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IMPROVING ON-SITE MATERIALS TRACKING FOR INVENTORY MANAGEMENT IN CONSTRUCTION PROJECTS

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ABSTRACT

Construction materials constitute a large portion of the total cost in construction projects. It may account for 50-60% of the total project cost. As the cost of materials is important, the management of materials especially at the inventory level are crucial for the successful project completion. The tracking and locating of materials in construction jobsites has increase a great concern among construction entities. The improper handling and storage of materials in construction site has made it difficult to track and locate materials when the time they are needed. The on-site materials tracking and locating are made complicated by the use of traditional tracking process which is labour intensive, error-prone, unreliable and contribute to the increase in construction costs. Thus, this paper provides a review of the existing issues in material tracking of inventory management process in construction projects. The findings reveal that there is a need for more sophisticated technology to be implemented in construction project in order to facilitate materials tracking process and at the same time, reduce dependency on paper-based reports in inventory management.

Key words: inventory management, materials tracking, construction projects.

1.0 Introduction

Materials and inventory management plays a definite role throughout construction process. It is because construction materials contributed 50-60% of the total project costs (Song, 2005 and Nasir, 2008). Materials and inventory management is important especially in large and complex construction projects where there is significant amount of money invested in every single process. Materials and inventory management on-site are made complicated as increasing in project size and complexity.

In construction project, the tracking and locating of materials at the construction jobsites are the most important problems related to construction materials and inventory management (Song, 2005; Navon & Berkovich, 2006; Nasir, 2008). Materials' tracking and locating is important to ensure that materials are available at the right time, in the right place (Song, 2005), and at the quantity required. Issues regarding the tracking and locating of materials on-site have received a great concern in construction industry as materials always come in bulk without proper identification. The improper or inadequate

management during the materials receiving process, together with the traditional materials tracking has made it difficult to track materials location in construction jobsite when the time they are needed. In addition; the traditional manual method used sometimes provides unreliable information regarding the materials.

The traditional materials tracking method used in construction industry have clear limitations. That limitation has made it unsuitable to be used in construction industry, so as increasing in sophisticated technology has made ICT become compulsory for the purpose of business enhancement. Thus, this paper will provide a review on the existing issues in materials tracking for inventory management on construction sites.

2.0 On-site Materials Tracking and Inventory Management

Materials inventory management is important as materials constitute a large amount in construction costs (Lu *et al.*, 2011). This is because the poor inventory management can affect not only to the increase in costs, but also contribute to schedule and project delays. For large construction projects, the good management and control over inventory is important. It is to ensure that the right quantity and quality of materials and equipments to be easily specified in a timely manner, obtained at reasonable cost and are available when needed (Bell & Stukhart, 1987).

Inventory management in construction project could be affected by several factors such as; inadequate storage space (Sardroud, 2012), over ordering and double handling (Donyavi & Flanagan, 2009); and incomplete and lack of up-to-date information regarding on-site stock (Navon & Berkovich, 2006). The lack and incomplete of up-to-date information regarding on-site stock is caused by the poor tracking and locating of materials in construction sites. Thus, there is a need for a proper inventory management in order for the materials to be tracked and located easily; and without employing additional costs.

Tracking of materials and components in construction project is not an easy task. Navon & Berkovich (2006) agreed that materials tracking still remain as a big problem in construction jobsites. The difficulty in tracking over materials and components is contributed by the large amounts of materials and components involved in the development process. Besides that, an on-site material tracking is also bound with the traditional-manual method (El-Gahzali *et al.*, 2011; Kasim, 2010; Jang & Skibniewski, 2008; Navon & Berkovich, 2006), which has several limitations. This limitations has make them unsuitable to be use in construction projects which demand a prompt action primarily in decision making process.

Navon & Berkovich (2006) in their study has highlight several limitations of traditional tracking method which is; labour intensive, inaccurate and subjected to error prone which further leads to waste and surplus of materials, schedule delays, decrease in productivity, and the lack of up-to-date information regarding the status of materials. This manual process is labour intensive and data collected using this method is not reliable as they are dependent on workers motivations and skills to track the materials (Sardroud *et al.*, 2010). Besides that, traditional materials tracking also rely greatly on the manual data collection process. Sometimes, collected information is not reliable or complete due to reluctance of workers to monitor and record the flow of large quantities of materials. Moreover, data collected through manual method are usually kept and transferred in paper-based format, which is difficult to be trace and access in the future. Thus, some information ends up being unavailable to the

parties who need access to them in a timely manner; for the decision making process (Sardroud *et al.*, 2010).

