BIM-Based Knowledge Management in Construction Projects

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ABSTRACT

Construction organizations have increasingly realized the importance of knowledge management (KM). They have also increasingly applied various tools and strategies to manage their knowledge. Due to the temporary nature of construction projects, however, there continues to be certain barriers and challenges of KM that are hard to overcome. This article explores the use of Building Information Modelling (BIM) to achieve better KM in UK construction organizations. First of all, why and how BIM can facilitate KM in construction projects are identified from the literature review. Secondly, a questionnaire survey in quantitative measurement is used to investigate key aspects of KM that can be improved by using BIM. The results of quantitative data analysis are further discussed with the help of literature review. It is found in this article that BIM has the potential to support KM in construction projects. In particular, BIM contributes to proactive KM, lifecycle KM, and KM processes. The findings of this article provide researchers and practitioners with a better understanding of BIM-based KM.

KEYWORDS

BIM, Construction, Knowledge, Knowledge Management, Project Management

INTRODUCTION

Knowledge Management

Knowledge is seen as one of the most competitive resources in any organizations (Ofek & Sarvary, 2001). A lot of researchers are trying to define knowledge by distinguishing among data, information and knowledge (Alavi & Leidner, 2001). A common view with minor variants is that data is raw numbers and symbols while information is the processed data (Dretske, 1983). Quigley and Debons (1999) defined that information can be regarded as resources used to answer “when”, “where”, “who”, and “what” questions while knowledge is the application of information to answer “how” and “why” questions. As a result, data, information and knowledge can be placed at three different levels, ranging from data at the bottom to knowledge at the top (Rowley, 2007). According to Nonaka, Umemoto and Senoo (1996), on the other hand, information is an essential material for eliciting and formatting knowledge. The creation of knowledge is based on information.

Wiig (1997) holds that KM is a process to try to understand and manage systematic, explicit, and deliberate knowledge creation, renewal, and application. The objectives of KM are: (1) to make the organization act intelligently to secure its competitiveness and overall success, and (2) to realize the best value of its knowledge assets. The KM process can be seen as a series of structured activities for managing knowledge effectively and efficiently, which generally includes knowledge creation, sharing/
communication, storage, and application (Alavi & Leidner, 2001). In this study, knowledge creation is explained based on the SECI (socialization, externalization, combination, internalization) model proposed by Nonaka and Takeuchi (1995). This is because that this model has been widely accepted in and has been used in many studies (Husse, 2004; Jakubik, 2007; Ngulube, 2003; Zheng, Yang & McLean, 2010). Based on this model, knowledge can be created as various new types. Socialization (S) aims to transfer tacit knowledge into new tacit knowledge through social interactions among members. Externalization (E) converts tacit knowledge into explicit types. Combination (C) is a process that upgrades explicit knowledge into more complex and systematic sets of explicit knowledge by combining explicit knowledge with some key pieces of other knowledge. Internalization (I) involves the process of changing explicit knowledge into tacit knowledge. Additionally, knowledge sharing is defined as the exchange of knowledge between and among individuals/teams/organizational units/ organizations. There are two roles in this process. One role involves the communication of knowledge and the other has to do with assimilation (Schwartz, 2006). Knowledge storage/retrieval can be seen as organizational memory, constitutes a crucial aspect of KM of an organization. Organizational memory refers to knowledge residing in various component forms, such as paper-based documentation, information stored in electronic databases, codified human knowledge stored in expert systems, documented organizational procedures and processes and tacit knowledge acquired by individuals and networks of individuals (Tan, Teo, Tan & Wei, 1998). The process of knowledge application is related to how the existing knowledge can be utilized to make decisions and perform tasks based on the direction and routines (Becerra-Fernandez & Sabherwal, 2014).

Knowledge Management in Construction

Construction is a knowledge-based industry (Egbe, 2004). It is widely accepted that various benefits can be acquired through effective KM in construction. For example, Shelbourn et al. (2006) mentioned that appropriate KM can save time and cost in projects and improve project quality. Ribeiro (2005) emphasized that a successful KM system should and can facilitate the core activities of construction organizations. Love, Huang, Edwards and Irani (2005) agreed that KM leads to better performance of construction projects and can obtain sustainable competitive advantages. In addition to these benefits, Tserng and Lin (2004) identified that KM can help construction organizations promote innovation, facilitate experience reuse, enhance the effectiveness of training, improve the effectiveness of job, increase intelligent assets, and decrease repetitive problems.

Construction is known as a project-based industry that is temporary (Lindner & Wald, 2011). According to Prencipe and Tell (2001), and Sydow, Lindkvist and DeFilipelli (2004), the temporary nature of organizations leads to a lack of mechanisms to capture, store, obtain and exchange knowledge. This will, therefore, hinder knowledge communication and storage between projects or project phases. Sydow et al. (2004) believe that it is very easy to lose knowledge at the end of a project as senior experts will move to a new project with the knowledge existing in their mind. Carrillo, Robinson, Al-Ghassani and Anumba (2004) and Boh (2007) agree with this and stressed that it is hard for a temporary project to transfer its knowledge to the permanent part of the organization because there is very little time for that at the end of the project. As a result, few project-based organizations are well established in permanent memory. Hari Egbe and Kumar (2005) pointed out that the UK construction industry suffers from a lack of awareness of important issues associated with knowledge capturing and its benefits for construction organizations. A survey carried out by Carrillo et al. (2004) presented the main barriers to manage knowledge such as time limitation, different work procedures, communication ineffectiveness and poor IT infrastructure. They also stressed that UK construction projects need systematic procedures for collecting and reusing lessons learnt and best practice. Project-based organizations, such as construction organizations, are more likely to encounter problems in the process of KM.

In a construction project, the content and context for KM changes throughout its lifecycle. For example, during the design phase, there is much more potential to facilitate an innovative design
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