

Let's understand building automation and controls





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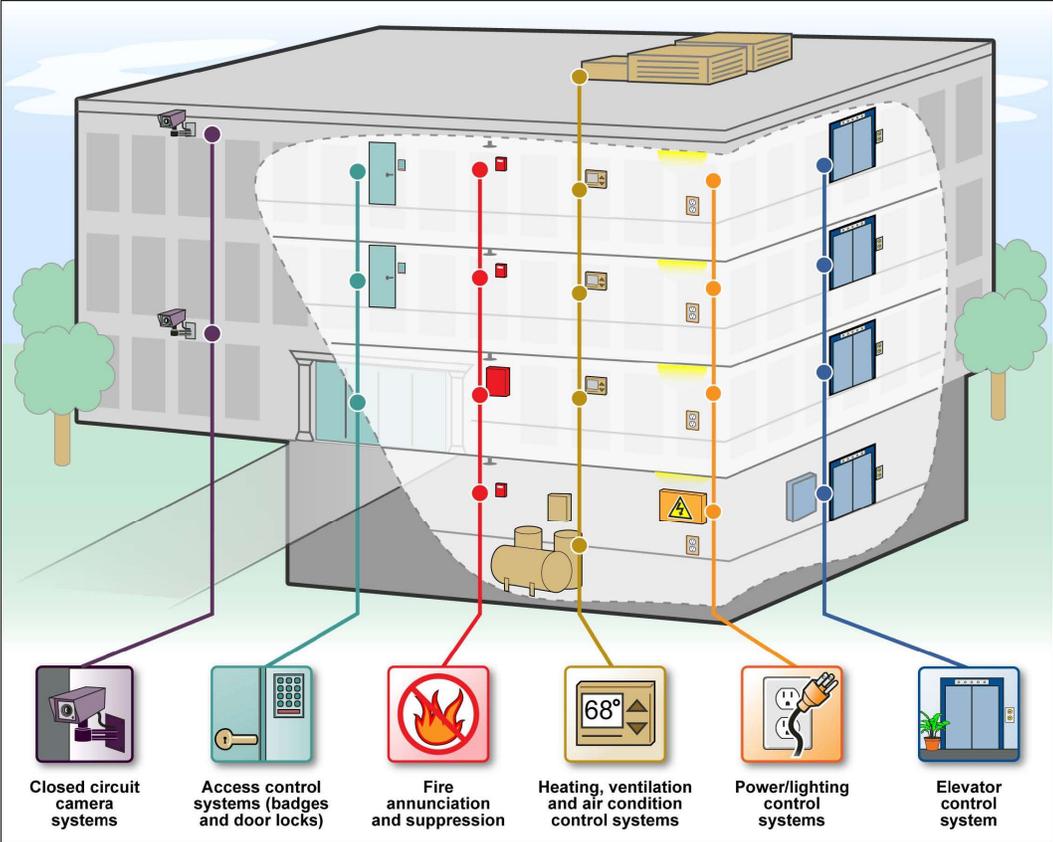
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Building automation and controls

A Building automation system provides automatic centralized control of a building's heating, ventilation and air conditioning, lighting, safety, security and other systems. Or in other words, it allows an operator to monitor, adjust and report on the status of a control system. Building Management Systems (BMS) and Building Automation Systems (BAS) are essentially the same and used interchangeably. Both BMS and BAS refer to a computer-based system that consists of software and hardware.

Further, buildings use different types of controls in buildings such as pneumatic, electromechanical control and digital controls. Simply put, building equipment is integrated with microprocessors that communicate with each other and possibly to a BAS server. The server and controllers in the building automation system can be networked to the internet or serve as a stand-alone system. Thus, the BAS helps monitor and manage a building through the controls.



Source: GAO. | GAO-15-6

BAS is most commonly used in commercial HVAC control systems and energy management system applications. Typically, such control systems are installed in new buildings or as part of a renovation where they replace an outdated control system. BAS could also be linked to access control and security system, fire alarm system, elevators and plumbing systems as well. With advancement in technology and internet of things, the controls have become more sophisticated. These advancements are paving the way for complete building automation in the future.

