Defining a Smart Building: Part Five

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Numerous research companies and organizations are predicting significant growth in the smart building market. One company, Markets and Markets, expects the global marketplace to grow at a stunning compounded annual rate of 35% over the next five years. While it's difficult to compare market research because there are various definitions of what sub-markets (smart homes, smart grid, etc.) make up the larger smart building market, most research of the smart building area indicates substantial growth worldwide. Given the general economic outlook for the global economy is relatively flat or for modest growth it's impressive that smart buildings are such a rapidly growing segment, but this is by no means a surprise.

There are several factors creating demand for smart buildings. One of the most potent are the results from building owners that have already deployed smart building technology. These building owners have found reductions in energy consumption, enhancements to operations and a very attractive return on investment. Such examples and stories validate the approach, verify the likely results and reduce the risk for other building owners to plan to deploy the technologies. Another element driving the market for smart buildings is our global society's habituation to real-time information and communications technology; people not only accept cutting-edge technology as an integral part of our buildings but expect that their buildings will be smart.

An additional factor is that while the marketplace is expansive and rapidly evolving, there are elements that comprise a smart building. These include system integration, advanced building management tools, extensive automation and sensors, energy management, enterprise data management, data analytics, software applications and the leveraging and incorporation of IT. It is this type of emerging clarity that can guide designers, contractors and manufacturers, as we complete the definition of a smart building by addressing HVAC, communication and data infrastructure, access control systems, advanced building management systems and sustainability.

Advanced Building Management System

The driver in advanced building management systems is the increasing complexity of buildings. From an equipment or hardware perspective we now have buildings with energy and sustainability systems which are relatively new for buildings, systems that even five years ago were not commonplace. These include systems such as rain water harvesting, exterior shading, water reclamation, renewable energy, electric switchable glass, sun tracking systems, etc. Maintaining and optimizing each of these new systems is a challenge, further burdening and increasing challenging for facility management. The other aspect of increased complexity is related to management decisions regarding building operations. Many of these decisions now involve several variables, with some situations requiring real time decisions, for example a demand response event from a utility requiring immediate action.

The shortcomings of the typical legacy BMS is quite a long list, including limited integration capabilities, inadequate and elementary analytic tools, proprietary programming languages, a dearth of software applications and legacy user interfaces.

A smart building will have an advanced building management system with an open programming language where all integration is accomplished via software. It requires middleware to normalize and standardize all data from sub-systems into an open, standardized database using SOAP/XML or other computer software exchange architecture. The database would include all physical, virtual and calculated points. The user interface to the advanced systems are displays and dashboards completely configurable and customizable by users, with access via a browser. The system would be capable of data exchange with information in enterprise and business level software, providing a suite of software applications such as energy management, building performance analytics, alarm management, and automatic fault detection and diagnosis.

Communication and Data Infrastructure

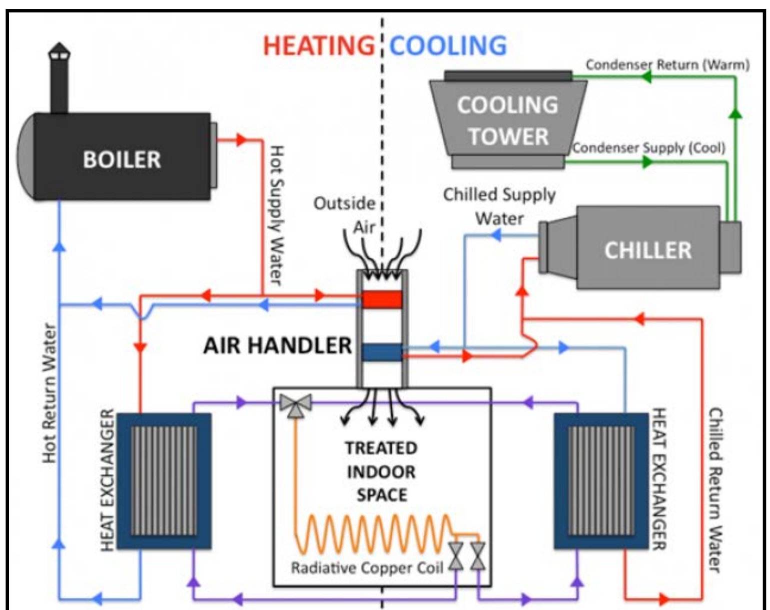
The method of communication and data exchange within and between building systems is vital. It is a foundation that will determine the difficulty or ease of integrating system functionality and data. Smart buildings shun proprietary protocols in favor of standard open communications protocols based on the ASHRAE BACnet I/P, OPC DA, Modbus TCP, oBIX, XML, SOAP and SNMP standards of data exchange or similar open standard protocols. Many building products now incorporate open protocols, some going through a process that verifies or certifies their adherence to the protocol standard.

