

9. **Facial Recognition.** Video analytics is used to identify individual building users and visitors, who then receive a personalised experience.

5. A Smart Asset

Smart buildings offer considerable advantages to real estate developers, landlords and tenants, most prominently in regards to sustainability and protection against the spread of Covid-19. Employing intelligent energy management solutions in smart buildings is a critical step in reaching positive energy buildings; implementing these solutions allow buildings to rapidly reach de-carbonisation targets and ensure that the supply of energy keeps pace with demand. Actionable intelligence provided by building systems means that a smart building's iBMS can detect malfunctioning equipment or wasteful practices, reducing running and maintenance costs. Smart security technologies, like facial recognition, temperature checks and video analytics help facilitate a touchless workplace experience and can also help identify at-risk occupants for contact tracing following an outbreak of illness.

5.1 Sustainable Buildings

Smart buildings are highly energy efficient, using technology to carefully monitor and optimise the usage of electricity and water. In order to keep electricity grids functioning and achieve ambitious de-carbonisation targets set out by national governments, smart buildings will be vital.

Europe and North America are supported by an ageing national electricity infrastructure that requires significant investment to meet rising demand, putting pressure on utility companies to eke out operational efficiencies or find better ways of supplying energy. Alongside this, legislative targets to reduce carbon emissions requiring electricity companies to source a specific portion of their energy sales from clean sources within a fixed time-frame have been adopted in at least 67 countries.[14] The European Union, for instance, has set a goal to generate 32% of energy from renewable sources by 2030.

Meeting these challenges will require the creation of a smart electricity grid that can use data on energy consumption to realise efficiencies and improve the reliability of supply. In a smart grid, connected energy meters, appliances and sensors are used to give utility companies data on energy usage habits. This data can then be used to balance power generation with energy usage and generate operational savings. GB Smart Grid estimates that £19 billion of savings could be achieved from upgrading the existing network to a smart grid in the UK alone.[15]

The smart grid, however, relies on smart buildings. Buildings account for around 40% of total energy consumption and 33% of GHG emissions.[16] In the United States, commercial real estate consumes at least $179 billion of energy every year.[17] Without investments in improving the energy efficiency of buildings, achieving a more efficient, less carbon-dependent electricity infrastructure will be impossible.

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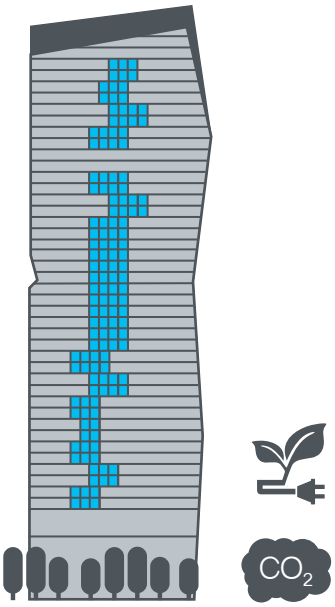


Smart and energy efficient: Ampere E+, the Paris HQ for Sogeprom generates enough power through solar panels and energy recovery to live temporarily off the grid

Developers of commercial real estate are finding themselves under more scrutiny from governments to invest in energy-efficient buildings. New York, Boston, Philadelphia and other major American cities have established building energy benchmarks ordinances requiring thousands of commercial buildings to track and publicly report their energy consumption. In the EU, Directive 2010/31 promotes the ultimate goalof ensuring that all new buildings are nearly zero-energy buildings (NZEB) by 2021, to produce almost as much energy onsite as they consume.

There are considerable gains to be achieved in terms of energy consumption in buildings through better management of how building systems are run and managed. Damper systems in buildings are designed to provide cool outside air, rather than relying on chillers or compressors. In many buildings it is common, however, for chillers and compressors to continue to operate even on cool days when outside air could be used, despite this being highly inefficient.

Furthermore, smart buildings that are highly energy efficient offer developers, landlords and tenants a number of other hard benefits. In a seminal study by the World Green Building Council, these buildings were found to command significant rent premiums and higher sale prices, had greatly reduced energy costs and contributed to better rates of staff retention for tenants.[18] Furthermore, by using energy more efficiently, smart buildings positively contribute to corporate social responsibility targets.

A number of exemplary, highly energy- efficient smart buildings have been completed in the last few years. Ampère E+, the 15,000m² Paris headquarters building for Sogeprom, is a prime example. The building is clad with sensors and actuators to control and optimise HVAC, lighting, and blind control, as well as managing the distribution of energy and fluids. By operating Schneider Electric's EcoStruxure Building Operation software all datapoints and commands for these various systems are centralised. Ampère E generates power through solar panels on the roof and energy recovery on elevators which is then stored in used car batteries. Discharged energy represents between 5-15% of the building consumption allowing Ampère E+ to temporarily live off the grid depending on the needs.