For example, the Edge building in Amsterdam, one of the smartest buildings today, connects to occupants via their smartphones to provide a host of innovative solutions. It recognizes each employee's car as they arrive and directs it to a parking spot. It suggests desk options, customizes temperature and lighting levels once an employee chooses a spot to work. (Bloomberg, 2015)

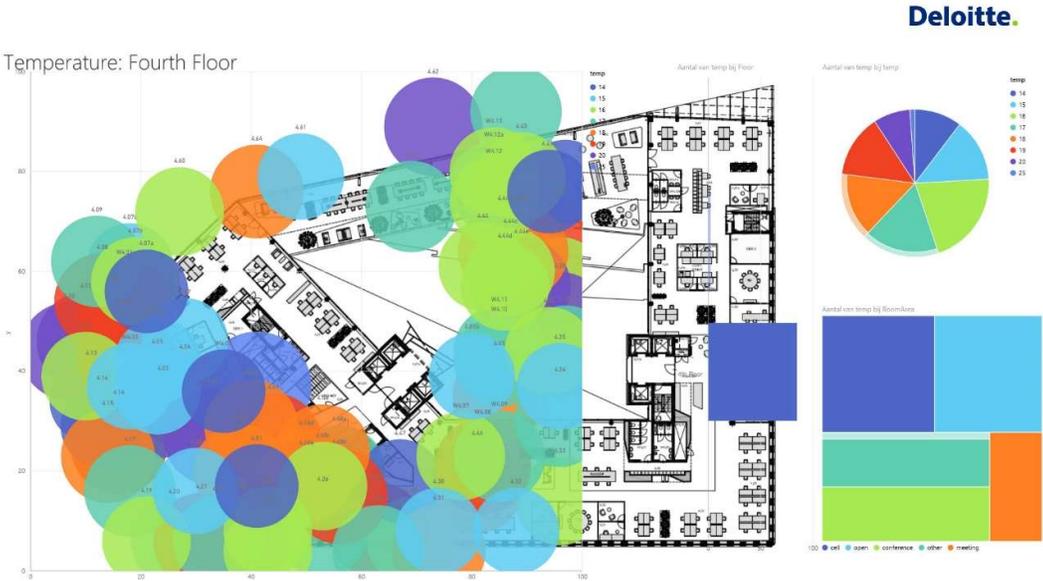


Figure 1 Sensors map the temperature zones on the fourth floor of the Edge, Amsterdam.

These are just of some of the ways in which building integrated technology is striving to maximize resource efficiency, reduce energy costs, and provide an improved and more comfortable environment for building occupants. Those who work in building automation hope to achieve comprehensive autonomous control of buildings and systems in the future.

While there is still much work to be done before we reach that goal, the continued advances and technological breakthroughs are bringing us closer to this possibility every day. Automation in buildings has an interesting history and even more interesting future. Let's first delve into the history of automation to better understand how we got where we are now.

A brief history of automation

Although humans have been creating buildings for several millennia, the history of building automation as we know it is relatively short, going back to the 19th century. Many consider the thermostat to be the first advancement in building automation. Created by Warren Johnson in 1883, the first thermostat kept track of building temperatures and activated a light in the boiler room when it dropped to a certain temperature. This would notify the janitor who would then shovel coal into the furnace to bring the internal temperature up.

While this is not quite as "automatic" as we expect our controls to be today, it set the stage for new ideas and the development of more innovative technology.

Building automation continued to improve over the next few years, with control systems being produced for different building services like ventilation, heating, and air conditioning. For the most part, these systems would operate steam and hot water to control temperatures. Though at this stage, automation was predominant in commercial buildings, the framework was laid out for residential use as well. For most of the 1900s, controls such as thermostats and valves were pneumatic.

However, in the 1980s, the introduction of digital computers to building automation systems began to change this. Once the central computer became incorporated into building controls, individual devices in a building were able to communicate with a central server. This ensured that all parts of the building were running on the same schedule. This efficiency improved further in 1995, when central controls gained the ability to communicate through the internet. That was the precursor to cloud-based automation servers that are widely used in buildings across the world today.

Building automation in modern times

Today, many residential and commercial buildings are fully on board with the automation trend. While older concepts such as thermostats and valves are still widely used, the technology surrounding them has improved greatly over the years, and we are rapidly seeing new innovations emerge. While many buildings still use a physical central computer server, the past decade have seen a shift to cloud computing. This means that building managers no longer access building automation systems (BAS) from a physical location within the building. Instead, data is transmitted through the internet and so, automation processes are operated remotely.

