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Smart Building Opreations with BIM

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Learning Objectives

- Gain a new perspective on why smart building operations is different from conventional building operations
  Discover current trends in the building industry with respect to Building Information Modeling beyond geometry
- Understand the role of BIM and IoT in smart building operations
- Discover the business opportunities possible when taking BIM to smart building operations, and understand the importance of Forge and BIM360

Description

Smart Building is a rapidly growing market segment with an evolving specification. This class intends to focus attention to the type of building operations that makes a building ‘smart’. Then, discuss the technology that can be used for creating such solution – including Autodesk Forge.

Both BIM and IoT technologies have limitations today, which presents the opportunities for solution providers for smart buildings.

This class also includes short demonstrations of ‘iviva Smart BIM’ solution that is built on top of Autodesk Forge.

Speaker

A technical expert with extensive experience in software design and development, integrated solutions across SCADA, ERP, BIM and Cloud Services, and management of IT personnel, in the fields of facility and infrastructure management, industry automation, BIM and enterprise software integration especially in the areas of smart workplace, smart cities, Internet of Things and mobility. Inventor of patented technologies.

Thought leadership and specialties: Understanding technology trends and applying them to products & services, Managing technical people, Intellectual property management, Communicating technology matters to non-technical people, Technical team building, training, coaching and mentoring of technical staff.

Closer look at Building Operations

Conventional building operations

Before discussing 'smart building operations', it is worth having a closer look at what is known as 'building operations' today.

Conventional building operations is about managing the building infrastructure to provide a living environment with hygiene and comfort for the occupant while attempting to make best use of building's assets with less energy usage and other costs.

While this is still important, requirements of today's organizations are much more than reducing operational costs of building infrastructure. It is about using the building infrastructure to win mindshare of occupants, make them love their living environment and project organization's image positively.

During recent years, many have realized that the 'building' could contribute significantly towards these goals, which requires a significant expansion of the scope of building operations.

Innovative building operations

Smart building operations such as life safety, security and sustainability are topics discussed at the boardroom with highest level of attention. On the other hand, there are no standards about how 'smart building operations' should work – hence the opportunity to be innovative.

'Operator' redefined

As the goals of building management expands, it is necessary to expand the definition of 'operator' of the building systems. Operating objectives are no longer static rules but a mix of high-level policies, individual preferences and human emotions.

As such, when it comes to smart building operations, operator is 'everyone' in the building.

'Systems' redefined

As everyone gets involved in operating the building, definition of 'systems' have to change to a higher level of abstraction. Users will not know if the device that controls air-conditioning in their space a FCU or a AHU with VAVs.

Equipment oriented control functions that were conventionally used (i.e.: controlling a given equipment) get replaced by space oriented settings. How it actually translates to equipment control is not operator's concern but something smart building has to take care.

Further, modern definition of 'system' would naturally contain multiple building subsystems as well. 'Open meeting room' could mean a sequence of operations that cut across multiple subsystems and equipment such as air-conditioning, lights, card-access, blinds, etc.

Expectation of 'location awareness'

As Google made search results more meaningful by combining user's current location, today's users expect systems to be 'intelligent enough' to understand their intentions by being location aware.

For example, 'available facilities' function is expected to show facilities in the building where user currently is, although the organization may have multiple buildings worldwide.

