Mechanical Contractor's Association Implementation of RFID

A Concept Paper

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Introduction

The Mechanical Contractor's Association of America (MCAA) have solicited the Radio Frequency Identification & Supply Chain Logistics Lab (RfSCL) led by Dr. Erick Jones at the University of Nebraska – Lincoln. The objective of this project is to prove the usability and flexibility of RFID technology in construction industry. The desired result of the project is to create asset tracking through the use of Radio Frequency Identification (RFID) at the construction site. From this result, RFID asset

DeWALT, a tool manufacturer, defines three top construction site concerns. These concerns are replacement costs for lost or stolen equipment, lost time costs, and decreased personnel productivity [2]. In addition, the United States National Insurance Crime Bureau estimates the construction industry loses $1 billion each from loss and theft. The number raises about twenty percent each year [2]. The security and tracking management of construction site have been an issue for most of the construction company. Therefore, inventory asset tracking by any means is an important tool to save billions of dollars every year in the United States alone.

Background

RFID is a technology that involves tags or transponders that can collect data and manage them in a portable, changeable database; communicate routing instructions and other control requirements to equipment; and withstand harsh environments. In certain applications, it outperforms other auto ID technologies. For example, in places where vision is blocked or where surfaces become dirty, it performs better than bar codes; physical contact is not required, which is an advantage that magnetic strips and touch buttons do not have (Forger 1990). An RFID system is classified as active, which means they include a battery, or passive, which means they are powered by the reader's energy field. The memory capacity of the tags varies from 64 to 32,768 bytes [3].

While RFID has only recently made an appearance in mainstream industry, the technology has been in existence since radar was discovered in the 1920s. Therefore, this project will not be the first of its kind, but has only recently been introduced into the construction industry by means of supply chain management and asset tracking. Zebra brand RFID solutions discusses the use of the barcodes in harsh environments and prides itself on supplying tags and printers capable of withstanding these conditions on its website [4]. It is expected, the materials used to keep the barcode tag intact could be used to protect the RFID tag. In conjunction with strengthened barcode tags, Zebra has also created barcode printers that are rugged enough to be taken to the construction.

An article in *Contractors Magazine* entitled "RFID and the Construction Industry: What you need to know", discusses the advantages of using RFID at construct sites. Four points in particular for use of RFID in the construction industry were defined as:

- Protecting tools, equipments, and supplies from theft, loss, or hoarding
- Improving inventory tracking, re-ordering cycles, and maintenance scheduling
- Ensuring workers have the right accreditations to use the tools they check out

- Saving money, time, and hassle from what can happen without a tracking solution like RFID

In the article, a company called VeriChip Corporation based in the United Kingdom used FIATECH equipment to track tools. In the first year, VeriChip was able to reduce the tool budget by twenty five percent and saved an estimated $92,000 in tool and equipment inventory losses. [1]

Another example of successful implementation of RFID in the construction industry is also from a company located in the United Kingdom. The company, BT, implored the help of the asset-tracking specialists at OxLoc also located in the United Kingdom. Using the battery power associated with active technology, longer ranges are able to be achieved for asset-tracking and monitoring. After implementing the RFID asset-tracking equipment for two months, BT said that equipment visibility was increased and reinstallations were reduced. These results were accredited to the fact that active technology was used rather than the lesser expensive passive tags due to faster deployment times and less reconfiguration time. [2]

A final example of RFID in the Construction Industry is research being conducted by the Danish Technological Institute led by Finn Zoëga. Construction sites in the United Kingdom, Sweden, Denmark, and Finland are included in the study. Goal for this project are as follows:

- Tracking and recording of certain vulnerable building components (such as windows)
- Maintenance of building service systems (for equipment, plant, distribution system, fire alarm system, etc.)
- Deconstruction of building (for safety and correct disposal of construction waste)
- Counterfeiting, fraud, and theft

In this paper, Zoëga attributes the intrigue in this research to not only the potential cost savings, but also to the price decreases over the last few years. From 2001 to 2005, tags decreased in price from $2 to $.13 per tag and are expected to drop to $.05 in the next few years. These dramatic cost decreases have created sparks of interest in many other industries as well. [3]

Methodology

The proposed methodology in this part has three phases. The first phase is to identify environment and review the current technology. The second phase is to build scenarios and identify the function of each scenario. The third phase is to test the performance of RFID integrate with mechanical construction site in real environment. To determine the equipment needed for the desired results for MCAA, a construction site must be visited to determine environmental hazards and obstacles. First, we must clear what function of RFID we need to achieve in the job site, from security function to inventory tracking. From these observations, proper equipment and the determination of whether passive or active technology may be made. Next, equipment choices will be tested for ability to withstand the hard environmental conditions in conjunction with economic analysis will

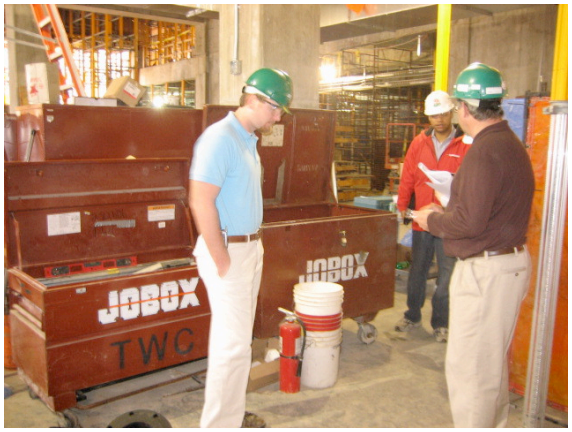
determine the best brand choice. Finally, a final product ready for immediate implementation is to be presented to the members of MCAA.