Al Bahar Towers in Abu Dhabi also uses an iBMS to achieve high levels of energy efficiency, despite being situated in a climate where temperatures regularly exceed 100 degrees Fahrenheit. The building features an intelligent façade that reacts to the movement of the sun to limit solar gain and glare, helping to reduce the use of the HVAC system.[19]

The 50,000 sq. m. head office of the Cooperative Group at One Angel Square in Manchester is one of Europe's most sustainable office buildings. It is rated 'outstanding' on the Building Research Establishment Environmental Assessment Methodology (BREEAM) scale. The building has its own source of heat and power generation onsite, allowing it to give back surplus energy to the UK's electricity grid.[20]

It is not just new developments like these that can employ smart building technology to improve energy efficiency. IoT sensors can be employed in existing sites to significantly lower operating expenses and energy consumption. American telecoms firm AT&T, for instance, retrofitted 240 of its offices, garages and call centres with sensors built by Enlightened, a California- based provider of lighting and energy management systems. The sensors optimise lighting according to the levels of ambient light to save energy. AT&T now saves $8 million on its energy bill and expects to save a further $200 million over the next ten years as the sensors are introduced in more facilities.[21]

Case Study: Kallang Pulse

Situated at Singapore's Kallang Avenue, Kallang Pulse is the 18,500 m² East Asia headquarters of Schneider Electric. It is home to over 1,200 employees and while it did not officially open until March 2018, the smart office tower was certified under Green Mark Platinum in 2017 for its commitment to sustainability.

The 25-year old retrofitted structure utilises some 3,000 connected devices in an IoT network solution for all data reporting and analysis within the building. Data on occupancy levels, carbon usage and building performance is available at a granular level and fed into Schneider Electric's own EcoStruxure Building Advisor solution for a 'single pane of glass' approach to unified systems management. All electrical devices can be manipulated remotely from the single control panel while building data is reported and analysed in real-time through pre-set modelling and is displayed on live dashboards to building managers.

EcoStruxure Building Advisor operates an advanced suite of technologies and data tools such as predictive analytics, condition-based maintenance, optimised asset availability to both improve the user experience and ensure efficient running of the building. In a clear testament to this approach, the building is set to reach its carbon neutrality target by 2021, with 98% of daytime energy coming from solar power.

Analytics software can also be used to monitor and control energy consumption. EcoStruxure Building Advisor, a solution from Schneider Electric, interacts with building control systems to analyse and predict the consumption and costs of energy, as well as the comfort needs of the building occupants. Data from weather reports, rate tariffs and demand response events can be included to further optimise the performance of HVAC systems automatically.[22]

New types of building façades and materials allow further energy efficiencies to be achieved. BIQ House in Hamburg has a bio-reactive façade that generates hot water using glass panels filled with microalgae

Developments in nanotechnology could impact the properties of building materials by allowing modification at the molecular level. Types of concrete have already been developed using this method that are many times lighter and stronger than traditional concrete. In the future, the same technique may be able to make building materials more thermally efficient.

5.2 Actionable Intelligence

Smart buildings provide huge volumes of data on the performance of building systems and services. Using specialist software, analysis of this data makes them easier to manage and maintain.

In a smart building, building managers are provided with control software that gives them a simple, visual solution to manage all systems on one interface. This software can be accessed remotely, allowing portfolio owners to manage multiple properties from a single location.

Continual monitoring of all building systems ensures that high levels of performance can be maintained across a building's lifecycle. In any building, the operation of one building system inevitably has consequences for another. One component or system that deviates from optimal performance may cause other elements to overcompensate or begin to underperform. Consequently, it is common for a routine commissioning to take place every five years so that systems can be recalibrated and returned to optimal performance. In a smart building, however, the continual monitoring of operations allows the building to sustain high levels of performance at all times.

EcoStruxure™ Building Operation, a Schneider Electric solution, is a software platform that integrates the data collected from multiple building systems to report a smart building's energy, process and resource performance.[23] Schneider Electric's EcoStruxure Building Advisor solution monitors the workings of building systems and components and uses artificial intelligence to detect any faults, potential inefficiencies or energy-saving opportunities. At one facility, the software detected that a preheating coil and a cooling coil were operating simultaneously. This insight enabled the service technician to pinpoint and repair a leaking chilled water valve, leading to a cost avoidance of $46,000 (£40,000) per year and a positive return on investment within one month.[24]

The bathrooms at Dubai Airport have been fitted with sensors that report when bathrooms are experiencing high volumes of traffic and need cleaning. This enables better scheduling of cleaning rotas, helping to save time, supplies, staff and energy.