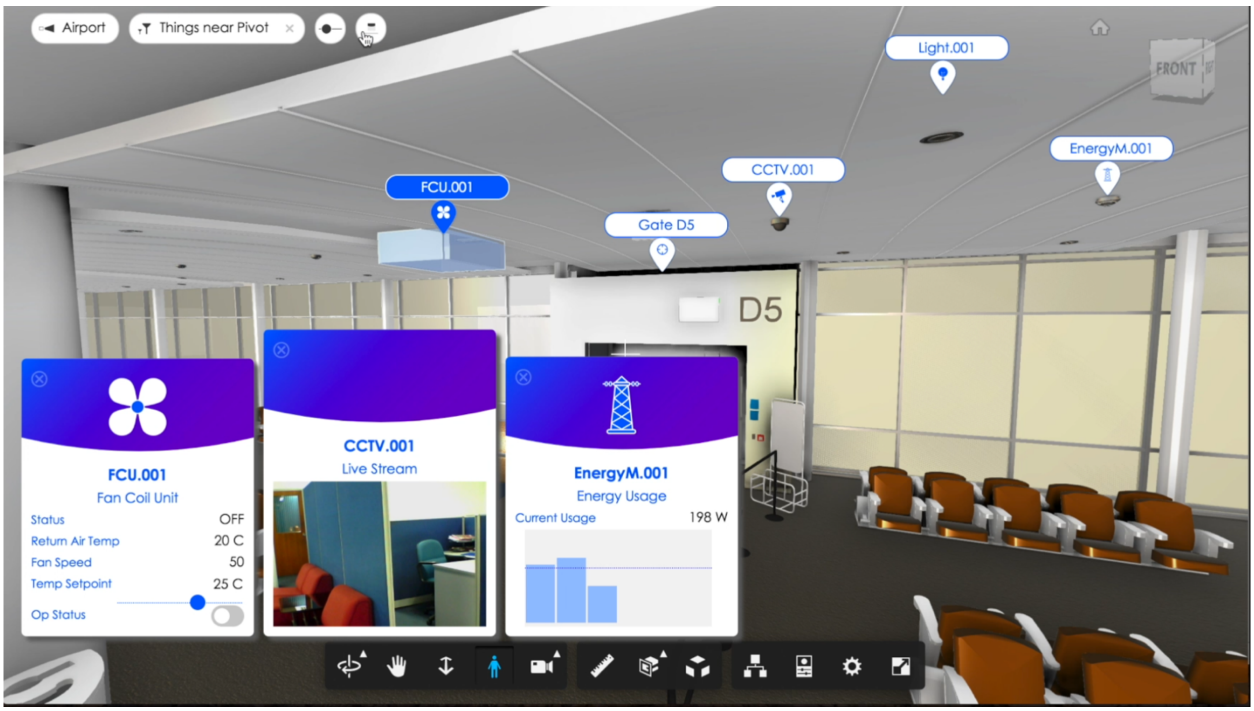

Figure 1 - Natural location awareness provided by BIM

Acceptance of 'fuzziness'

Not everything about smart building users makes solution provider's life difficult. For example, today's users are open to accept certain level of fuzziness in the system behavior. As they do not expect Google search to all shops in search results, they would tolerate (and often prefer) system presenting them with limited choices.

This allows system integration to become 'loosely coupled' in a smart building thereby reducing configuration overhead.

Demand towards 'platforms' and 'components'

As the value of 'user requirements' is getting faded out and 'user experience' is becoming how systems are defined, demand is shifting from (proven) 'systems' to (flexible) 'platforms'.

Platforms would allow building administrators to experiment with new concepts by putting components together or rearranging them, and presenting new operation options to users with a quick turnaround time.

BIM – Building Information Modeling

Building Information Modeling is becoming a fundamental component of the smart building implementation platform.

Why BIM

BIM can be the 'canvas' where smart building concepts are placed. In effect, BIM can become the 'digital twin' of the building, which represents how building looks and works.

Primary use of BIM in smart building operations is the 'location awareness' that it naturally provides. As no strict expectation of how 'things' should look like in a BIM geometry, it provides a greater flexibility for customers to choose 'level of details' based on intended usage, budget and personal preferences.

Widened definition of BIM

While the term 'BIM' is commonly used to refer to Revit and other files carrying geometry information with or without other metadata embedded in them, holistic definition of BIM remains as the entire information model of the building. Let's call it 'operational BIM'.

Operational BIM of a building combines the following:

- Geometry – definition of 3D space comes from the BIM
- Metadata of things – data describing 'things' in the building that are in static nature
- Operational data – information belongs to operations, which change dynamically

In other words, operational BIM is the complete building information model that is ready to support operations.

Metadata in BIM (CDE)

Conventional practice was to embed metadata (such as information of equipment) as attributes of drawing elements. However, this inherits many limitations when it comes to data exchange.

