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BIM & RFID Model

The following paragraphs explores the current implementation of two distinct technology, though which are equally revolutionary on their own, have the potential to adopt a hybrid model. The combination of these technologies looks forward towards improvement in accountability and the creation of a network of information to combat existing problems.

RFID

Radio Frequency Identification (RFID) technology has been around for decades primarily for its purpose of improved asset tracking of individual objects. It is an automatic identification technology which comparing to traditional method, significantly shaves a huge amount of time while improving data accuracy.

In today's scenario, we are able to benefit from its substantially lower inventory cost, increase in tags' material choices as well as its higher volume of data capacity. The availability of hard tags which can be made from a wide range of materials allows this technology to be use in punishing environments of the building process. This includes the need to adapt to a wide asset class, the delivery from factory to site as well as actual construction on side.

BIM

Building Information Modelling (BIM) and its methodology in building process management have seen a rise of its usage in recent years due to government efforts to deliver a holistic approach; towards the design, construction and operational phases of buildings in the building industry. This results in productivity increase and a reduce in data wastage.

For larger projects, it is mandatory for companies to deliver BIM Model, as such the players in the project are equipped with a digital twin on a platform capable of storing large amount of information on a single source. Such technology directly improves communication, collaboration and coordination even after building completion. Traditionally, facility managers would retrieve the information needed for operation & maintenance from a wide range of formats, existing in multiple physical space. With BIM, there is a single gateway to all relevant information within the virtual model as long as all project participants involved contribute to the data prior to handover.

Hybrid Model

The application of RFID in the field of construction to allow building materials tracking & monitoring, integrated with BIM as a data repository will allow the formation of a closed-loop visibility and traceability mode in which different users can supervise the construction statuses, progresses in real time. A RFID-enabled BIM platform will allow primarily allow contractors to ensure the integrity of building components during the 'check out' from factory, 'check in' on site and 'completion' on site. For surveyors and facility managers, it eases the asset identification process while providing them access to all data in the BIM database.

With RFID in building components, the traceability is drastically increase while streamlining data management along the supply chain through instant data transfer amongst relevant parties via internet. A project manager can keep track of the security of building materials stored, and the same information can be used to track the progress of work on the construction site. A BIM model that is compliant with the Industry Foundation Classes inherently adheres to a common data model. RFID data can be imported into the BIM Model and displayed, thus allowing the manager to ascertain that the materials are in the proper location. An indirect benefit of a digital platform Is it saves paper and storage space for documents.

To facilitate this use in the environment, it requires a module that interacts and perform transactions between the BIM Database and RFID Readers (stationary and mobile); mobile readers can be mobile

devices, tablets, or notebook with a RFID reader attachment. Below describe the three phases that would benefit from this implementation.

Current Limitation

Contractors require a large amount of effort in tracking & monitoring of building materials, and are usually working with a mental model of the location and quantity of these materials. This low traceability does not facilitate an environment of efficient workflow, as it is hard to ensure the right delivery with the right materials being deposited and use at specific zones on site.

The second issue stems from unlinked formats of data. Upon completion of work of a single material or building space, the installer will capture the scene with photos to send it to the contractor, or done minimally with text messages/WhatsApp. This creates an issue of identifying said completed work due to project size as well as a cumbersome data collection point which will make it harder for log backtracking. This escalates when the completion of work has to be verified by the surveyor, the object identification process is complicated with mental models of multiple projects. In all, though still being able to perform the tasks, the verification process takes a substantial amount of time and is an error-prone process. A lapse potentially causes conflicts between the parties of Installer, Contractor, Surveyor and Client.

The last prevalent issue is pertaining large projects. The implementation of BIM provides the facility manager a quick and easy information retrieval through a 3D model interface. However, with a large file the identification and selection of BIM materials that corroborates the real-world component becomes a time-consuming task. This scenario assumes the availability of a BIM model for the facility manager. Without a BIM Model, FM staff usually refers to information such as specifications, checklists, maintenance reports, and maintenance records on hard copies. Consequently, there will be gaps in data capture and entry, such means of communicating information between the facility location and the management office are ineffective and inconvenient.

In summary, the information collection and usage throughout the project life cycle is fragmented, have poor interoperability and scarce real-time information thus having an adverse influence in the construction process.

Detailed Process

In BIM Software Revit, information can be digitally programmed into each element through predefined or user created parameters. A single BIM personnel, such as a BIM modeler, BIM coordinator or BIM manager is required for this process. A new shared instance parameter, "BIM_RFID_TAG" is needed to be created for all elements to be tagged with RFID tags. Subsequently a unique identification number must be populated into the tags and parameter of the elements. This step allows the choice of one of two options,

1) Using a module in the application capable of alpha-numerical generation accounting for element category to be inserted into BIM_RFID_TAG parameter in Revit

2) Using software provided by the supplier of RFID to generate unique identification number.

Note that the generated number coming from either Revit or software from supplier have to be sync between the tags and parameter of the elements. The status of materials before exiting the factory will show "Fabricated"

Key location for identification of materials will be installed with RFID readers, which will pick up any materials which comes into proximity or through a general direction. Once the targeted materials are tagged with RFID tags of unique numbers, they will be monitored during transportation from factory to site, as well as within site. Site manager will be able to monitor the materials through a notebook, and will be able to ensure materials are at the right location. Materials at this point will have a status of "Delivered"

Once a material is installed, the installer/contractor will use the RFID reader to scan the element, and as a result receive an interface on their devices which allows them to interact with the information provided by the BIM model. Once they mark at element as completed (installation), status shows "Installed", and the module will send a notification to all relevant parties. Changes/updates will be kept in a log for future reference. The interaction on the module through the devices also ensures that any changes will be updated to the BIM Model, and as such a BIM personnel will be able to apply colour coding to elements on their status of completion, or their date of completion. This information can be used for as-built analysis, providing detailed visualization for actual site work throughout the construction process.

In the FM phase, FM staff will be able to use the same RFID reader used by the previous parties to extract information from within the facility. This can be done by scanning in the proximity of an equipment/material, and information can be readily retrieved.