Cloud-based automation servers have many advantages. In addition to facilitating remote access to building controls, cloud-based servers are also very beneficial in gathering useful data, reporting and evaluations. Facility managers can even analyse data from a group of buildings and determine which building is operated more efficiently.

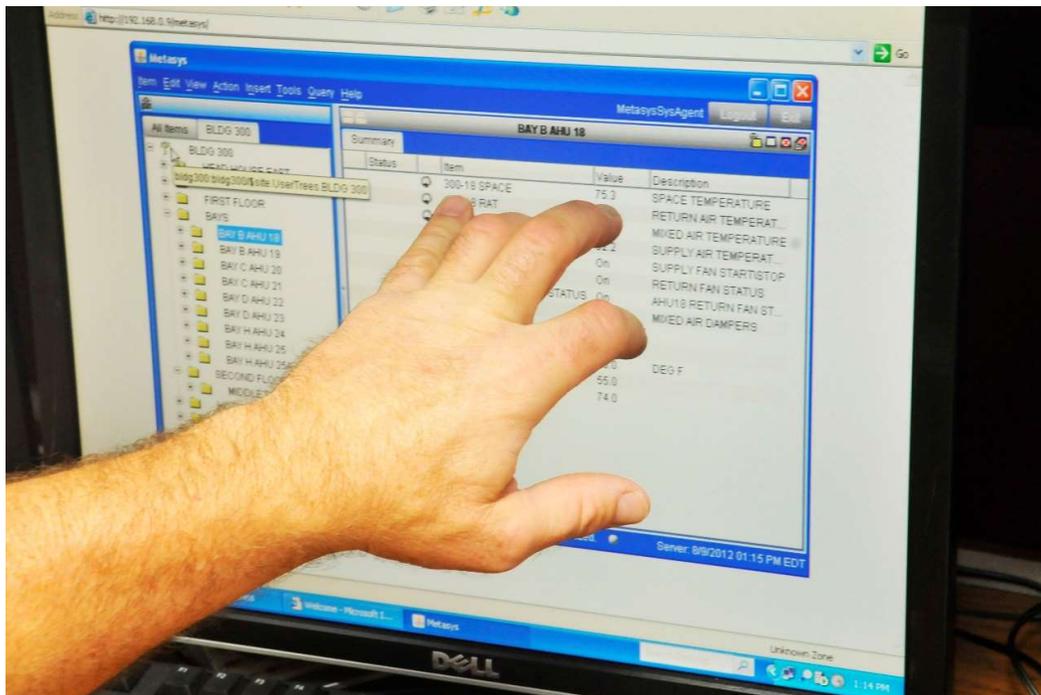


Figure 2: Facility managers can easily share data with each other

They can use this knowledge to implement better practices in their other facilities. When managers can exchange data with each other, it can lead to improving the effectiveness of automation systems across the board. This data can also be harnessed in the creation of new algorithms that are designed to optimize output.

One of the main reasons for the proliferation of automation in both residential and commercial building is advancement in technology. Smart homes are no longer a futuristic concept, instead they have become somewhat of a regular occurrence in today's world.

People can control everything from their lights to their security systems, all with the help of easy-to-use apps and cloud-based computing. Today, if you want to ensure that the lights in your living room turn on at sundown, it can be automated very easily and at a low cost too. In fact, it may even save on energy costs in the long run.



Then, some other applications allow people to automatically unlock their doors when they arrive within a certain radius, meaning that there is no more fumbling around for keys, or even a need to worry about what will happen if you lock yourself out. Individuals can be notified if a security point has been breached, so they can call local authorities to check on their home even if they are vacationing halfway across the world. This integration between hardware and the Internet of Things (IoT) have transformed many houses into veritable technology beacons, making life far more convenient than it ever was.

Indoor environmental quality controls are no longer limited to monitor temperatures. Sensors can monitor several parameters like levels of humidity, carbon dioxide level in the air, particulate matter, and barometric pressure. These automatically alert building managers to take corrective measures if they get out of hand. Such impressive controls are not limited to residential households. Large buildings and groups of buildings are taking advantage of the newest in automation technology to create for an efficient and comfortable working atmosphere and take advantage of energy efficiency. Automation in commercial buildings used to be reserved for service systems such as elevators, escalators, and access control, but it is now virtually inclusive of every aspect related to building operations.



Figure 3: Smart Lock (Image source: <https://www.flickr.com/photos/156229839@N02/>)

Modern state-of-the-art controls allow us to stay on top of every aspect of the building's health without having to tune into the processes every time.