First, geometry is created with tools such as Revit and stored as files. Reading and modifying data embedded within drawing elements require parsing entire file and rewriting it which is not practical, and almost impossible in multi-user environment.

Concept known as CDE (common data environment) has come up to address this concern. Both geometry definition files and non-geometry data are maintained in a structured data storage allowing easy data exchange between systems.

Platforms such as Autodesk BIM360 is addressing part of the CDE requirement – mainly managing the geometry files. It has potential to grow into structured data storage allowing metadata also to be hosted hence becoming true CDE.

Autodesk Forge allows filling the current gap by allowing CDE to be hosted externally and referenced, and then merging both embedded metadata and referenced metadata together with geometry in runtime. This solves the problem of having to rebuild Revit files when metadata needs to update.

Operational data in BIM

Operational data was never in the BIM in conventional practice because it is almost impossible to modify 'files' as data changes dynamically during operations.

Further, ownership of operational data could be different from geometry and metadata. Hence it would be required to kept separately and merge at runtime.

IoT – Internet of Things

IoT is another term that is used under many variations. It could be an addressable IP node of a network or a device that is indirectly connected to the network node through a non-IP based communication protocol (such as ZigBee).

For the purpose of this document, definition would be kept generic, and it refers to a device that can be setup independently without needing it to be a part of a building subsystem.

Why IoT

With the increasing need of flexibility to rearrange smart building systems to experiment with ideas and to allow incorporating user feedback, it is desired that devices stay loosely attached to the systems.

Another reason for IoT is its promise to be 'do-it-yourself' item, although not all of them are there yet. Supplying and fixing an IoT device is far more cost effective than retrofitting a commissioned building subsystem.

As smart phone's camera takes photos, scan documents and read QR codes, a single IoT device has potential to contribute to multiple systems simultaneously. That would be another strong reason to have them in smart buildings.

Legacy devices

Most of building systems are still made up of legacy devices that are not suitable for facing IP networks. Some of them lacks IP compatible protocol support while others do not have adequate security to guard against potential misuse.

They have to continue to stay behind a ‘subsystem’.

As IP cameras have started replacing analog cameras in CCTV systems, it would be just a matter of time before all devices in the building would become IoT. However, the transition will happen over many years.

As such, successful solution of smart building must address both IoT and legacy device connection.

Two-way communication

Similar to the term IoT being wide, IoT-platforms is also a term with a wide definition. While a few solutions are able to provide two-way communication with the devices (for monitoring and control), many IoT platforms only collect the data transmitted by IoT devices and make them available to users or to analytics.

Limitations of technologies and the opportunity

In theory, BIM and IoT would provide an excellent base-platform to build a smart building solution. However, all these technologies got limitations today – hence the business opportunity for the service providers.

Navigation through BIM

Today’s smart phone users are quite comfortable with touch and swipe gestures. Similarly, navigating through 3D view of the BIM is quite intuitive to upcoming generation who are familiar with computer gaming concepts.

However, building operation will likely be dominated by the ‘previous generation’ for next 10 years, who find it quite difficult to traverse through the 3D space. Although many supporting technologies are coming up especially with VR and AR to take away the pain of navigation, they are still at experimental levels.

Using ‘viewports’ can be a solution to minimize the requirement of using natural navigation. Autodesk Forge provides many functionalities to enable viewport based navigation.

Limitations of indoor location services

Although AR is very promising when it comes to enabling 'natural navigation' through BIM, one of the bottlenecks today is lack of indoor location services to determine current location.

QR codes and BLE (Bluetooth low energy) beacon could be alternative technologies that could be used.

Large BIMs

Revit files made during construction phase can be quite big because they contain structural elements and details of the building. Although they are not very useful for operation stage, they sit behind the 3D view by making it unnecessarily bulky.

BIM platforms such as Autodesk Forge are currently not able to allow client applications to extract only what is necessary – by filtering out unwanted segments and details. However, these are expected to be in the works.

CDE – common data environment

Platforms such as Autodesk BIM360 is still evolving to play the role of CDE. There is a room for creating and hosting a CDE for metadata and operational data outside BIM360, and merging them with geometry with Autodesk Forge at runtime.