IoT devices can further enable the detection of system faults and the avoidance of costly breakdowns. To better schedule maintenance and repairs, lift-maker ThyssenKrupp Elevators partnered with CGI and Microsoft to deploy an IoT solution which monitors the performance of the company's lifts. Embedded sensors measuring everything from motor temperature to shaft alignment, cab speed and door function have now been installed. This data is fed into machine learning algorithms, which can predict when maintenance will be required. The system has helped ThyssenKrupp Elevators, which runs 1.1 million lifts worldwide, and its customers reduce expenditure on repairs and servicing.[25]

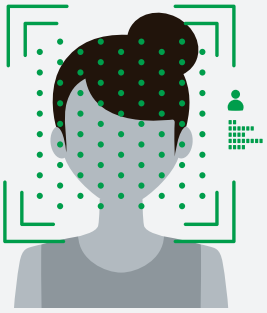
Efficiencies in the management and operation of buildings can be achieved through the deployment of smart sensors. The bathrooms at Dubai Airport have been fitted with sensors that report when bathrooms are experiencing high volumes of traffic and need cleaning. This enables better scheduling of cleaning rotas, helping to save time, supplies, staff and energy.[26]

For servicing technicians, methods for overlaying digital displays of smart building components onto the real world using Augmented Reality (AR) can be used to aid maintenance and identify faulty equipment. When combined with Building Information Modelling (BIM), the standard for designing buildings using detailed, digital representations of their component parts, AR displays allow technicians to access detailed models of components via a tablet or pair of smart glasses. Inspections or quality controls can use BIM AR to check the performance of components concealed behind other fixtures, further assisting facilities operations and smart maintenance.

5.3 Smarter Security

Late night visitors to The Edge in Amsterdam may encounter a security guard shuffling along the building's corridors. But unlike security personnel in other buildings, the ones at The Edge are not human, they are knee high robots that come out at night to autonomously patrol the office building. These machines can identify and challenge potential intruders, and are one example of the security benefits that smart buildings can offer to landlords and tenants.

In addition to robotics, a number of other advanced security systems are arriving on the market that can be easily implemented in a smart building. Smart cards that use Radio-Frequency Identification (RFID) technology, for instance, can be used to capture the location and movements of individual building users. Near Field Communication (NFC) technology (used in contactless payment apps like Apple Pay) can be used to allow building users to enter the building using their smartphones.



Facial recognition technology, an area that has advanced considerably in recent years, can be used to identify banned persons or record exactly who is in the building at a given point in time. It can also be employed to soften the visitor arrival and check-in process. The reception staff in a smart building could be alerted to returning guests and important persons, providing personal details to a reception's display screen and notifying their host of the guest's arrival as they approach the building.

Smart buildings can also leverage video analytics software to analyse security surveillance data and flag up any potential incidents to security personnel in real time. Sophisticated video analytics solutions can detect unauthorised access to a prohibited area, abandoned baggage that may require investigation, or a person who is injured and requires help. In buildings with large numbers of surveillance streams, it is impossible for security personnel to monitor and detect all incoming security issues. Intelligent video analytics solutions enable developers of commercial real estate to ensure the security of their buildings. Security is an increasingly important topic for businesses, which are more aware than ever of the threat of industrial espionage and information theft. It is particularly important to unify a buildings security infrastructure with the building management system, or iBMS. EcoStruxure Security Expert from Schneider Electric protects building occupants and assets through an integrated, role-based physical security access control and intrusion detection system. Developers who can offer prospective tenants comprehensive physical security through investing in smart security solutions can make their spaces more desirable and command considerable rental premiums.

Case Study: IntenCity, France

Schneider Electric's new office in Grenoble, France, is set to be one of the most sustainable commercial office buildings in the world. It embodies the ultimate smart building and is a testimony to the future that Schneider envisions for itself and for its customers, prioritising green energy, efficiency, sustainability and occupant comfort.

Expected to go live at the end of 2020, IntenCity will be a showcase for building performance, energy autonomy, renewables production, monitoring and control. It will be an active participant in Schneider Electric's Exchange, an open sharing-economy ecosystem for IoT energy management and automation solutions.

IntenCity will achieve several firsts including the first five-storey, fully energy-autonomous building in the world and the first to exceed 100 LEED points, with a target of 102 under LEED version 4. It will tout an energy consumption proportion to space of 37kWh/m² vs – the average in Europe is 150kWh/m².