As described by Grau *et al.* (2009), in traditional materials tracking process the delivered materials are first unloaded from the trucks; then the items were hand-marked with delivery information for further identification. The workers will manually recorded the item code of each received components and the grid where it was stored in the lay down yard. This manual method provides less assurance for materials later identification, furthermore the delivered materials and component are left to be scattered everywhere at the construction site. It is not impossible that upon installation, the materials are relocated several times to other locations, so; its new location and grid must be collected and recorded again (Ergen & Akinci., 2007). This condition has raise difficulties among labour craft in accessing the required materials. A lot of working time is wasted in searching for the materials. This situation has contributed to the poor site inventory management which will further result in schedule delays and costs overrun.

3.0 Improving On-site Materials Tracking for Inventory Management

In an uncontrolled environment especially in construction projects where inventory management and tracking of materials becomes everyone concerned, it is almost compulsory to apply information and communication technology (ICT) on those processes. ICT implementation could expedite the process of data transfer (Kasim, 2008) and facilitate the effective and efficient control over materials on-site (Kasim, 2005). Molnar *et al.* (2006) also agreed that ICT plays an important role in construction, which is to make the sector more efficient and customer oriented.

ICT has brought new evolution in construction industry where previous construction practices used traditional methods of construction which is labour intensive, time consuming and subject to error-prone (Navon & Berkovich, 2006). With the implementation of ICT, the dependence on traditional manual methods could be reduced. Construction projects also could be managed effectively and efficiently, reduces labour and materials costs, and at the same time reduce time consuming processes. One of the possible areas for ICT application in construction processes is in the materials tracking field.

The study on ICT applications through construction project and processes has been done a few decades ago. Moselhi and El-Omari (2006) has conducted a research that integrates barcodes and Radio Frequency Identification (RFID) to automate the data collection process from construction sites. In another study, barcodes were integrated with Geographic Information System (GIS) to control the erection of prefabricated components (Caldas *et al.*, 2004). Besides that, the latest study on the integration of RFID with other technology in construction has been done which include; on-site support system (Yabuki *et al.*, 2002), tracking of pipe spools (Song, 2005), tracking the movements and location of materials (Song *et al.*, 2006), tracking tools (Goodrum *et al.*, 2006), automate data collection in highway construction (Moselhi & El-Omari, 2006), identify accurate location of underground assets (Dziadak *et al.*, 2006), the real-time monitoring of material (Kim *et al.*, 2009), ubiquitous tracking and locating construction resources (Sardroud *et al.*, 2010) and real-time data collection (Sardroud, 2012).

A study on technology applications in construction also has been done using Global Positioning System (GPS). In the study, Grau *et al.* (2009) used GPS to identify and localize the steel components in construction project site. On the other hand, Sardroud *et al.* (2010) has integrated GPS with GIS and RFID to track and locate construction resources on-site. From the aforementioned examples, it is clear

that many research interests have been done on the implementation of ICT for site inventory management. This is particularly to discover the practical implementation and benefits of implementing ICT in construction industry. However, further steps in this research will only explore the practical applications of RFID and compare it with corresponding technology which is barcodes.

4.0 Need for Improvement

The ICT applications in construction project can have a good impact especially in improving construction activities. Several researches that have been conducted shows that RFID, barcodes, GIS, GPS and other technology has potential to contribute a great impact in inventory management especially in materials tracking process. However there is still lack of direction in terms of processes in order for those technologies especially RFID to be successfully implemented in construction project. Besides that, an initial assessment regarding such technology suggests that most of them are still under development with only a few being used in a commercial basis, especially in construction projects (Kasim, 2005). Accordingly, the subsequent work in this research will explore the processes used in real-time materials tracking to improve inventory management.

5.0 Conclusion

This paper provides a review of the inventory management and on-site inventory tracking in construction projects. It is important to manage all materials and inventory throughout construction activity and processes. Failure in managing site inventory will result in cost overrun, delays in project completion and reduce overall project performance. Thus, there is a need for ICT implementations in construction project. The use of ICT, for example RFID in materials tracking could facilitate the effective and efficient control over materials in construction. Furthermore, it has potential to reduce construction costs, reduce project delays, improve productivity, reduce labour working hours and promote time savings. The next stages of this research will try to investigate the current issues, which is what really happen in materials tracking and inventory management processes in construction project. The next stages of the research also will suggest a process which is useful for the successful deployment of such technology in construction sites.

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