Data security concerns

Many organizations in sensitive domains do not prefer to 'host' their data outside the country. Services such as Autodesk Forge has a distinct disadvantage of using US-based data hosting.

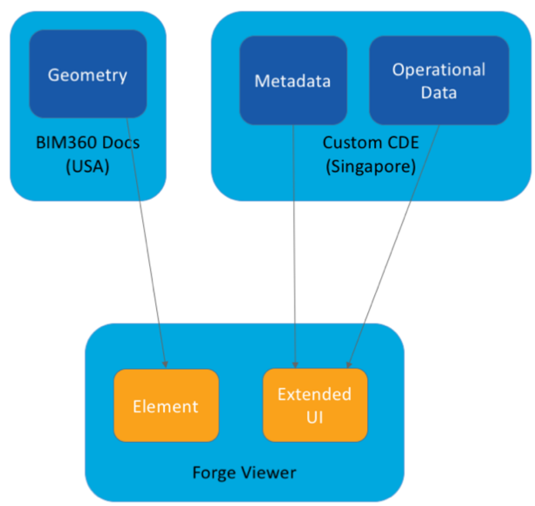

Figure 2 - Combining geometry and metadata at the viewer

One of the solutions is to make sure geometry of the BIM (Revit files) do not contain metadata that could be sensitive, and then use a private CDE to host metadata and operational data.

Autodesk Forge provides adequate functionality to build such solutions.

Identifying elements in different BIM file formats

Although majority of BIM files are Revit based, there is a significant share of the market that uses other file formats produced by other BIM design tools.

Autodesk Forge allows translation of many file formats into its native SVF format thereby solving this problem. However, a problem does exist.

During file translation, Forge defines an 'object ID' that allows identifying elements uniquely. This ID can be used by resolve reference with CDE and merge correct metadata with the drawing element.

However, when a source geometry file is modified and re-translated, object IDs could change thereby breaking the synchronization between geometry and metadata.

One workaround is to 're-synch' the data using 'external ID', which is a GUID generated by BIM design tool (Revit) to uniquely identify the element. However, external ID is not consistently available for all file formats supported by Forge.

Another solution is to use a custom attribute to uniquely identify the element, which has to be inserted at the BIM design stage.

Internet facing devices

As definition sounds, IoT devices could be placed 'internet facing' where they can receive commands through the Internet. This architecture is often considered risky because built-in security of a low-cost IoT device is questionable.

Preferred approach would be to use an 'application level gateway' to bridge the private network carrying IoT devices and the Internet (or the office network). This architecture allows gateway to receive commands through Internet through a secured channel and 'approve' them before sending to the device to execute.

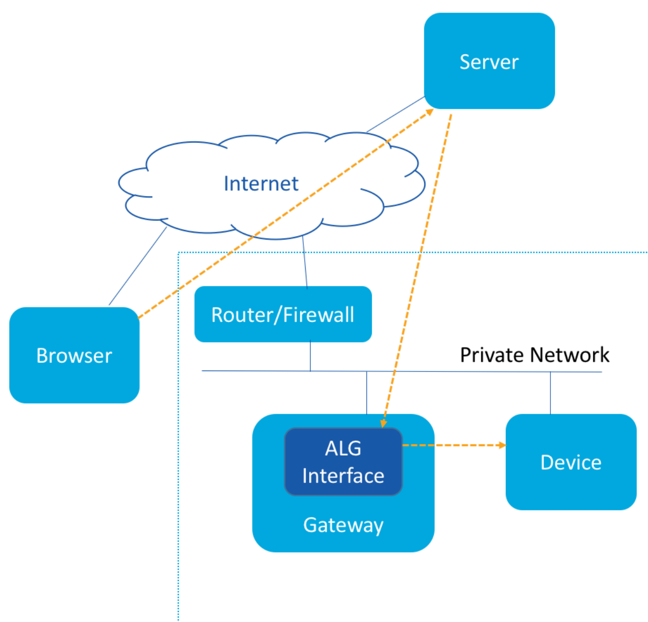

Figure 3 - Safe deployment architecture for IoT