the hammersmith group
research report
may 2009

Clicks & Mortar:

The use of RFIDs in construction

the hammersmith group
new york: 203 rivington street, suite 3a
new york, ny 10002
massachusetts: 259 south main street
bradford, ma 01835
t 917 447 8800
f 978 372 2949
thehammersmithgroup.com

Beyond the supply chain

RFID technology is best known for its role in supply chain management for manufacturers and retailers. However, the same qualities which make RFIDs essential for tracking products through supply chains — the ability to accurately the location, amount, and condition of items by the data they transmit – lend them to a number of innovative uses in construction, hospitality, and real estate development.

Essentially, RFID tags connect physical objects to databases, so that real-time data about their location and condition can be collected and analyzed. Each RFID tag has a unique identifier, so it can be associated with a specific object. These tags consist of wireless transponders with a miniature antenna, within a durable casing. They require no internal power source, but respond to radio-frequency queries from a reader by broadcasting information about their location or condition. The reader then conveys this information to a database.

RFIDs have a number of characteristics that lend themselves to construction applications. Unlike bar codes, RFIDs can collect comprehensive data. They can also be read wirelessly, without manual scanning or a direct line of sight. The chips are encased in a durable casing that can withstand dust, moisture, and physical impact or vibrations. Some chips are rated for extreme environments, operating within temperature ranges of -40˚F (-40˚C) to 356˚F (180˚C), tolerating 100% humidity, and can be immersed in water for days without losing functionality.

RFIDs assist yard management operations: scheduling, staging, and asset tracking.

Using RFIDs for yard management is a natural extension of its use in supply chain management. In major construction sites, locating materials can be challenging because staging yards occupy acres of space, and items may be hidden among many similar components. Tagging items with RFIDs increases the findability of materials and reduces the risk of mismatching components. For example, some firms are using handheld RFID readers or those mounted onto lift trucks to read tags as items are placed in a staging area. As a result, faster and more accurate deployment of materials leads to better efficiency and reduced operational costs.

RFIDs also create value by automating manual equipment inventory management methods and check-in/check-out procedures. Time spent searching for equipment and inventory reduces productivity. RFID readers can track tagged equipment between tool cribs and job sites. If contractor badges also contain RFID tags, then the system can automatically associate items with specific workers. By increasing accountability, RFIDs can increase the bottom line by decreasing shrinkage loss.

RFIDs can be used to communicate with items located underground or behind walls.

In most buildings, it is difficult to locate specific runs of cables, ducts, pipes, or wires without opening walls or removing ceiling panels. Because low radio frequency (RF) signals are less affected by intervening materials such as paint, soil, or even concrete, certain RFIDs can be used to communicate with infrastructure that is not easily accessible.

It will likely become standard practice not only to update blueprints with changes, but also to tag the data, electrical, HVAC, and phone systems in order to simplify maintenance, repair, and upgrades. Similarly, tagging underground electric and gas lines with RFIDs can help assess their condition without needing to excavate.

RFIDs can accurately monitor concrete curing.

It is often difficult to know exactly when poured concrete is fully cured. Structural components such as pre-stressed concrete beams must be fully cured before having weight placed on them. If forms holding poured concrete in place are removed before it is fully cured, the concrete may break or prematurely fail, incurring costs, delays, and human risk.

Concrete cures at different rates depending on factors such as humidity, mix, temperature, and volume. By determining the poured concrete's maturity as quickly as possible, construction crews can shave hours of waiting time off each day's workload and can move onto subsequent phases of construction, enabling them to complete projects ahead of schedule.

Temperature-tracking RFID tags embedded in pre-stressed or cast concrete can provide accurate, real-time information about the maturity of the concrete. When wall or floor slabs are being poured, construction workers toss active RFID tags with temperature sensors into the concrete. The temperature data can be wirelessly read from the tag's sensor, and temperature changes can be tracked over time. 'Active' tags are battery-powered, meaning that they have a more powerful signal and can be read from longer distances or through thicker layers of intervening materials such as concrete.

These RFIDs provide a more accurate alternative to the conventional wired sensors which are prone to error. Even field samples that are measured in a lab can cure at significantly different rates from those on-site. Identec Solutions AG, based in Lustenau, Austria supplied the RFID-based concrete maturity monitoring system for the Freedom Tower project in Manhattan.

These same systems can also play a critical role in determining concrete maturity for road-construction projects that have a quick turnaround, such as repairs to a stretch of highway that need to be repaired over a weekend or even overnight. Using RFIDs to accurately track the concrete's maturity can shorten project times, and avoid the significant additional labor costs such as overnight crews and police patrols. Opening the closed lanes more quickly restores normal traffic flow, avoiding the lost productivity of people sitting in traffic.

Michigan's Department of Transportation was among the first to employ RFID technology for this application.

RFIDs can help schedule time-sensitive products such as hot-mix asphalt pours.

Hot-mix asphalt is a "real-time product" — it is made to order offsite, and needs to be transported to the paving crew within a window of less than three hours. Paving and compaction must be performed while the asphalt is sufficiently hot. Delays between production, loading, and paving can result in scheduling issues, subpar paving conditions, and lost revenue.

RFID can help to ensure that asphalt is poured within its time window. Affixing tags to the trucks that transport the HMA from the plant to the site eliminates the need to manually record load details reduces delays during loading and paving, and ensures the accuracy of data. RFIDs also provide a superior alternative to manual dispatching and paper-based tracking systems, ensuring proper coordination between the asphalt producers, delivery trucks and paving contractors. With real-time information available, asphalt manufacturers can optimize delivery schedules so that the dump trucks never need to wait at a paver to dump their loads of hot-mix asphalt, or that the paver never has to stop and wait for a delivery.

RFIDs can support risk management, quality assurance, inspections and insurance.

RFID technology allows manufacturers, developers, and insurance companies to guarantee the origin and authenticity of components, and to avoid the substitution of items. In the event that a building component fails, the manufacturer of the component can verify whether it was indeed their product that had failed, or whether a cheap copy had been substituted.

There is also the potential for RFIDs to reduce insurance premiums by providing accurate, real-time data about corporate or home safety equipment such as fire extinguishers. Tagging these devices makes it possible for them to automatically report their condition, location, and whether it is time for them to be serviced or inspected.

Calculating the ROI of RFID

RFIDs can also extend a firm's bottom line in a number of direct and indirect ways.

RFIDs can help construction firms reduce delays, prevent errors, and efficiently schedule deliveries, equipment, and labor. Decreasing time spent looking for tools and equipment increases productivity. Ensuring that the right components are installed in the correct locations prevents the delays and expense of having to perform the jobs twice.

RFIDs can avoid bottlenecks in construction by providing real-time data on production, transportation, or component status. Using RFID systems to determine concrete maturity or to track

hot mix asphalt between the plant and the site can translate into shorter turnaround times and compressed project schedules.

RFIDs provide a convenient and reliable way to automate a number of administrative processes that are currently done manually. These administrative processes, while necessary to reducing error and tracking data, do not increase the value of the end product. As a result, RFIDs can increase the bottom line by reducing the time and expense associated with these manual processes. As RFIDs begin to be used more broadly in construction, there will no doubt be many less intuitive applications which will take advantages of the possibilities of this technology.

Constantine Archimedes Valhouli *is a principal of The Hammersmith Group, a strategy consulting firm. Hammersmith's primary areas of concentration are real estate, alternative energy, and technology. He holds an MBA from Columbia Business School and is a Charles G. Koch fellow in economics and public policy with the Institute of Humane Studies.*