The assessment of RFID facilitated construction material management system - a case study of water supply project

Zhaomin Ren  
*University of Glamorgan, UK*

Xiaolong Xue  
*Harbin Institute of Technology, P.R. China*

**Keywords:** construction, material management, information flow, radio frequency identification

Poor material management has been identified as a major source of low construction productivity, cost overrun and delay (Olomolaiye et al., 1998). Due to the complex and dynamic nature of the construction industry, construction material management faces many unique challenges during the material management process from material planning, ordering, receiving and storing, material handling and distribution, site usage and monitoring (Ren et al., 2007). There is a lack of integrated process to consider the dynamic material management, which is particularly important for material intensive projects such as oil or water pipe-laying projects.

The Radio Frequency Identification (RFID) technology offers wireless communication between RFID tags and readers with non line-of-site readability. These fundamental properties eliminate manual data entry and introduce the potential for automated processes to increase productivity, safety, and cost efficiency. Some of the major advantages of the RFID can be summarised as: moderate contactless identification range; reads multiple products at the same time; expressive read reliability and durability; massive data storage; high level of data security (Farragher, 2004).

Several research initiatives have been developed to adopt RFID in the construction industry such as material tracking, tools and equipments tracking, security, service and maintenance, asset management, safety and health and supply chain supporting. On the other hand, the application of RFID is far from mature. Many existing systems over-exaggerate the strengths of the technology, but ignoring the effective and seamless integration of the technology and construction theories (Deloitte 2004). As a result, many application of RFID in construction appears to be ‘shallow’; deep understandings of the industry problems and theories are required.

This research developed a RFID-facilitated construction material management system (RFID-CMM) based on project planning and material management theories and practices. Unlike the previous studies, this research focuses on the improvement of the overall material management system by integrating the discrete and dynamic material information flow. RFID is used as a key lever.

The system links the material information in the following activities.
1) Tracking changes to the requirements as the design progresses.
2) Generation of inquiries and purchase orders for materials.
3) Expediting and recording material deliveries.
4) Control of material deliveries.
5) Control of material issues and movements.
6) Inventory/Stock control management.
7) Management of material traceability.
8) Project progress monitoring.
This paper particularly focuses the application and assessment of the RFID-CMM system in a water supply project which was delayed due to the complex operation environment which led to short of major pipe fittings (e.g. 111/4, 221/2 DI bends of different diameters, strengthened couplings and adapters, gate valves and air valves). The RFID-CMM system is used to track the key information of 19 major pipe fittings (e.g. Product ID, Name, Material, Diameter, Nominal Length, Weight, Quantity, Batch no., Type, Drawing no., Specification, Manufacturer, Instore Date, Inspection done, Scheduled_construction_date, Construction site, Site_in_charge, Site store, Site_store_received_on, Site_store_received_by, Site_store_issued_on, Site_store_issued_by, and Special_requirements) through the material management lifecycle.

After the system was implemented and tested in the water supply project, a workshop was held on site to assess the overall system and the prototype developed. Twenty four staff from this project attended the workshop which include the project manager, construction manager, design engineer, planning engineer, quality control manager, site managers, site engineers, technical officers, and store keepers. They had knowledge about the system and have been involved in the operation directly or indirectly.

Four major aspects of the system (i.e. effectiveness, fitness, utility/usefulness, and usability) were regarded as important for material management, and thus were assessed.

**Effectiveness:** The result shows that project participants have a high consent on the time and cost savings brought by the system while the impact on quality improvement is not very obvious and needs to be verified. Regarding to the process related criteria, the enhanced information sharing obtained the highest score which indicates the system has a very positive impact on the material management. Interestingly, project participants stressed that the enhanced information sharing is mainly due to the overall system rather than the RFID technology.

**Utility/Usefulness:** All participants saw the system was well-targeted. 89% of them agreed that there was a potential for the RFID technology to be used to solve the existing problems in materials management and other areas (e.g. health and safety).

**Fitness:** A simple ratio of available features to desired features in the prototype was used to evaluate the fitness of the overall RFID-MMC system. The list contained a total of 63 features, which were classified into three main categories: novel features, supporting features and deployment features.

**Usability:** The evaluation was carried out to test the usability of the prototype, which includes two parts: a) whether the prototype developed can be used by project staff; b) whether the RFID-CMM system could fit the existing project management system. 82% of project participants agreed that the system could be used by intuitive users with little instruction. Since several departmental teams were involved in the application, their understanding about the usability are different which is highly related to the existing system of each department and each individual participant’s position.

Apart from the benefits, the participants also raised the problems such as the additional resources required, stability of the system, and the compatibility between the RFID-CMM system and other existing management systems.

**References**