6. A Smart Workplace

The Covid-19 crisis has redefined what it means for a workplace to be smart. Where major operational gains were once the core driver for the implementation of advanced workplace technology, today the focus has shifted to the enhancement of staff safety, wellbeing, business performance and employee engagement. As IoT and sensor technologies continue to develop, the smart workplace is becoming better equipped to help businesses better coordinate the performance of their real estate with the safety and productivity levels of their workforce.

6.1 Data in the Workplace

Historically, rising real estate costs have led companies to seek as much value from their office space as possible. Activity Based Working (ABW) and other agile models of workplace design in which employees share workspaces have allowed companies to unlock significant space savings whilst enhancing the effectiveness of their workforce.

However, the emergence of the coronavirus pandemic has propelled vigilance around cleanliness and staff safety up the corporate agenda. This has given pause for thought for the early adopters of the agile, activity-based model of shared workspace. The smart office will now be defined instead by the success of technology in aiding people to work as effectively as possible in the post-Covid era.

Data will play a central role this. Smart building technologies are enabling companies to capture data on occupancy, location and environmental factors, ensuring that the smartest workplaces are also the safest. Sophisticated utilisation sensors can be used to capture data on office utilisation and interact with smart building systems to optimise space performance through demand-led servicing.

With sensors measuring both occupancy levels and environmental metrics in a meeting room for instance, a smart workplace can identify when the air quality is poor and prompt the participants of the next session that they may wish to use another room; alternatively. the iBMS can direct better ventilation to that room.

Deciding with data will become the norm to maximise every square foot of the workplace. The IoT sensors that capture data to understand utilisation and occupancy have significantly matured and are now being deployed at scale. It is now possible to measure at the granularity of a desk or office; or count the number of people in meeting rooms against capacity; or monitor usage levels of amenities like gyms or cafeterias to make workplace design more effective. Using IoT sensor data for optimisation or guiding employees in a dynamic workplace has gained mainstream importance so that several new workplaces choose to deploy them during new-built stage or major renovation as part of the building management systems.

EcoStruxure Workplace Advisor is a solution developed by Schneider Eclectic that monitors building occupancy to support the effective use of ABW environments following the changes brought about by Covid-19. The solution uses a network of connected sensors and anonymous RFID tags inserted into the badge holders of building users. These tags transmit information to the sensors, allowing the real-time usage of different spaces to be reported and visualised. The iBMS in a smart building is able to use this data to optimise lighting and temperature levels according to the number of people in a space or the preferences of individual building users. The solution can also monitor humidity, sound and prevalence of VOCs (volatile organic compounds) in the air.

6.2 Enhancing Employee Experience

The quality of a company's workplace is increasingly key in its ability to attract and retain the best people. As the competition for talent intensifies, it is imperative that companies provide high quality work environments that match the workstyles and expectations of potential recruits.

Smart buildings can positively contribute to talent strategies by enhancing the experience of employees. According to the CEO of a large property management company interviewed as part of this research, smart buildings offer the possibility of "markets of one in the workplace" with individual users able to adjust the lighting and temperature settings of their workspace according to their individual preferences. Building users in Puteaux, France, for instance, can control lighting, temperature and blinds from a smartphone app. Preferences follow a user around the building, optimising the environment as they go from one space to another. As the workforce ages, workplaces will have to accommodate comfort needs that differ significantly across different generations. Letting users set their own light and temperature preferences will, therefore, be essential.

Workplace apps, such as Schneider Electric's EcoStruxure Engage Enterprise App, have emerged as the key interface connecting users with the building. Working as a digital infrastructure layer the mobile app unlocks access to a range of services and amenities through a single, accessible engine. Tracking the usage of space in real time allows the building to identify available worksettings alonside the functionality to book a desk or meeting room. At The Edge in Amsterdam, building users can find working spaces, reserve meeting spaces and even locate their colleagues using the building's app. Other services, such as ordering food and beverages, checking the availability of car parking spaces, and scheduling classes in the building's gym could also be available via an app, with all the relevant data being provided by a smart building's iBMS.

What gets measured gets managed. Through monitoring the quality of the work environment and the activity of those who use it, companies can better understand how their workspace is helping (or harming) the well-being of their people. Smart building systems and sensors, which both capture the data and optimise the environment, allow companies to realise productivity gains through enhancing the wellness of employees. Of particular importance is indoor air quality monitoring – air quality is emphasised in WELL, Fit-Well and other accreditation schemes for well-being.

