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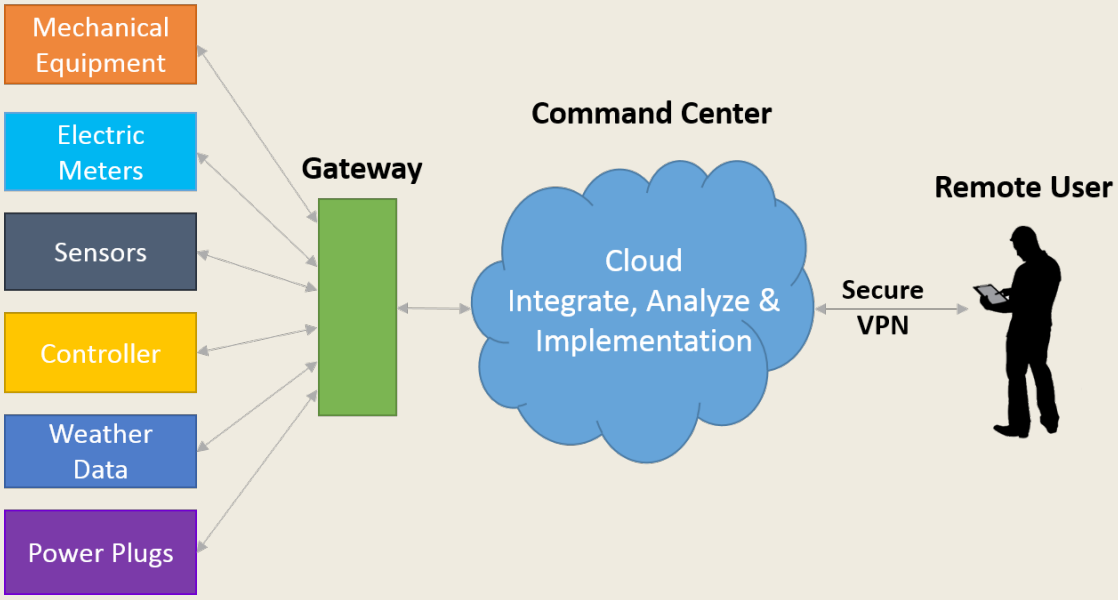
Connected for Life, Connected for Building Life

How the Internet of Things is Shifting AEC Culture

By Sandeep Kulkarni



In our 21st century, technology-driven environment, the status quo is simply no longer a viable solution for the AEC world. Industry professionals today have to embrace emerging design breakthroughs to fabricate a more capable built environment. Today, we must become the masters of effecting radical change by making use of high-tech project solutions.

Thinking outside the box—tag, you're it!

About 17 years ago, a young assistant brand manager in the cosmetics industry saw a need to make the world a little better, a little more efficient. In his day-to-day work, Kevin Ashton encountered a variety of inefficient processes, which he felt cost his company valuable resources. Compelled to find a technological solution to these problems, his research efforts led him to another trade's technology, which he believed could be modified to solve his employer's dilemma. Ashton's use of radio frequency identification (RFID) technology paved the way to revolutionize how people and devices remotely interface with physical objects on an entirely new level—through the Internet.

Repurposing RFID technology was Ashton's ticket to becoming a pioneering innovator and consumer sensor expert. In 1999, Ashton coined the now popular idiom, "The Internet of Things," (commonly referred to as IoT), which involves embedding actuators and sensors into physical objects to facilitate wireless communications between people and devices.

The IoT movement is shifting AEC paradigms in ways that affect everything from design and fabrication, to construction and facility management. This intelligent

tagging system has already had a major impact on residential construction processes via smart home automation. It is now also rapidly transforming commercial and industrial sectors.

IoT technology—BIG results come in small packaging

Small RFID chips, which are roughly the size of a grain of rice, are embedded within equipment and building materials to provide a unique digital representation of each "tagged" object. Each tagged object syncs to a cloud-based interface, where all sensors and devices are linked together under one common Internet Protocol (IP) platform. This unified "command center" allows the synced devices to digitally communicate with each other and interchange information via analytical software.

This diagnostic system measures and compares datasets from all synced objects within a building to information communicated by third-party sources by means of the Internet. The end-result is an instantaneous assessment, or "building health check," providing details on how building performance can be optimized.

Objects synced to the cloud-based network can then immediately and autonomously adjust themselves to accommodate for findings provided by the predictive analytics software. You don't have to lift a finger, because these synced objects do all of the work for you by using the cloud network. The accumulated information remains stored on the cloud to provide users with comprehensive datasets for future assessment.

How IoT methodology translates to the AEC world

Building information modeling (BIM) is widely used to design and construct facilities. IoT technology builds upon BIM technology by adding an extra element—the Internet—as a means to streamline processes to make smart building design even smarter. Lachmi Khemlani, an architect who specializes in intelligent building modeling and the founder and editor of AECbytes, speaks eloquently on the subject of IoT in her article, The "Internet of Things" in AEC. Khemlani states, "If buildings in the IoT era will be designed differently, it seems logical to conclude that the software applications used for designing them will also change." Khemlani points out that current BIM processes will have to adapt to accommodate for smart building elements' newfound "self-awareness," per se. RFID-tagged objects that are synced to a cloud-based network are able to talk with each other, so BIM systems will also need to be able to simulate these relationships digitally.

