THE MANAGEMENT OF INDUSTRIALIZED BUILDING SYSTEMS (IBS) PROJECTS USING RADIO-FREQUENCY IDENTIFICATION (RFID) TECHNOLOGY

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To my beloved mother and father

This thesis is dedicated to them.

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ABSTRACT

Radio-frequency Identification (RFID) technology has been widely used globally in the field of construction during the last two decades, specifically in Industrialized Building Systems (IBS) projects. IBS is a construction method that produces pre-manufactured building components in factory which are then being transported and assembled into the intended building structure at construction site using appropriate machineries and equipment. Subsequently, in recognition of the importance of management in IBS industry, this study aims to review methods of using RFID technology in IBS projects by reviewing current practice of IBS industries and identifying solutions to overcome common problems that often detriment this sector. Also to study the potential of RFID implementation to overcome the problems in the IBS projects. Quantitative approach is used to obtain information from respondent that utilize the IBS methods in their projects. The use of RFID technology in IBS projects which was studied pertains only the management of finish products and materials which are then being transferred on-site. The objective of this study to explore the use of Radio-Frequency Identification (RFID) technology in the management of Industrialized Building System (IBS) projects was achieved.

ABSTRAK

Teknologi Pengenalan Frekuensi Radio (RFID) telah digunakan secara meluas dalam bidang pembinaan dalam tempoh dua dekad yang lalu, khususnya dalam projek-projek Sistem Industri Berpusat (IBS). IBS adalah kaedah pembinaan yang menghasilkan komponen bangunan pra-pembuatan di kilang yang kemudiannya diangkut dan dipasang ke dalam struktur bangunan di tapak pembinaan menggunakan mesin dan peralatan yang sesuai. Seterusnya, sebagai pengiktirafan terhasap kepentingan pengurusan dalam industri IBS, kajian ini bertujuan untuk mengkaji semula kaedah-kaedah menggunakan teknologi RFID dalam projek IBS dengan mengkaji amalan semasa industri IBS dan mengenal pasti penyelesaian untuk mengatasi masalah biasa yang sering menjejaskan sektor ini. Juga untuk mengkaji potensi pelaksanaan RFID untuk mengatasi masalah dalam projek IBS. Pendekatan kuantitatif digunakan untuk mendapatkan maklumat daripada responden yang menggunakan kaedah IBS dalam projek mereka. Penggunaan teknologi RFID dalam projek IBS yang dikaji hanya berkaitan dengan pengurusan produk dan bahan-bahan yang kemudiannya dipindahkan di tempat. Objektif kajian ini untuk meneroka penggunaan teknologi Pengenalan Frekuensi Radio (RFID) dalam pengurusan projek Sistem Industri Berindustri (IBS) telah dicapai.

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LIST OF ABBREVIATIONS

ACA	-	Acceleration Capital Allowance
ARPANET	-	Advanced Research Projects Agency Network
Auto-ID	-	Automatic Identification
CIDB	-	Construction Industry Development Board
CMU	-	Concrete Masonry Units
CSFs	-	Critical Success Factor
EAS	-	Electronic Article Surveillance
GIS	-	Geographic Information System
IoT	-	Internet of Things
IBS	-	Industrialized Building System
ICU	-	Implementation and Coordination Unit
LRT	-	Light Rail Transit
MHLG	-	Ministry of Housing and Local Government
MoD	-	Ministry of Defense
MoF	-	Ministry of Finance
PC	-	Personal Computer
PKNS	-	Perbadanan Kemajuan Negeri Selangor
PWD	-	Public Work Department
RFID	-	Radio-Frequency Identification
ROI	-	Return of Investment
SPNB	-	Syarikat Perbadanan Negara Berhas
TIRIS	-	Texas Instruments Registration and Identification System
UHF	-	Ultra-High Frequency
VSWR	-	Voltage Standing Wave Radio

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Industrialized Building Systems (IBS) is a construction method that produces pre-manufactured building components in factory which then are being transported and assembled into the intended building structure at construction site using appropriate machineries and equipment with minimal workers on site. Besides, IBS can also be interpreted as mass production of building components whether in factory or at site factory according to the intended specifications with standardized shapes and dimensions, which later on being transported to the construction site to be assembled to form a building. Project development using IBS is not a new thing in construction industry. In fact, the government of Malaysia has started its first IBS project on 1964 to build affordable flat at Jalan Pekeliling, Kuala Lumpur.

Another common term that is significant to the IBS sector is Radio-Frequency Identification (RFID) technology, which allows information to be read or written without contact on tags that can be fixed into tools and materials used by the construction companies. As a result, it has become possible to track and trace individual movement of items through what has been termed as the “Internet of Things (IoT)”. This will further develop within organizations in the quality of data management by changing the methods of manual data collection with the computerized instead. RFID technology are possible to identify assets and consumable materials information about the resources by enabling the consolidation of data needed to improve the accountability of materials. RFID also capable to track tools, construction equipment and material pallets. This technology is allowing data to carrying tags many components of a construction project. Low cost scanners can

be used to read or written with ensuring a quick and contactless way of starting location the materials and the latest status of each components.