By tying all processes to a smart system, buildings can always operate at maximum efficiency. This allows building owners to save money on energy and reduce the need for extra security.

The most advanced buildings of today take a truly holistic approach when it comes to integrating their systems – things like HVAC, security, lighting, IT, and even communication systems are meant to work together for the advancement of the building. This also contributes to sustainability, which will be touched on a little later.



Smart buildings continue to impress people with their innovative technologies, and there is no doubt that the buildings of today are more efficient and far more comfortable than they were in the past. Much of this can be attributed to a focus on automated systems and advanced building controls.

These controls are no longer only about maintaining a certain temperature – the goal is now to build a fully autonomous facility that knows exactly when and how to carry out its vital processes.

The Future of Building Automation

With so many impressive ways to currently automate a building, it may seem like we are already living in the future. However, there is no reason to believe that automation inventors and developers are closing in on the finish line. For every new technology that comes out, dozens more are still being worked on. Some conceptual projects may seem like fantastical pipe dreams, but the same was being said, only a decade back, about certain well-established smart home devices.

Before looking too far into the future, we must acknowledge that a large part of the existing building stock continues to run on seemingly primitive systems. Whether due to aging infrastructure or an unwillingness to adapt to the newest trends, many facility managers still prefer basic, older technology. This is basically out of their personal choice, but it seems that these outdated systems will soon fade into relative obscurity in the coming time. What this means is that cloud-based automation systems will soon be considered the norm rather than an impressive exception. These controls will become part of our everyday life, and we will soon look at them as standard, just like how we see smartphones today.

The future of automation and control is increasing centralization and integration of different services. The Internet of Things IoT will soon enable devices and equipment to connect to each other or to a network. For example, cars could detect when their tyres are due for repairs or replacements and notify the nearest garage. Refrigerators that automatically send out grocery orders are already available to consumers. These technologies will providing more opportunities to integrate automation into our built environments and help create smart environments.

We are also likely to see the wireless trend continue, with more and more devices becoming increasingly portable and giving way to wireless functionality. Electricity, will, of course, always require wiring, but that doesn't mean that certain automated processes can't be done wirelessly. It's already common for cell phones to be connected to smart homes, and these wireless devices will be more relevant in automation as time goes on.

This leads us to the next advances – automation apps. Today, apps can be used to turn on the lights in a building or to regulate the internal temperature and humidity levels of an entire commercial facility. Many automation apps are still in the early stages, but they've improved greatly over just a few short years.