6.3 Smart about Wellness

The impact of workplace design on the physical and mental wellbeing of employees is increasingly well understood. With salaries and benefits comprising around 90% of the operating costs of any typical large business, even modest increases in productivity arising from better working environments can have a significant impact on the bottom line.

Recent scientific research has been able to demonstrate that higher levels of physical activity can lead to more effective employees. Consequently, companies are starting to weigh up how their workplaces can encourage movement and combat sedentary lifestyles. One major accounting firm has trialled giving its employees fitness bands that capture data on their physical activity, which they can then use to better understand their health habits.

The quality of indoor air can also impact the productivity and wellbeing of building users. High levels of CO2 have been shown to impact feelings of tiredness and decision-making in a number of studies. Research has found that CO2 at levels as low as 600 parts per million (ppm) can have a significantly detrimental impact on individual performance, despite this figure being well below the normally accepted level of 1000 ppm.[27] Smart building sensors, such as those deployed at The Edge, can detect and measure levels of CO2, allowing the iBMS to adjust HVAC settings accordingly.

Natural ventilation or mixed-mode conditioning has also been shown to bring a number of benefits. Research compiled by Carnegie Mellon identified significant savings on health costs, HVAC energy and productivity gains from natural or mixed ventilation. Another study found that short-term sick leave in buildings ventilated by an outdoor air supply rate of 24 litres per second (l/s) was 35% lower than in buildings with rates of 12 l/s. The value of the increased ventilation was estimated to be worth $400 per employee per year.[28]

Smart building systems and sensors, which both capture the data and optimise the environment, allow companies to realise productivity gains through enhancing the wellness of employees.

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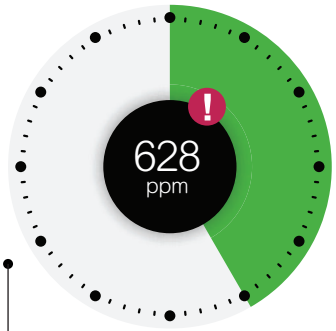

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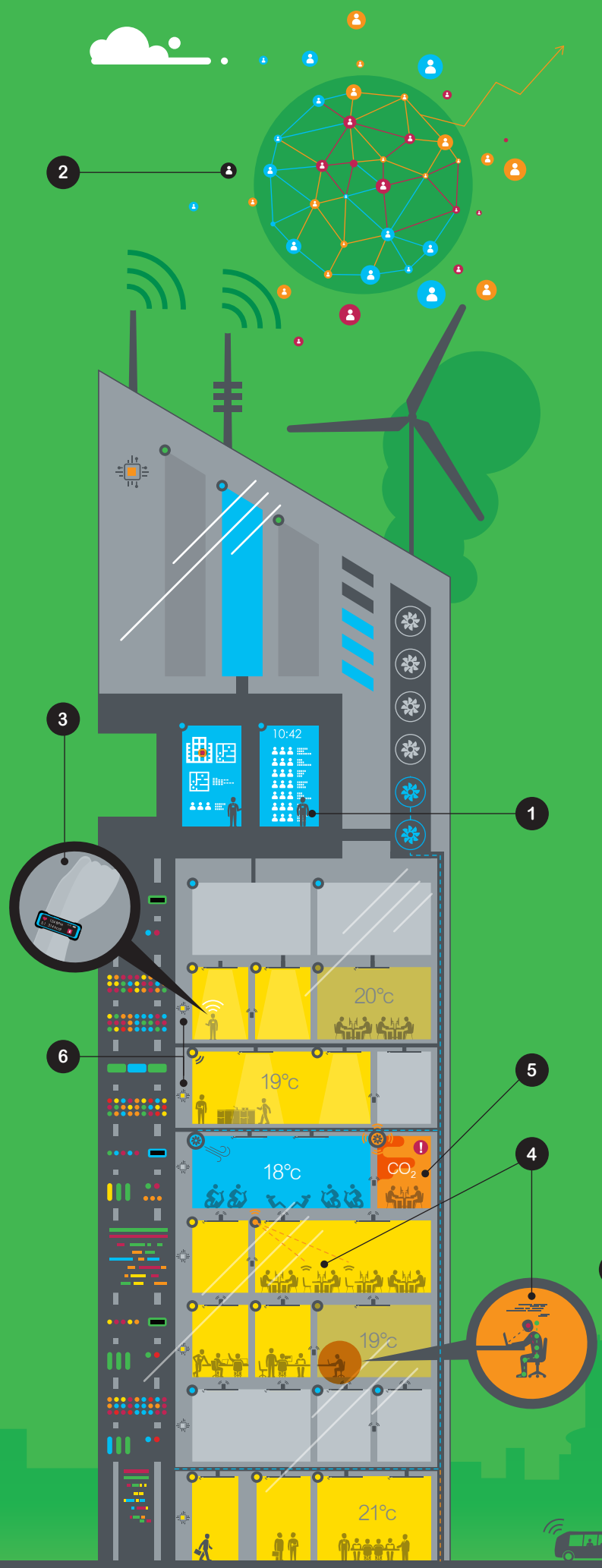


A Smart Workplace

1. **Real Time Occupancy.** Sensors are used to measure the occupancy of workstations in real time, and observe the movement of people across space.

