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A causal model of BIM adoption in the Thai architectural and engineering design industry

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Abstract

Building Information Modeling (BIM) is a computer technology for design and management of buildings and facilities, which is widely adopted for implementing design projects in many countries. Thailand is one of those countries which has adopted the changing design technology of BIM to use in the Thai architectural and engineering design industry. The purpose of this research was to develop a causal model of the factors influencing BIM adoption behaviors in the Thai architectural and engineering design industry. The related theories and research papers were thoroughly explored and examined in order to find out the related factors. The initial factors were confirmed and validated by a group of experts. The final factors were used to formulate a structural equation model (SEM) for studying the relationship among the factors. The empirical data was collected from a group of Thai engineers and architects with experiences in using BIM (278 respondents). The results suggested that the factor that had a positive significant influence on BIM adoption was BIM characteristics. The indicators of the BIM characteristics comprised the following: (1) quality of the product, (2) relative advantage, (3) trialability, (4) ease of use, and (5) compatibility. The strategies for the adaptation of the Thai architectural and engineering design industry to the BIM adoption were also discussed in the conclusion of this article.

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Keywords: BIM; adoption; architectural and engineering design; structural equation model

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1. Introduction

Recently, the development of design technology has reached an important turning point driven by Building Information Modeling (BIM). BIM has totally changed the input data process from traditional coordinate system (x, y-axis) of Computer-Aided Design (CAD) to 3-dimensional object-oriented approach, which has greater potential than ever [1]. BIM is a computer technology for design and management of buildings and facilities, which is adopted for implementing design projects in many countries. Thailand is one of those countries, which has adopted the changing design technology of BIM to use in Thai architectural and engineering design industry. However, the lack of professional architects and engineers who have appropriate knowledge and understanding is found to be the current barrier to BIM implementation in Thailand. Thus, the main objective of this research is to develop a causal model explaining BIM adoption behaviors among Thai architects and engineers in this industry. This present study will enable the relevant executives, division managers, architects, and engineers to understand and assess the current status of their preparation for BIM technology implementation. In addition, the findings of this research should be helpful in determining the strategies for the adaptation of the Thai architectural and engineering design industry to the BIM adoption.

2. Research background

Troff [2] states that “diffusion of innovations or technologies in a society, in general, includes many more factors such as the influences of psychological or personal preferences, technology perceptions, communication behavior, and socio-demographic attributes on diffusion or an adoption process”. Rogers [3] suggests that “diffusion is the process by which an innovation is communicated through certain channels over time among the members of a social system” and also defines innovation as “an idea, practice, or objective that is perceived as new by an individual or another unit of adoption”. In this present research, BIM is specified as an innovation which is diffused to the Thai architectural and engineering design industry. The diffusion of innovation model suggested by Rogers [3] shows that the innovation characteristics that influence the rate of diffusion can be categorized into five groups, which are (1) Relative Advantage: the degree to which an innovation is perceived as better than the idea it supersedes by a particular group of users. It is measured in terms that matter to those users, like an economic advantage, social prestige, convenience, or satisfaction. (2) Compatibility: the degree to which an innovation is perceived as being consistent with the values, past experiences, and needs of potential adopters. An idea that is incompatible with their values, norms, or practices will not be adopted as rapidly as an innovation that is compatible. (3) Complexity: the degree to which an innovation is perceived as difficult to understand and use. (4) Trialability: the degree to which an innovation can be experimented with on a limited basis. An innovation that is trialable represents less uncertainty to the individual who is considering it. (5) Observability: the easier it is for individuals to see the results of an innovation, the more likely they are to adopt it. Considering the definition of awareness, the Wikipedia website [4] states that “awareness is the state or ability to perceive, to feel, or to be conscious of events, objects, or sensory patterns. At this level of consciousness, sense data can be confirmed by an observer without necessarily implying understanding. More broadly, it is the state or quality of being aware of something. In biological psychology, awareness is defined as a human's or an animal's perception and cognitive reaction to a condition or event”. As for the word “adoption”, Schiffman and Kanuk [5] state that “adoption is the decision to make full use of an innovation as the best course of action available”. Sorescu et al. [6] present a conceptual framework describing the determinants of customer response to an innovation that captures the factors influencing the diffusion of new products. This conceptual framework shows that the four major groups of factors affecting both the first and repeat purchases of a new product by customers are adopter characteristics, innovation characteristics, firm characteristics, and environment characteristics. Davis [7] proposes a Technology Acceptance Model (TAM), which later becomes a famous model and has been widely used in studying consumers’ behavioral acceptance of technologies such as smartphones, LED TV, and other innovative devices. This model suggests that the perceived ease of use and the perceived usefulness of a technology are the factors affecting technology acceptance. It is also found that the perceived ease of use and the perceived usefulness have a direct effect on the attitude toward technology adoption. Finally, the attitude toward technology adoption has a direct effect on the actual technology adoption.