Khemlani illustrates this concept with the following example: "If a smart beam and a smart column 'know' that they have to fit together in a certain way when they are being constructed, the design tool has to take that into account and make sure they come together in the same way in the BIM model."

The IoT system is versatile and can be applied to many AEC trades, including construction. Robert Lutz with Systech Corporation provides five examples of IoT's transformative potential within the construction industry:

- **Equipment Monitoring and Repair**
  According to AEC Big Data, equipment repairs represent the third largest operating cost in the construction industry. With the advanced sensors available today, machinery can self-detect the imminent need for a repair before it becomes a problem.
- **Management and Ordering**
  Downtime caused by lack of supplies or personnel on site is another major drain on construction companies. With the IoT, systems will alert site managers when resources are getting low and reinforcements are needed.
- **Energy Conservation**
  A system that can monitor the lighting on a site eliminates wasted energy costs that construction companies often incur. For indoor construction, temperature monitoring can also conserve energy.

- **Tagging and Tracking**
  Advanced tagging and tracking technology can vastly reduce the costs incurred by businesses for lost or misrouted materials.
- **Safety**
  This one is pretty simple—if machines are capable of doing the most dangerous jobs on a construction site, people won't get hurt doing them. Making a job site safer has a wide-reaching impact, potentially reducing costs for insurance and training—and most importantly, lives.

BIoT: A step in the direction of *BUILDING* progress

The fundamental premise of IoT revolves around making individual technologies smarter so that they pair seamlessly with other systems. In a CommScope blog post titled, How Internet of Things Can Transform Building Management, UK Sales Director Bryn Jones sheds some light on how the IoT concept and intelligent building design work hand-in-hand. He says "IoT is about two emerging trends brought together to work in combination. The first is a shift in Internet technologies embracing objects and embedded technologies. The second is the development of cloud data repositories and analytics specifically designed to work with data produced by 'things.'"

The cloud component of IoT is what really makes intelligent building design truly intelligent. It allows for massive amounts of information to be continually collected, stored and cross-referenced against other building data, or even outside data provided by third-party Internet sources. Information provided by online hubs (such as weather and energy networks and utility pricing indexes) can feed into the cloud's predictive analytics system for comparison against a building's existing operational processes. Smart buildings can use these analytics to make real-time operational adjustments. In short, integrating the IoT model into smart building design will result in more sophisticated building systems that are easier—and less expensive—to operate and maintain.

Commercial and industrial enterprises have been using web-enabled technology, sensors and integrated solutions for over 30 years; but we are just now starting to tap into the sky-high potential of this Internet-based, global network infrastructure. Today's building design professionals are now infusing their future artistic goals with the "Building Internet of Things" concept, or BIoT, the AEC industry's spinoff of IoT.

Adding buildings to the IoT discussion is naturally the next step for intelligent building design. Smart buildings help improve operational efficiencies and minimize energy consumption, and can positively impact the human experience in terms of convenience and safety. Building components, when connected to the Internet, are able to conserve valuable operational resources and optimize financial investments. An article published by AutomatedBuildings.com cites that the BIoT concept is well on its way to transforming the design of commercial, corporate, government and institutional real estate buildings across the globe.

The perfect host for IoT's neural network—Building Automation Systems

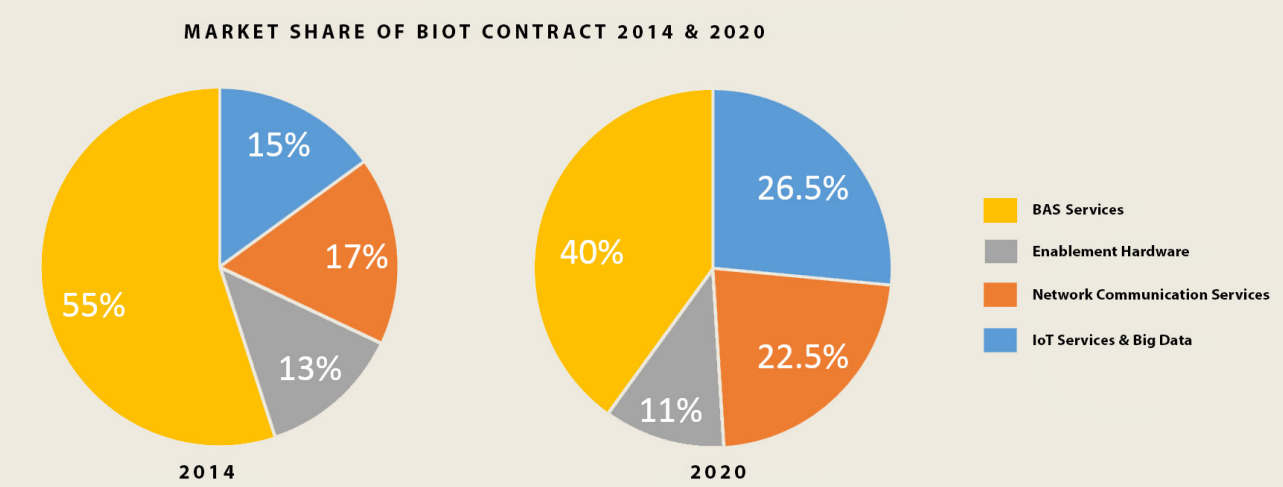
Assimilating the concept of IoT into facility management plans, like building automation systems (BAS), can integrate stand-alone systems in ways that enhance structures and benefit occupants. Traditionally, equipment that controls building functions, such as HVAC, refrigeration, lighting and security systems, has operated on a standalone basis. Nowadays, this form of segregation is disappearing as designers create more unified building schemes. Integrators and resellers focused on building automation are now looking to tighten and refine their customers' systems.