1.2 Background of Study

Over the past decade, Kamarul et al. (2009) said that since the early 1960's the level of IBS procedure is still very low. IBS method practice are seeming to be reluctant to construction industry. However, Warszawski (1999) stressed that by implementing IBS, manual labor on-site can produce additional saving with increased construction speed and higher construction quality. Thanoon et al. (2003) also point out that improvement of overall construction quality, cost saving and faster construction time as the result of IBS enactment. The implementation of IBS has so gained a good status among the researchers in general which achieve the basic objective of construction time, resources and quality.

Additionally, Badir (2002) has studied the building system technologies in Malaysia and point out the problems that constraints connected with this technology. Haas & Fagerlund, (2002) have been discussed that existing challenge in IBS construction is managing the transportation. They usually require an additional lift planning as the components arrive at the construction site. Issues in transportation of material will influence on crane cost, construction schedules, and the design plan of the projects.

It is needed to understand the general coordination required when selecting IBS as an option to construction procedures. Efficient modifications in the supply chain, scheduling for materials management, drawings, and work breakdown structure should also be taken into consideration. Other than that, effective communication for construction operations is turn out to be energetic with the relating to increase of coordination. Meanwhile, integrated involvement of various parties is required for occurrence through regular meetings. RFID technology has

also been extensively practical in various areas such as logistic, supply chain management, electronic transaction, security and etc. It has brought about great benefits in these areas by improving immediate information visibility and traceability. Moreover, RFID can be costly for either its software or hardware. RFID requires high-priced equipment that needs to be comprehensively maintained throughout its life cycle. Although its prices have fallen accordingly with numerous upgrades since the 1970s, businesses are still taking a pass because of its steep price (Stankovski S., 2010).

The difficulties in understanding, implementing and using an innovation depends on how complicated and complex the technology is (Rogers, 2003), while presently, with lack of standardization, high costs of implementation, and slow technology development are factors has contributed in preventing the widespread of implementation of RFID technologies in the construction industry. Although with all issues that exist in adopting the use of RFID technology, it is still proven to help improving data accurateness by tracking material products through supply chains and by identifying items or objects at specific place through Automatic Identification (Auto-ID) as the RFID technology enables detection and identification of tagged objects using the data it transmits.

With RFID technology, it has become possible to read tags without having to get through the packaging where the tags can be easily read from the outer layer of the product. The tags can be read efficiently without regards to its orientation, plus without having to place the tag on any specific side as performed using barcode label. Perhaps a significant amount of labor is required in the practice of barcode scanning for which to scan the barcode, but RFID scanning on the other hand can be automatically done by readers and it does not require manual data recording. Thus, this technology is proposed to be applied in IBS industries for management of material tracking, in hope that it will make future works more efficient, less reluctant, and easier to be completed.

1.3 Problem Statement

IBS has been clear stated as a construction method in which components are manufactured in a positioned, controlled environment, assembled and transported into a structure with minimal supplemental of site work. It consists of precast component systems, prefabricated timber structures, fabricated steel structures and modular block systems. Parts of the building that are casted as standardized components in the factory or at the worksite are then transported to the construction site to be assembled. IBS was also well-known as an industrialized production procedure and construction method which components are manufactured under an organized environment either at site or factory, then transported to assembled into a structure with minimum additional site of works. Difficulties that currently occur in the IBS industries is that the components are being manufactured explicitly as according to the requirements and then transported to the intended construction site as according to the time material delivery. Without proper planning by the management of the construction companies, issues will emerge due to the limited storage area and reducing of raw construction materials at the worksite. The minimization of the use of formworks and props at the worksite frequently results in poor organization of the assembled materials. RFID technology has been promoted in recent years as an alternative approach to improve asset management. Although RFID has some limitations and restrictions, they can easily be reduced if it is integrated with other type of sensors. These RFID based technology has been developed and improved over the years with the aim to provide more accurate positioning and identification of materials. RFID tag has used instead of barcode and magnetic stripe to deliver the exact identification functionality with less complexity. With regards to the RFID technology, the need for it to be efficiently adopted by companies is a must as it will comprehensively nurture their proficiencies and performance given the gallant features of the RFID communication methods, plus the non-hectic components integration and installation within the existing infrastructure of information technology of an organization.

1.4 Research Aim and Objectives

The aim of this study is to acquire the acceptant use of Radio-Frequency Identification (RFID) technology in the management of Industrialized Building System (IBS) projects. To achieve this aim, the following objectives has been identified:

i. To review the current practices of managing the IBS projects using tagging technology and the problem faced by the IBS industry.
ii. To recognize the methods to address problems encountered in the IBS projects by using technology.
iii. To observing the potential of RFID implementation to overcome the problems in the IBS projects.

1.5 Research Scope

This study will take place on residential projects which are utilizing the IBS method and implementing component identification systems to track and trace each components during transportation and assembly. On the other hand, information related to costs, security and legal issues are excluded from this study. As regards, the scope of this study is limited only to the following:

i. Information and data taken only covers the IBS structures using precast concrete systems.
ii. Area for data collection is confined within the state of Johor and its closest area.
iii. Only residential construction projects are selected as the area to collect information.
iv. Additional practices have studied in logistic companies that implement the RFID technology.

1.6 Summary

The project focus on RFID technology and current practices of IBS systems. Chapter two (2) presented literature review of previous researches related to the topic. For Chapter three (3) are discuss about the research methodology and focus on data collection instrument as well on the techniques used in analyzing data. Chapter four (4) focus on analyzing research results and logical interpret of research findings. Chapter five (5) concludes the overall research, discuss the findings and provides recommendations.

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