2. **Predictive Analytics.** Advanced analytical tools utilise AI to spot patterns in building data and respond to demand proactively.

3. **Location Aware.** Beacons track mobile phones to provide location-based services and contextual notification to individuals.

4. **Dashboards.** The smart office is dataled. Large dashboards can display live data about the building, local amenities and business performance that helps employees make better decisions.

5. **Air Quality.** Levels of CO2 are constantly measured, with the HVAC systems responding to levels that might impact building users' productivity or concentration.

6. **Lighting and Heating.** Temperature and light levels of the building automatically adapt to the individual preferences of users.

7. **App-enabled.** Building users are able to identify spaces to work, reserve meeting spaces and locate colleagues via a smartphone application.

7. Creating a Smart Building

Smart buildings can only deliver the benefits set out in this report when they are specified, procured and commissioned properly. Developers and investors who overlook critical requirements in the design and construction of their buildings risk being left with buildings that do not perform as intended or an asset that exposes them and their tenants to grave security risks. Companies who use smart technologies need to put in place the right practices so they can use data effectively to measure performance.

7.1 Procurement

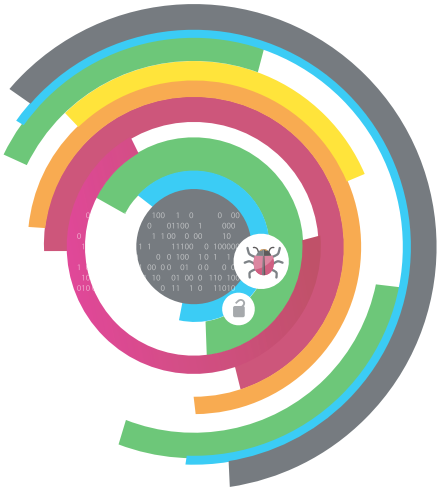
Throughout the interviews that were undertaken as part of this research, there was a recognition that a new approach to building procurement was needed to realise the benefits that smart buildings offer. A common complaint among the developers we spoke to was that reliance on the traditional procurement route led to smart building systems being de-specified through value engineering and the delivery of buildings that failed to meet their performance goals. To create a truly smart building, developers of real estate need to first articulate their concept of operations and articulate what outcomes they intend to achieve from their building. This needs to be stated in the form of a clear vision that all stakeholders can align to and are incentivised to achieve. The Activ8 outcomes identified in this report provide a robust starting point for thinking about how a smart building can deliver significant value for both developers and consumers of commercial real estate.Smart building specialists need to be engaged during the strategic development stage. The reason that many buildings fail to meet developers' expectations or deliver on the promise of smart buildings is that construction often proceeds to near completion before considerable thought is given to building intelligence.

Certain fundamental requirements must be incorporated early in the planning process and a smart building strategy and brief need to be established. This includes an open systems architecture, open protocol product selection and IP compliance for the purpose of data transfer.

Planned integration of enterprise business services and procurement of building technologies must be undertaken in accordance with clearly-defined performance goals. Deviation from the requirements should not be tolerated. A common point of failure in developing a smart building occurs when value engineering results in fundamental principles being compromised. This can have disastrous effects on both the operation of the building and its lifecycle costs.

It is often assumed that constructing and commissioning a smart building is inherently more costly than a conventional building due to the added complexities presented by emerging technologies and their impact on building systems. In fact, there is the potential for capital expenditure to be reduced or cut by integrating building systems. The use of a common infrastructure enables savings from the reduction of multiple independent system networks that exist in a conventional building.

As more companies begin to see the benefits of locating in a smart building over a dumb one, it will be essential that developers have the expertise and knowledge to create smart real estate. Developers who move first to incorporate smart building strategies into their future developments will be able to increase the desirability of their locations and the value of their properties.



