# The Guide to Smart Building Technologies

## Enhancing workplace experiences and efficiencies by transitioning to smart and intuitive buildings

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# Introduction

## Smart. Transformative. Intuitive.

We've often heard that smart buildings simply have a fourth utility, technology, in addition to the traditional water, gas, and power. But smart building technologies are more than just another utility. More than smart, they're transformative. In many ways, they allow buildings to become living organisms that are able to sense the world around them, make decisions that impact themselves and others, and interact with devices and humans in a variety of ways.

Smart buildings are also surprisingly intuitive. By using a variety of technologies to collect, aggregate, and analyze user data in real time, they provide insights and analytics that enable them to rapidly adapt to their users. A key result is better resource management and more sustainable outcomes, both physically and financially. But this intuitiveness can also enable buildings to create user-centric experiences to promote a trusted workplace environment that:

- Protects personal health
- Personalizes facility resources
- Offers unique opportunities for collaboration
- Enhances personal efficiencies
- Keeps users and their data secure

### How we got here

Typically, when people think of smart buildings, their thoughts drift to shrinking carbon footprints, lowering building and labor costs, and of course the biggie: dramatically reducing energy usage. These are all important. But recent events have shifted a key driver of smart buildings away from benefits to the building and back to where it should be—the building's users.

Challenges due to the world-wide pandemic has created a renewed interest in making smart buildings serve their users first. As public and private sector organizations seek to safely welcome users back into their buildings, they're seeking solutions that will proactively defend their occupants against current and future health concerns while still enabling new operational models, like hybrid work environments. But the rules for what makes a safe, efficient, and effective workspace have changed. Solving these challenges will require a new way of thinking in office and building management.

*"The rules for what makes a safe, efficient, and effective workspace have changed. Solving these challenges will require a new way of thinking in office and building management."*

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### Health and safety as a driver

Much of the renewed interest is being driven by the need to retrofit facilities with capabilities to sanitize and disinfect physical surfaces, air systems, and controls. Existing structures also need solutions that aid social distancing and contact tracing. There is also the need to ensure business continuity by providing safe physical and remote access to facilities. This is especially important for public sector or healthcare entities tasked with providing continuity of critical services for citizens. And across all industries, there is the need to provide immediate flexibility in workplace location and workspace configuration so that unexpected health events do not impact resiliency. This is already driving a rapid transition to hybrid work environments, giving workers freedom to work remotely or at their office as personal needs change. This transition was in play but accelerated significantly due to the pandemic.

### The need to control costs

The move to smart buildings is also being driven by rising energy and operational costs. As traditional utilities become more expensive or difficult to deliver (whether through scarcity, labor costs, or government mandates), there is the need to optimize resources to hold down costs. The same is true of staffing, which can quickly escalate to include training, benefits, and any associated work tools. These, along with the occasional government incentive program, have combined to drive sustainability as a cornerstone strategy for many organizations. Some have merged these issues into corporate responsibility programs and green certifications like Leadership in Energy and Environmental Design (LEED).

### Rising user expectations

Our increasingly digital world is also lifting expectations of facility users. As we've become more accustomed to using mobile technologies throughout our day, it just seems natural that they would follow us into the buildings where we work, learn, and live. As they do, we expect them to do so seamlessly and in a personalized way.

## Smart building top fives

**Top five reasons that now is the time to transition to smart and intuitive buildings:**

1. Improve workplace health and safety
2. Create smart, intuitive spaces to maximize space utilization
3. Reduce physical staffing and utility costs
4. Increase the sustainability of available resources and advance corporate responsibility
5. Prepare the groundwork for future smart devices and smart building use cases

**Top five risks of delaying your smart building initiative:**

1. Increase in health-related risks to employees and visitors
2. Lower employee morale due to perceived fears or rigid workplace scenarios
3. Inefficient use of facilities and resources, resulting in unnecessary costs
4. Increase in staffing and utility costs
5. Lack of integration with new and emerging technologies, resulting in larger long-term capital expenses

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## How do smart buildings really work?

When discussions turn to the inner workings of smart buildings, environmental controls that autoregulate building temperatures often steal the limelight. And they definitely play a key role, sensing vacancies and adjusting for better efficiency. But to operate at their highest efficiency, they need a little help in the form of a single management system that unifies a variety of smart building functions to simplify oversight and better coordinate response. This requires an intuitive and secure network powered by devices at the edge that can collect real-time data, enhance collaboration, and enable a wide variety of unique applications.