Site Visit

On March 27, 2007, Professor Tim Wentz, Dr. Erick Jones, and Kelli Kopocis of the University of Nebraska – Lincoln RFID design team toured the UNMC tower project with Dan Zimmerman and Nick Doht of The Waldinger Corporation. The main purposes of the site visit were to build understanding of the environmental conditions of a job site, discover first hand processes that may be improved by implementation of RFID, and discuss the site and possibilities with representatives from Waldinger. The following

Picture 1 – South Entrance

The entrance gate represents the main artery of the flow of traffic and personnel. In picture 1, the south entrance would be an ideal location for an RFID portal. Passive and active tags on pallets, vehicles, tools, equipment, and supplies can be tracked as it enters and leaves as long as a tag is present.



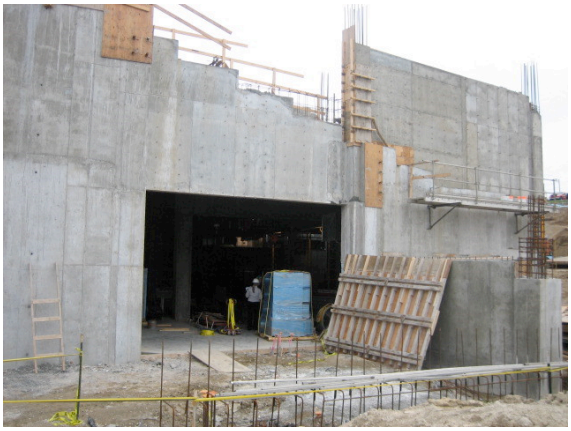
Picture 2 – Tool Boxes

Tools on a job site are a component that may be tracked by RFID tags. Options for identification include a small passive tag on tools of the most value to the contractor to be tracked within the site by readers at each entrance; notification of a tool leaving the site will deter pilferage. A creation by the University of Nebraska – Omaha called the

Intelligent Toolbox is another option. The Intelligent Toolbox has readers within the toolbox held behind a lock with keypad. The worker keys in a personal identification number and chooses the appropriate tool. The toolbox logs the identification and tool removed. Once the tool is returned, the box is opened in the same fashion and the tool is returned. The internal readers determine which tool was returned based on the RFID tag on the tool and log its return. The toolbox pictured in picture 2 currently houses tools and may be locked with a padlock at night.

Picture 3 – Gas Bottles

Collaboration between the mechanical contractor and the supplier of gas bottles (picture 3) can be encouraged with the use of RFID. Portals at the dock will track the arrival of the gas bottle and document when the bottle was taken for use onsite. Once the empty bottle is returned to the drop site, an RFID reader will alert the supplier and contractor the bottle is ready to be picked up. Results include better estimates of order quantity and frequency. As a safety precaution, these bottle tags will contain hazardous material information pertaining the bottle.



Picture 4 – Pallet Entrance

Picture 5 – Pallets & Manlifts

Equipment and pallets moving entering the jobsite may also be tracked using RFID. In this case (pictures 4 & 5), the pallet already containing RFID tagging (as noticed on the site visit) as well as equipment tagged with active tagging may be tracked upon entrance for contractor knowledge of supplies within the job site for more efficient workmanship.

From these options two have been determined as the most beneficial for the project. The first, asset tracking in the form tracking gas bottles onsite including delivery and pickup dates and the gas contained. The second, percent build statistics for foremen and managers. Tags used for shipping cargo and handheld readers from Symbol are currently the best fit for the project at hand. The cargo tags are built from plastics and have been graded to withstand the hazards of the oceanic shipping industry. The handheld readers are equipped with Microsoft's Pocket PC Operating System and are capable of sending data along the 802.11b wireless frequency to any mainframe computer for web-based access to all concerned. The database may be easily protected in the same manner as any website and maintained as such. Microsoft's Access is an option for the database maintenance.

Limitations

Although the advantages of RFID in the mechanical construction industry are efficient and well-accepted, the cost of installation and maintenance is also high compared with barcode. Also, like other industrial application of RFID, the standard and interference is also noticeable. The problems may be lack of standardization, which prohibits one manufacturer's reader from reading another manufacturer's tag; and potential interference from steel objects and other radio frequency signals. Presently, each RFID supplier has its own proprietary technology for reading and writing to the tags. In general, it is not possible for one manufacturer's tag to be read by another company's reader. In other words, RFID systems would work well in a closed environment but would not function well in an open environment as is envisioned for application in the construction industry [4]. RFID system may malfunction in certain environment, RFID operations can be hampered by nearby metals and the operation other RF-linked systems in the vicinity [5].


Pictures 6 & 7 – Shoring

Because RFID uses the electromagnetic field to rebound data between tags and readers, the vast amount of metal used for shoring (pictures 7 & 8) in buildings such as the UNMC building toured for this project could create a virtual wall that will greatly impact the range of the readers. Therefore, tests must be performed to determine how great the impact will be on the range of these readers. Shoring along with harsh environmental concerns are the two greatest limitations to implementing a RFID in many

aspects of the field. However, continuous technological advances and analysis of variables may conclude otherwise after testing.

Conclusion

While the project has moved from the conceptual stages to the second stage of development including testing, implementation of RFID for use by various mechanical contracting firms is near. This is due to the fact that RFID equipment manufacturers, such as Zebra, have already begun to embark on adjusting tags and readers to endure the harsh environments experienced at construction sites. This project demands results and products from these results to be implemented as quickly as possible on construction sites of most MCAA member companies. On the other hand, the conceptual development of RFID application in mechanical construction industry is an encouraging stage for both RFID technology and the development of automation of construction site. The research is stand out the science and application arena which contribute the future RFID development. The given analysis of cost and technology limitation provides several considerations regarding technology improvement and capability. Also, the results of the test will provide a practical reference for future implication of RFID in construction industry.

References

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