



A service-oriented integrated information framework for RFID/WSN-based intelligent construction supply chain management

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ABSTRACT

As buildings are now taller, larger, and more complex, it has become increasingly more difficult to secure stockyards for materials and to resolve the surrounding traffic problems, creating an increased need for Just-In-Time (JIT) delivery. To support JIT delivery, it is necessary to build a framework that can facilitate the collection and share of information on construction components and material flow throughout the whole supply chain process. Many researchers have suggested that radio frequency identification (RFID) and wireless sensor network technologies could improve the effectiveness and efficiency of JIT management. In addition, service-oriented architecture (SOA), the services of which enable the interfacing of a heterogeneous system environment of parties involved in the supply chain management process, is suggested in the manufacturing industry as one of the solutions for effective collection and sharing of information in supply chain management. However, the construction industry has limits in applying the framework suggested in the manufacturing industry since the supply chain process in the construction industry is extremely dynamic due to frequent changes in the design and plans of construction projects. Therefore, the objective of this research is to develop a seamlessly integrated information management framework that can provide logistics information to project stakeholders for their decision making. The pilot test of the framework developed in this research showed that it can improve time efficiency by about 32% compared to the traditional supply chain management. The result of this research is expected to be utilized effectively as a basic framework to manage information in RFID/WSN based construction supply chain management (CSCM) environments.

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1. Introduction

As buildings have become increasingly taller and large-scaled, project managers of high-rise building construction projects experience problems in securing storage and handling space for materials, consequently requiring Just-In-Time (JIT) management to ensure the procurement of materials at the right time and place. To build a JIT management environment, status information of components manufactured based on the request from the construction site as well as delivery information should be effectively available to the parties involved in the planning, manufacturing, shipping, delivering, and erecting processes. That is, information generated through the whole supply chain should be collected and shared with a consistent information framework.

Such a JIT framework has been studied by many researchers. Many researchers [11,14,16,20,21] showed that radio frequency identification (RFID) and the wireless sensor network (WSN) could help improve the collection and sharing of information in the supply chain process. Although existing research has presented approaches on the automated collection and sharing of information in the supply chain process, there has been a lack of research carried out on a framework that can support effective communication among various actors in the supply chain process, such as people, equipment, and legacy systems of companies involved, where the actors have different system environments. A number of studies [17,28,30] have shown that service-oriented architecture (SOA), which is independent from various implementation platforms, can support seamless integration of information flow in the supply chain environment of the manufacturing industry that involves many companies with heterogeneous programming languages, databases, and operating systems, by using extensible markup language (XML) and hypertext transfer protocol (HTTP).

However, previous research, which relied on formalized patterns and standards in the logistics industry, has generally been limited in supporting dynamic supply chain processes of the construction

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