### It all starts with a network of "Things"

Smart buildings start with a central network connected to the Internet of Things (IoT). Think of IoT as the "edge" of your network. Often located in remote or hard-to-reach areas, IoT devices can be sensors that collect and transmit data securely back to the central network. They can be automated mechanisms for environmental control of lights, window blinds, and ventilation Or they can serve to enhance workplace productivity by connecting to and enhancing the flexibility of conference room equipment and workspace furniture. And they can be security-related devices, such as badge readers, remote cameras, and automatic door locks.

*"Devices blossom in purpose when they connect to the network wirelessly and share data."*

Even though they are smart and can perform many functions by themselves, these devices blossom in purpose when they connect to the network wirelessly and share data as they gather, aggregate, and analyze it. As part of a larger collective of "things," these devices work together to deliver smarter outcomes for users and building operators. But since they are connecting to your broader network, they must remain secure at all times. That's why smart building networks should enable pervasive connectivity for any networked end devices. Networks should also be built around a core that features automation, security, and ease of integration. And they should be mobile friendly, easily scalable, and provide some level of future-proofing.

### Real-time data analytics

The greatest value for most organizations that transition to smart building technologies is the capability to use all the data that previously sat unused. Real-time data gathering and analytics is the pivot upon which smart buildings constantly churn. And the product they churn out is extremely valuable in helping your smart building determine which course of action to take. In the past, data was compared to oil and the network to a pipeline. That is true to some extent. But due to the rapid evolution of edge computing (placing computing capabilities on edge devices themselves) and IoT, the distinction between well, pipeline, refinery, and gas station has blurred. And that's a good thing.

By moving the processing of data to the edge, we've been able to reduce latency (the speed of transmitting information) and speed decision making. This lets you take all the raw data collected throughout your building, via sensors and other devices, and quickly understand user behaviors, detect patterns, and even anticipate threats. The results are powerful: increased situational awareness, real-time decision making, and greater efficiencies.

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## Wireless communications and user interface

The universal nature of wireless communications has been critical to making buildings smarter. It's a well-understood technology that helps eliminate many fears while empowering real-time collaboration and information (or data) sharing. Plus, it's readily available and relatively inexpensive to implement. As wireless devices have evolved, there has also been a trend toward simple user interfaces that help break down complicated or information-heavy data. In combination, these have worked to accelerate the adoption of smart building technologies among users who otherwise might hesitate to do so.

Building operations like scheduling, mapping usage, running diagnostics, and submitting paperwork (or just retrieving associated physical tools and documents) can slow productivity dramatically. Real-time communications tools and streamlined user interfaces bypass all that, speeding collaboration and information sharing. They provide direct access to a building's operations and its multiple connected systems, increasing situational awareness in real time to deliver more accurate diagnoses, better service, and faster responses—all at less cost.

Smart building users and visitors gain similar value. Through mobile devices and innovative workplace solutions, they can gain instant access to real-time information and user-friendly apps for an enhanced user experience. And smart buildings can do so while embedding personalization based on an individual user's behavior, enhancing their experience even further.

From onboarding and secure access to wayfinding and safeguarding health, wireless technologies help create a trusted workplace environment. A key example of their value can be illustrated via the current pandemic. In a trusted workplace, an employee's personal mobile device can let them check in virtually when they enter their building. As they do, they receive instant real-time stats on social distancing, plus any alerts. When applicable, they are instantly notified that densities have been reached in their assigned workspace and then are quickly redirected to a safer location. And it all happens through the collective power of personal mobile devices.

*"By leveraging technology as a force multiplier, building operators can do an end run around budget and staffing constraints."*

## Security and safety

Creating a trusted workplace means making users feel safe. Fortunately, IoT devices are good at this. They excel in providing a sense of security to smart building users while also being functional. Reference to Cisco end point/Meraki MV cameras, sensors, badge readers, and other devices can all coordinate to provide more accurate and timely data for better decision making. They can also implement automated policies and controls to restrict access or provide a predetermined response based on user behaviors. By leveraging technology as a force multiplier, building operators can do an end run around budget and staffing constraints.

Smart buildings are best known for their promotion of security- and safety-related environmental controls and building automation systems. Depending on a facility's use, these could be deemed mission critical (e.g., healthcare, research, utilities). These systems can be enhanced to protect the health of users via apps for social distancing and contact tracing, and even for automated disinfection. More important, these solutions can be applied to existing buildings to mitigate various risks, including to health, while ensuring business continuity.