7.2 Cybersecurity

The security of any Internet-connected device can never be completely guaranteed. "Smart buildings", according to a partner at a property developer interviewed as part of this research, "could be de-railed by poor cyber security". With more connected devices installed in workplaces and greater dependencies between different building systems, the security of these devices is paramount. Poorly encrypted smart lighting systems can leak a network's administrative password, connected printers can be spied on to steal documents, and the processing power of any smart device can be hijacked to send spam emails or mine cryptocurrencies. Many IoT devices, especially inexpensive consumer, and smart home products, have been shipped without adequate security protocols. According to a study by IT specialists Zscaler, 91.5% of corporate IoT data transactions were unencrypted.[29]

According to a study by Zcaler, as much as 92% of IoT transactions are unencryted

The networking of different building systems means that they are only as secure as the weakest device on the network. An iBMS is networked with IoT sensors, data centres, remote access servers and utilities through open protocols, exposing them to greater security vulnerabilities. Hackers could exploit these for malicious purposes or even shut building systems down until a ransom is paid. Furthermore, there is no clear precedent for who is ultimately responsible for any security breaches arising from insecure technology. Landlords might even find themselves liable for damages if a tenant is hacked through their smart building systems.

Developers and landlords can, however, mitigate the risks of breaches through putting in place a number of security procedures. Default passwords, for instance, on any devices should be changed as soon as they are initialised. Risks assessments should be undertaken to determine the relative risk of the individual field bus networks running in an iBMS, and firewalls used to secure different parts of the network where appropriate. Physical access ports, such as USB and IP ports, that are not being used should be disabled to prevent the inadvertent loading of malicious software onto networked devices.

Ultimately, no system can ever be wholly secure. Building managers should aim to stay one step ahead of any potential hackers by putting robust security procedures in place and ensuring that all building systems use best-in-class security protocols. Device manufacturers are starting to offer financial rewards to people who can identify security flaws in their products. It is possible that building owners in the future may start doing the same.

With more connected devices installed in workplaces and greater dependencies between different building systems, the security of these devices is paramount.

7.3 Data Privacy

IoT devices allow the monitoring of all kinds of metrics relating to the performance of a building and of the people who use it. This data, however, presents building and business managers with both opportunities and challenges. Operational efficiencies and real improvements in business performance can be achieved through capturing building data, but this must be balanced with ensuring the privacy of building users. Smart technology has made it possible to track where people are in a building, who they talk to and how active they are. As more applications of IoT technologies are developed, new ways of tracking and measuring performance at an individual level will become possible. Yet just because new kinds of data can be captured, does not mean they should be. Not everything that can be measured is actually interesting or analytically useful. Firms need to identify what their objective is in capturing data from their workplaces, and communicate this clearly to their employees. Companies who fail to develop clear data policies that articulate why they are collecting certain types of information, and how they are using it, risk damaging their reputation and ability to attract the best people.