Residential, commercial and industrial sectors have invested heavily in BAS over the last 25 years. While these systems have successfully delivered full connectivity to end-users, there are certain drawbacks that prevent wide-spread development. First of all, the design process itself is costly, which is one of the

primary reasons most business developers shy away from BAS facilities. Building automation solutions also lack a certain flexibility and robustness because these systems are incapable of providing complete automation. With the arrival of IoT, its cloud-based interface can now connect building components more efficiently and cost-effectively than BAS ever could.

A 2015 study conducted by Memoori, a company that offers independent market research on smart building technologies, concluded that BIoT "can and will add a further dimension through more effective convergence with the business enterprise." Memoori predicts that BAS as we know it today will eventually merge with and into BIoT.

synced sensors, utility meters, and other cloud-enabled devices. Modern building system components such as occupant and daylight-sensors, radiant cooling and heating controls and ventilation monitors can now be self-regulated, and also digitally accessible and controlled. The convergence of the BIoT and BAS has given new meaning to truly "green" building capabilities. For example, improved functionality can help lower GHG emissions, thereby optimizing energy performance. Devices and sensors used for thermostats and lighting systems will be equipped to recognize statistical data patterns to automatically self-regulate, thus conserving energy during times when these systems are not typically in use. The increase in data sharing between systems—and between systems



Source: http://www.memoori.com/portfolio/transformation-BAS-to-BIoT-2015-2020/

In just the last few years we have made equipment and machinery capable of being fully automated without any human interventions. Most small business owners and homeowners do not have the capital needed to install and maintain building automation solutions, thus making it very difficult for them to capitalize on such energy efficiency.

IOT can provide an affordable alternative by offering low-cost solutions through the installation of Internet-

and humans—will ultimately promote energy savings, enhance productivity, and position AEC professionals toward building for a greener future.

The transition from BAS to BIoT is a work in progress, so the outcome is still unknown. This progressive piece of technology will likely not be a cost-effective solution for retrofits, since devices and equipment may not be compatible; but BIoT still offers a great solution for replacing existing BAS systems.

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Converting a traditional building into an intelligent building does not require the replacement of the building's entire existing technology infrastructure. Rather, a large portion of current equipment can be effortlessly adapted to pair with IoT technologies. A perfect example of this type of adaptation is the Empire State Building, an 87-year-old structure, which was successfully transformed into an intelligent building.

IoT integration helps future-proof building investments

The long-term benefits of IoT-enabled buildings shift the focus of operations maintenance from preventative to predictive. From reducing operational costs and other expenditures, to decreasing the need for systems maintenance, to extending equipment life, IoT technologies ultimately provide a higher return on building investments. IoT systems will eventually overcome all of our present deficiencies in BAS and BIM and, over time, will be less expensive to install and operate.

Individuals in the AEC realm sometimes struggle with not knowing about available project solutions, like IoT. It is important to empower the industry through continued technological advancement, which means that professionals need to focus on meeting project needs through additional research efforts, not necessarily by using tried-and-true design and construction methods.

Becoming familiar with technological solutions available in other industries may spark innovative breakthroughs in the AEC field. By expanding upon existing concepts, procedures and tools, we can push the envelope of our existing technological capabilities. Sometimes a happy accident can lead to a monumental discovery, as was the case for Kevin Ashton.

The IoT principle can be applied to both new builds and retrofits in a variety of exciting ways, which is why it's so important for AEC professionals to learn how to harness the power of wireless automation and analysis systems.

By embracing this evolving resource, industry leaders can potentially unlock new, creative ways to apply the technology. Potential is what you make it, and the possibilities are endless.

Sandeep Kulkarni is an MEP Project Engineer at NV5. Sandeep's project management expertise has helped project teams and facility managers promptly and accurately meet objectives for new and existing facilities across the nation, as well as support other design, coordination, construction, commissioning, operation, maintenance, and retrofitting processes. Contact him at: sandeep.kulkarni@nv5.com.