A smart building's network must also provide end-to-end threat-centric security, including for all connected end devices. Establishing a proactive defense that searches for threats or issues before they take hold prevents downtime and loss of services. Plus, it keeps facilities operating at peak efficiency. But more important, it keeps facility and user data secure.

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### 90W UPOE+

With 90W Universal Power over Ethernet Plus (UPOE+), available through solutions like Cisco Catalyst 9000 switches, smart buildings deliver DC power to devices over copper Ethernet cabling, eliminating the need for separate power supplies and outlets.

UPOE+ lets building operators gain unprecedented flexibility to design workspaces around users, not outlets. This can return a 30-percent reduction in electrical materials costs.

By using a DC microgrid with UPOE+, you can eliminate conversion losses from AC to DC, resulting in savings at every load. Smart buildings can often provide a 45-percent improvement in energy efficiency through the use of DC power.

## 3. Key ways that smart buildings add value

The transition to smart and intuitive buildings is an especially beneficial strategy for owners of existing properties. The ability to retrofit their facilities to offer healthy and flexible hybrid work adds immediate value to a property by creating a trusted workplace environment. Solutions like Cisco Spaces, Cisco devices, and Meraki MV cameras are a key part of this by providing insights into users' behaviors that help you create an experience centered on your occupants' well-being. While these and other solutions enable smart buildings to provide value in a variety of ways (see "Smart Building Use Cases," Page 11), there are three key ways they do so.

### Workplace health and safety (sense of well-being)

Smart buildings provide personal protection and peace of mind for their occupants by leveraging innovative technologies that monitor spaces, detect risks, and implement automated responses. But they also serve to protect physical assets and brand value, adding to users' sense of well-being about their environment. When properly designed, smart buildings promote workplace health and safety through various means, including:

- Location-based services and device-level tracking, via Wi-Fi and collaboration endpoints, for monitoring people movement, social distancing, and contact tracing, plus real-time alerts and notifications for violations and remediation suggestions
- Automated environmental monitoring and reporting of air quality, temperature, humidity, lumens and ambient sound which enhances health, safety, and quality of the workspace
- Instilling confidence in the cleanliness of facilities and assisting deep cleaning of spaces with intelligent building disinfection
- Enhancing fire, electrical, and mechanical emergency management/communications
- Monitoring of spaces, automated access controls and intruder detection, and correlation of incident video evidence

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### Smart, intuitive spaces and space utilization

Smart buildings add significant value by providing smart and flexible spaces that deliver better experiences for users, enable greater collaboration, and optimize a building's usage rates.

Smart, intuitive spaces provide:

- Attractive, flexible, and welcoming spaces that foster productivity and enhance the user experience
- The latest technology developments while securely supporting wired and wireless connectivity
- Increased usage per square foot by better understanding and influencing use patterns and optimizing space configuration based on user needs and behaviors, as well as on real-time usage reporting and analytics
- Self-optimization and automation based upon user needs and preferences, availability of resources, real-time energy costs, weather, and other variables

### Money savings and sustainability (corporate responsibility)

Smart buildings empower advanced monitoring of building performance and system utilization, quantitatively, to lower resource usage and costs, increase revenue, and align with the expectations of corporate programs and applicable regulatory and certification bodies (such as the U.S. Green Building Council LEED rating system). They accomplish this by:

- Reducing the up-front construction cost and time for cabling, installation, and configuration
- Lowering CapEx, labor, and materials costs related to construction, maintenance, and life cycle
- Using the building's network as a sensor for data-driven equipment optimization and quantification of energy consumption, thus reducing carbon footprints
- Enabling pervasive 90W UPOE+ throughout the building, with multiple families of switches
- Centralized and automated environmental controls (using artificial intelligence, software applications, and a single-pane-of-glass management system)
- Creating automated, personalized environments that attract tenants and increase revenue per square foot
- Improving environmental conditions and air quality, which enhances health, safety, and quality of life
- Being eligible for a variety of local, state, and federal tax incentives and program credits

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## Smart building use cases

**Building foundation and compliance**

- Power savings and compatibility (fourth utility)
- Regulatory measurement and validation