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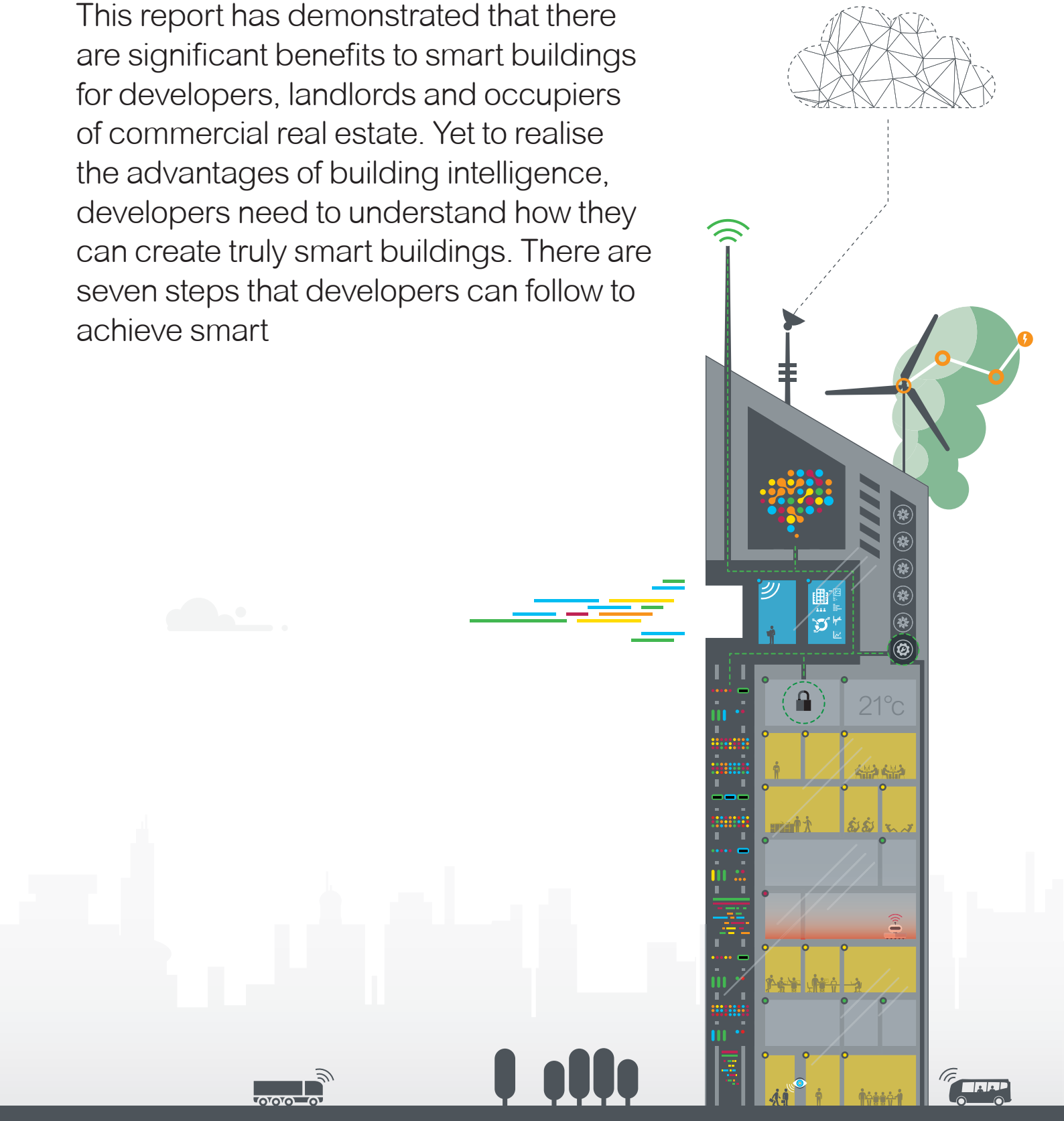
8. Conclusion: 7 Steps to Achieve Smart

This report has demonstrated that there are significant benefits to smart buildings for developers, landlords and occupiers of commercial real estate. Yet to realise the advantages of building intelligence, developers need to understand how they can create truly smart buildings. There are seven steps that developers can follow to achieve smart



Delivering a smart building – Seven Steps to Achieve Smart

1 **Choose smart from the start.** Choose smart from the start. Smart buildings with the best outcomes are born from conception. If you want to make your existing building smart, look to vendor partners who have open platforms and easy-to-install sensors to enable simple connectivity.

2 **Procure smart and challenge the status quo.** Identify experts that can help sell your concept to key stakeholders and work with your consultants to drive smart choices of technology, gain cost certainty and keep your chosen solutions on track.

3 **Don't forget the basics.** Power demand and supply, an iBMS and resilient building systems that interconnect can save time, manage risk, deliver cost efficiency and lifecycle value. The most commercially attractive buildings are those with built-in resiliency where systems are constantly open for updates and improvements

4 **Be as smart as your building needs to be.** Focus on the technologies and base-build inclusions that deliver maximised tangible benefits while still delivering the required concept of operation.

5 **Dealing with data.** Focus on the data that is needed for reporting – efficiency, business improvement and performance – and ensure that your technology partner or integrator is aligned to this.

6 **Don't rule out your lifecycle.** Understand the relationship between CapEx and OpEx choices. Smart base build decisions will open the door to smart facilities maintenance further down the line, pushing cost savings while driving ROI and system optimisation.

7 **Choose a strong smart partner.** Developers should seek to partner with global players that manage risk and reward equally and have well documented experience in smart infrastructure. Providers that forge leading alliances with other technology players and work regularly with the contractual chain in partnerships can be pivotal to a successful deployment.

About Unwork

UnWork is a management consultancy and research house focused on the new world of work.

It sits at the collision between people, place and technology and helps define the opportunities for innovation. It consults to companies in the process of change, helping to catalyse innovation and develop the ideas and concepts for the introduction of alternative ways of working, backed by robust data sets and an evidence-based approach that includes business case and cost-benefit analysis.

It has unsurpassed global knowledge of key trends and case studies of all the leading global workplace innovation projects and provides 'opportunities for innovation' consultancy with a focus on supporting culture change, diversity and talent attraction, digital workplace strategies and wellbeing. UnWork has a team of passionate and talented individuals with backgrounds in mathematics, economics, behavioural science, architecture, anthropology and organisational design; it provides a refreshing approach for those embracing the new world of work.

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