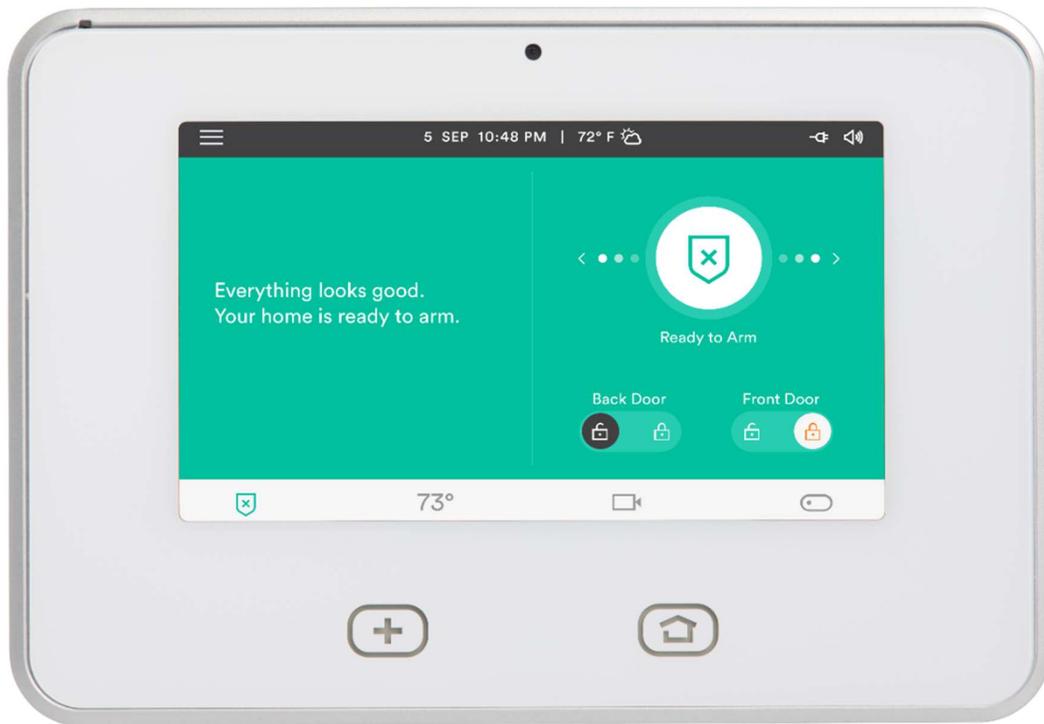


Figure 4: A touchscreen home automation hub, Skycontrol by Vivint.

Automation in Smart Cities

It's no surprise that automation is set to play a major role in creation of smart cities and smart neighborhoods. Simply having a smart home is one way to get the ball rolling on this, but cities and neighborhoods are also putting together initiatives to make their

communities smarter and more efficient using technology and autonomous buildings. Some developers have integrated smart technology in houses right from at the beginning, meaning that new homeowners will benefit from IoT programs such as automatic locks and voice-activated appliances. The rise of such communities sets the stage for entire cities to adopt IoT solutions. As the popularity of smart homes spreads, these communities may be more profitable and ultimately more liveable than their traditional counterparts.



Keeping this in mind, automation can also be utilized to help improve infrastructure and decrease traffic congestion in these cities. When roads are designed accounting for the potential future use of self-driving cars, it further promotes making autonomous vehicles more of a reality.

Traffic sensors can provide real-time data about both automobile and pedestrian congestion, helping cars avoid busy intersections and thus reduce chances of accident. It will also help people to plan their road travel more efficiently and save on time.



Figure 5: Wattway installed at West Point, Georgia

Smart systems can even optimize water consumption in landscapes. For example, the WaterBee project underway in fourteen European countries, incorporates networked sensors that can be centrally monitored and administered, letting water managers and farmers optimize their water use, right from their smartphone.

The system gives growers more control over their irrigation by delivering accurate data on field and crop conditions, thereby lowering their costs and raising their yields. (Derek Markham, 2013).

An improved infrastructure and increased energy efficiency will allow citizens to benefit from lower energy bills while enjoying greater convenience of their smart homes.

Sustainability

As automated processes often lead to higher levels of energy efficiency, it follows that automation is a major boon for sustainability. Because these processes focus on carrying out tasks with the minimal amount of work, they help conserve energy and contribute to a green environment. To better understand this, consider this- simply using the Building Automation System to control the light levels in the building by harvesting daylight can help achieve significant energy conservation. This minimizes the chance of human negligence such as forgetting to turn the lights off because this task will already be programmed. As more and more buildings become automated and as cities push forward with automation initiatives, loads of energy will be saved across the board simply by bypassing the possibility of human error or forgetfulness.

Newer technologies that utilize automation are ahead of the curve when it comes to using green energy, so by that factor alone, they are contributing to sustainability. Consider developers who are prioritizing solar panels and other forms of renewable energy.

Overall, it seems that automation is highly beneficial to the environment and is an overall sustainable process. Whether it is a single-family home or an entire city block of commercial enterprises, automation is key to creating healthy built environments in the future.

The beauty of building automation is that it makes things more convenient for us while allowing our environment to benefit from safer, greener practices. When other processes are automated and don't require our full attention, it also allows us to direct greater efforts to preserving the environment around us.

Although there is electricity that is required to run some of these processes, the algorithms inherent in them help ensure that it is used as efficiently as possible and that it is being constantly monitored.

Challenges

While projects are increasingly opting for advanced building automation and controls, there lies a challenge in bridging the gap between the BAS capabilities and how well equipped facility managers are to execute these. It is important that facility managers and supporting staff are adequately trained to make the most of an integrated BAS.

Another challenge is the rebound effect. Sometimes, an energy efficient equipment could end up being used for longer hours just because it is efficient. For example, if highly efficient LED lights are not switched off during unoccupied hours in a building, will lead to energy wastage even though the overall energy consumed would be lower compared to conventional light sources.

Summary

Building automation and control systems are helping built environments become more efficient, comfortable as well as sustainable. They can be integrated at different scales of a building, from commercial buildings, to residences and neighborhoods. As technology becomes more advanced, its important that its users receive adequate training and education on operating these systems to reap maximum benefits.

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