**Safety and security**

- People safety and security
- Cybersecurity
- Workplace health and safety

**Automation and optimization**

- Environmental monitoring, control, and optimization
- Asset management

**User experience**

- Smart, intuitive spaces
- Pervasive and secure connectivity
- Space utilization

To take a deeper dive into smart building use cases and architectures, visit cs.co/buildingexplorer

## Solutions that power smarter and more intuitive buildings

### Networking

- Cisco Catalyst 9000 switches, access points, and wireless controllers provide the most mission-critical component of the network.
- Cisco SD-Access Grow your network to include OT and IT, while improving security, efficiency, performance and reliability so your building can learn and adapt to support an always-on, trusted workplace.
- Cisco Spaces empowers location analytics to gain more insights into the behavior of people and things and how they interact in your physical spaces.
- Network Assurance Engine lets operators increase agility, predict outages, and assure security policy compliance proactively.

### Internet of Things

- Cisco IoT solutions help you bridge the possible.
- Cisco edge compute lets you deploy low-latency edge services on a trusted infrastructure and provide high-quality business user experiences.
- Cisco IBN bridges the gap between what your smart building operations need and what your network delivers.
- Cisco 90W UPOE+ enables next-generation flexible workspaces.

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- Meraki MV cameras and MK sensors provides valuable environmental data-driven insights.

### Security

- The Cisco Umbrella Cloud platform delivers security to defend against cyber threats and protect all your users.
- Advanced Malware Protection (AMP) protects with advanced breach prevention, continuous monitoring of malicious behavior, rapid malware detection, and malware removal.
- Identity Services Engine (ISE) enables a dynamic and automated approach for highly secure network access control.
- Cisco Secure Network Analytics (formerly the Stealthwatch solution) lets you know who is on the network and what they are doing.
- ThousandEyes offers end to end monitoring for visibility of performance, metrics, flows, and troubleshooting.

### Collaboration

- Cisco Devices portfolio help transform hybrid work collaborations with smart room and desk booking, touchless voice assistants, digital signage, wayfinding, and workplace analytics from built-in IoT sensors.
- Unified Communications Manager (UCM) brings people together anytime, anywhere, on any device, with reliable, secure, scalable, and manageable call control and session management.

## Summary

Smart buildings are becoming a transformative force in our society. Through a variety of technologies that revolve around networking, real-time data analytics, wireless communications, and advanced physical security and cybersecurity, they're realigning workplace and user experiences to create trusted workplace environments. This has been accelerated due to the need to create smart and intuitive buildings that provide a sense of health and well-being for users while maximizing space utilization around social distancing and other mandates. In addition, the desire to increase resilience to ensure business continuity, especially for critical government services, is powering a move to smart and intuitive buildings.

By leveraging innovative network and wireless technologies, architects, developers, and operators can add value to planned or existing structures. Through design with technology, they can build trusted workplaces featuring improved health and safety, smarter and more intuitive spaces, and reduced costs and resource usage, all while increasing sustainability. And together with their technology partners, they can help shape the next generation of smart and intuitive buildings.

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## About the Authors

Now that you've read the Guide to Smart Building Technologies, take the next step to enhancing workplace experiences and efficiencies in your facilities. Explore your path to smart and intuitive buildings at cisco.com/go/smartbuilding.

**Kenneth R. Dodson, RLA and SME**

As a Registered Landscape Architect (RLA), Kenneth was trained to "design with nature" while attending the class of noted urban planner Ian McHarg, father of modern geographic information systems (GISs). As a Subject Matter Expert (SME) and blogger at Cisco, Kenneth now urges architects and civil engineers to "design with technology" to enhance user experiences, strengthen the sense of community, and empower better stewardship over our world's limited resources. You can follow him on Twitter (@KennethRDodson) and LinkedIn (Kenneth R. Dodson). Explore his blogs on the future of cities at https://blogs.cisco.com/author/kenndodson.

**Brad Kincaid, SME for enterprise networking and wireless (smart buildings)**

Brad is an experienced technologist and sales leader with a passion for networking technologies. Currently, he leads the Americas sales for Cisco's industry-leading Catalyst switching, wireless, and intent-based networking solutions. Prior to this role, Brad held various worldwide and regional sales roles at Cisco and Motorola, and was a senior executive for a startup. As a native Oregonian, Brad proudly holds a BS in computer science from Oregon State University and an MBA from the University of Oregon. He enjoys playing in the outdoors all year round. Brad lives in Portland, Oregon, with his wife, daughter, and son.

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