# Dynamic Knowledge Map:
# reusing experts' tacit knowledge in the AEC industry

Jeong-Han Woo*, Mark J. Clayton, Robert E. Johnson,
Benito E. Flores, Christopher Ellis

*Department of Architecture, Texas A&M University, College Station, TX 77843, USA*

## Abstract

Much knowledge in the Architecture, Engineering and Construction (AEC) industry is experience-based and tacit. Nevertheless, the typical strategy for knowledge management is focused on computer-based approaches for capturing and disseminating explicit knowledge. AEC firms have been successful at collecting and storing explicit information in enterprise databases, but they are poor at knowledge retrieval and exchange. Consequently, AEC professionals find it difficult to reuse core experts' knowledge for highly knowledge-intensive AEC activities. This situation calls for a method for disseminating tacit knowledge from experts' brains to achieve higher quality AEC projects.

The primary purpose of this paper is to set a theoretical foundation for clarifying the contribution of experts' tacit knowledge in the AEC industry. The secondary purpose is to describe the concept for prototype software, Dynamic Knowledge Map, that can assist in the reuse of experts' tacit knowledge. Dynamic Knowledge Map is a Web-based knowledge navigator that searches for experts and facilitates communication with those experts by using internet technology. Higher performance levels theoretically can be achieved while accelerating the knowledge transfer processes. Future research will test the suitability of Dynamic Knowledge Map for tacit knowledge utilization in AEC organizations.
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## 1. Introduction

There are two kinds of knowledge: tacit and explicit. According to Polanyi's [1] definition, tacit knowledge is highly personal, context-specific, and therefore hard to formalize and communicate. Tacit knowledge is knowledge housed in the human brain, such as expertise, understanding, or professional insight formed as a result of experience. Explicit knowledge, on the other hand, refers to codified knowledge that is transmittable in formal, systematic language and is easily transferred by using Information Technology (IT).

Because of the orientation toward unique projects, much knowledge in the Architecture, Engineering and Construction (AEC) industry is experience-based and tacit. The knowledge needs are dynamic, depending on the task to be performed or the problem to be solved. Nevertheless, the typical strategy for knowledge management is to make knowledge explicit and store it as computer software and databases. It is

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* Corresponding author. Tel.: +1-979-863-901.
*E-mail address:* jwoo@tamu.edu (J.-H. Woo).

driven by the exponential advances in IT. Hansen et al. [2] and Johannessen et al. [3] pointed out that IT usefulness is limited to the transfer of explicit knowledge only. Chiti Ho, Chief Technology Officer of 3D/International, also said that the use of IT solutions influences the communication of explicit information only. Therefore, the emphasis on IT may compromise effective tacit knowledge; furthermore, experts' tacit knowledge could be wasted and ignored.

As a result, there are numerous problems with knowledge-based system resulting from the nonapplicable conversion of tacit knowledge to explicitly documented knowledge. It is often difficult to extend and enhance a knowledge-based system with additional expert knowledge once the system is fielded. The knowledge-based system works well only if the system contains enough input from human experts. The primary reason that most knowledge-based systems are not well integrated into the AEC process is that it is difficult for project managers to assess the applicability of this technology to the AEC processes [4]. Within the context of rapidly changing technologies and processes, an existing knowledge-based system might no longer seem capable of meeting the increasingly complex knowledge demands in the industry. Although the technical capabilities of knowledge-based systems are expanding, they still fall short of applicability to the AEC processes they are designated to support. On the other hand, some AEC companies have tried to implement a ''Lesson Learned'' system to record personal tacit experiences [5]. However, those systems require extensive efforts to record tacit experiences.

AEC firms have been successful at collecting and storing explicit information in enterprise databases, but they are not always good at tacit knowledge retrieval and sharing. Consequently, AEC professionals find it difficult to access core knowledge for highly knowledge-intensive AEC activities. This situation calls for a method for disseminating tacit knowledge from human experts, especially for use by large AEC firms. The primary purpose of this paper is to set a theoretical foundation for clarifying the contributions of experts' tacit knowledge in AEC industry. The secondary purpose is to describe the concept for prototype software, Dynamic Knowledge Map, to reuse experts' tacit knowledge more productively.

## 2. Tacit knowledge in the AEC organization

An enormous volume of AEC knowledge is generated during the phases of design, planning, construction, and maintenance of a facility. Throughout the whole life cycle of a construction project, AEC firms rely on their experiences, professional intuition, and/or other forms of tacit knowledge to accomplish satisfactory work. However, the difficulties of exchanging knowledge among project participants were observed by the author many times while working for general contractors. Specifically, the difficulties are more serious in large, geographically dispersed AEC firms, that have more experience than smaller firms.

In an AEC organization, it is more likely that employees will work on similar projects, although there is no explicit link between projects. Top managers generally assume the AEC professionals already possess tacit knowledge and experience for specific types of projects. This allows experienced workers to share their knowledge and experiences with apprentices through a form of storytelling and communities of practice [6]. Specifically, sophisticated construction methods are successfully applied by highly educated, experienced professionals on job sites. Rogus [5] pointed out that this knowledge is extremely important to the AEC organization because, once a project is completed, professionals tend to forget it and start something new. Therefore, knowledge utilization is a key factor in productively executing a construction project. However, there are no definite strategies for managing, interpreting, and applying tacit knowledge on a job site.

## 3. Reusing experts' tacit knowledge

Polanyi [1] presented the first theory concerning tacit knowledge in his book, *Tacit Dimension*. Since then, numerous studies have demonstrated the importance of tacit knowledge in real-world performance. In much of the literature, tacit knowledge has been emphasized and regarded as the important strategic resource that assists in accomplishing a task [7–9,]. Polanyi [1] also insisted that tacit knowledge is the basis of creativity. The research done by Sternberg et al. [9] showed that much of the knowledge needed to succeed in real-world tasks is tacit. Malhotra [10] also