The network architecture of building systems should take into account the minimum speeds for serial buses, maximum size in points and devices per serial bus, maximum number of serial buses per network controller, and the use of native open protocol controllers versus gateways in existing buildings.

The adherence to standard open protocols and detailed network design extends to not only building control systems but also to facility management systems, business systems and IT systems in the use of standard database structures such as SQL or ODBC, Oracle or DB2.

HVAC

In many ways, HVAC equipment is the most complicated building system, with numerous components arranged to produce heating, cooling and ventilation through the principals of thermodynamics, fluid mechanics and heat transfer.



The HVAC system not only makes the building comfortable and healthy for its occupants, it manages a substantial portion of the energy consumed, as well as plays a critical role in life safety. In maintaining the building's air quality the HVAC system must respond to a variety of conditions inside and outside the building (including weather, time of day, different types of spaces within a building and building occupancy) and do so while optimizing its operation and the related energy usage. Given the variety of conditions and the potential complexity of a substantial HVAC system this necessitates extensive automation and system integration. For example, in a smart building we expect the HVAC system to automatically sequence chillers, pumps, and boilers, as well as automatically rotate parallel chillers, pumps, and boilers by accumulated run-time. The HVAC system should also perform an optimal start calculation based upon real occupancy history instead of estimated start times.

Control of the HVAC system for occasional use facilities such as meeting rooms, conference rooms, cafeterias, etc. is also important in reducing unnecessary energy consumption. HVAC for those spaces needs to be integrated into another system which can supply data to the HVAC system regarding use or occupancy. These include data from access control system, video surveillance, a people counter system, lighting control, a RTLS/RFID system or more likely, occupancy sensors.

The HVAC system also plays a substantial role in a demand response events as well as demand limiting. Data from the utility or a power management system communicated to a BMS and chiller controls can be used to adjust the electric demand of the HVAC system to an acceptable level.

Access Control System

Access control systems are a critical component in smart buildings as security has become more important. The access control system is also essential for life safety and is interfaced to the fire alarm system to facilitate building egress during life safety evacuations. Access control systems must interface or integrate with several other smart building systems (video surveillance, HVAC, and others) as well as share data with business systems, such as human resources, and time and attendance.

In a smart building, a one electronic access control system for non-public areas should be deployed. Within secured areas the access control system would provide two levels of authentication. The system should support offline operation to allow doors to function if network connectivity is lost. The access control system should be supplemented by an intrusion detection system at potential unauthorized entrances, such as windows. While access cards are generally used in many systems, biometric authentication may be utilized for an additional degree of security.

The access control system should be configured to maximize security. For example its use vertical transport systems (elevators) can provide selective access to floors based on occupant identity, as well as spaces such as parking and garages.

Security levels would be determined by individual, floor, or areas, and access privileges can be changed in response to building occupancy states (i.e. time of day). An access control system can also generate anonymous occupancy statistics for building spaces and zones. Such data can be used to correlate occupancy to other building system such as energy consumption or lighting schedule.

Sustainability and Innovation

Green buildings and smart buildings have different focuses but they also overlap. A primary component of a smart building is energy efficiency and sustainability, acknowledged by an industry certification such as LEED, and a clear policy and plan for energy management by the building owner. This plan may involve delegation of responsibility for energy consumption, as well as tracking, monitoring, and reporting systems for energy consumption. In addition building owners would participate in demand response and automated load shedding in cooperation with the utility company

Innovation is integral to a smart building. Innovation by the building owner, designer, contractor or manufacturer that can demonstrate benefits, value and exceptional performance should be recognized and incorporated into the methods or criteria for deploying a smart building.

The series of defining a smart building has touched on seventeen attributes, with the intent of providing details and a common perspective or framework of a smart building. Over time we would expect additional attributes, features and continual innovation of smart buildings. With the worldwide demand for smart buildings expanding at a sizeable pace, the framework and definition can potentially guide the growth and deliver results.

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