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CRITICAL SUCCESS MODEL FOR AUTOMATION AND ROBOTICS IN MALAYSIAN INDUSTRIALISED BUILDING SYSTEM (IBS)

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ABSTRACT

The use of automation and robotics in industrialised building systems IBS commonly deals with uncertainties and complexity, thus requiring particular strategies to foster successful results. Despite the support and assistance from various government departments and private sector for the development of automation and robotics in IBS, it has been the subject of very few studies. Nevertheless, there is an increasing awareness among the IBS stakeholders of the use of automation and robotics to influence IBS projects success. This study aims to develop a critical success model based on the factors influencing the implementation of automation and robotics in IBS as view by IBS stakeholders in the Klang valley. In order to achieve this research aim, the first research objective is to identify the critical success factors (CSFs) for automation and robotics in IBS. The second research objective is to determine the success criteria of automation and robotics in IBS. Finally, the third research objective is to examine the relationship of the CSFs and the success of automation and robotics in IBS, simultaneously develop a critical success model for automation and robotics in IBS. This research adopts a quantitative approach to developing a conceptual framework for the factors influencing the use of automation and robotics in IBS through a literature review and questionnaire survey. The survey results were used to establish the critical success factors (CSFs) for automation and robotics in IBS and a structural equation modelling developed by using Smart-PLS version 3.2.7. In addressing the research aims, this study identifies four CSFs elements towards the success of automation and robotics in IBS: Strategy, People, Process and Technology. From the analysis, the top five factors in Strategy are: cost evaluation, risk assessment, economies of scale (EOS), government policies and vision. The top five factors for People are: technical capability, training, highly skilled, education, and an experienced workforce. For Process, the top five factors are: continuous improvement, coordination of design, transportation and installation, standardisation, modular design, and good working collaboration, and in Technology the top five factors are: Computer-aided design (CAD), information and communication technology (ICT), computer-aided manufacturing (CAM), building information modeling (BIM), computer numerical control (CNC). Furthermore, this study also identifies the top ten success criteria for automation and robotics in IBS: reduced construction and production time, reduced waste, reduced material consumption, improved occupational safety and health, improved working conditions, increased productivity, recycled waste material, workforce reduction and a high-quality product. Additionally, the research explores the impacts of critical success factors linked to automation and robotics' success in IBS by examining the standardized coefficient among the factors in the Partial Least Square-Structural Equation Modeling PLS-SEM. The finding indicates that Strategy, Process and Technology have a significant relationship on the success of automation and robotics in IBS. However, the People element was found to be statistically insignificant relationship, thus suggesting the moderating role for this element as a topic for future research. Finally, the research offers methodological and practical contribution as well as an opportunity for future research.

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CHAPTER ONE
INTRODUCTION

1.1 Research Background

Automation and robotics in the construction industry demands effective construction organizations, efficient construction processes, and innovative construction techniques to compete effectively in the context of increasing globalization, market competition, and technological advancements in the twenty-first century. It has the capability to generate higher output at a lower unit cost with better quality products that could improve global competitiveness. Theoretically, the construction worksite could become a safer environment, with more efficient execution of the work, greater consistency of the outcome, and a higher level of control over the production process (Mahbub, 2008; NHBC, 2016).

In the Malaysian construction industry, the best way to implement automation and robotics is through the Industrialised Building System (hereafter referred to as IBS) as such as system has a clear direction in adopting those technologies. This direction was first conceptualized by Richard (2005) through the degree of industrialization (see Figure 1.1). It was then been highlighted in the Construction Industry Transformation Programme (CITP) 2015-2020 and were strategized in the Construction 4.0 Strategic Plan 2020-2025 (CIDB, 2020).

Nevertheless, the IBS was defined by the Construction Industry Development Board (CIDB) as a construction technique in which components are manufactured in a controlled environment (on or offsite), transported, positioned, and assembled into a structure with minimal additional site works (CIDB, 2003). IBS also have been defined as a set of interrelated elements that enable a building's designated performance. In the broader sense, it may also include various procedures (technological and managerial) for the production and assembling of these elements (Ismail & Rahim, 2009; López-Guerrero et al., 2022). Abdullah & Egbu (2009) define IBS as a construction method arising from human investment in innovation and rethinking the best construction work delivery methods based on industrialization.