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Developing a knowledge map for construction scheduling using a novel approach

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Abstract

A knowledge map is a vital tool for better knowledge management and learning. While application of knowledge maps in the construction domain remains in the initial stages of development, the construction industry is experience-oriented and therefore suited to knowledge maps. This study presents a novel approach for developing a knowledge map for construction scheduling. According to framework-based classification, this study utilizes a science-specific search engine to search for literature on construction scheduling knowledge. Search results are then used to develop a file cabinet knowledge map consisting of a contour map, and several trend and density charts. This map representation compensates for the lack of various meanings in a single knowledge map. For novices interested in learning construction scheduling knowledge, results of this study provide constructive information to know the key issues and research trends in the construction domain. In summary, this study presents a suitable procedure for extracting knowledge from public knowledge sources for development of a knowledge map. The proposed approach can be used for rapid generation of knowledge maps.

1. Introduction

Schedule planning and control is a major task in successful construction project management. Since the 1950s, the critical path method (CPM) and program evaluation and review technique (PERT) have been extensively adopted for project scheduling and control. Excluding modifications on CPM and PERT, new robust scheduling approaches have not been developed by academics and practitioners in the recent decades. Investigations to enhance the performance of available scheduling techniques as necessary as requirements for researchers change in the construction industry. Researchers or new learners require an aid, a clear image of a study or learning target, as a basis for further study. The innovative concept of knowledge management is a good choice.

Owing to the rapid evolution of the knowledge industry, knowledge engineers are confronted with the challenge of how to construct a well-linked knowledge network that allows a

learner to acquire knowledge quickly. Many techniques have been developed to help the construction of knowledge networks. A knowledge map that creates relationships among isolated knowledge and represents knowledge via a hierarchy structure is a knowledge representation type that is most valuable. A knowledge map can clarify vague knowledge, enabling users and learners to easily find desired knowledge. Recently, domain knowledge about construction management has received considerable attention. Schedule management is an important topic within construction management. When a comprehensive knowledge map for construction scheduling domain can be constructed, domain development matures and learners improve their knowledge.

Although approaches have been used to develop knowledge maps, their usability for public knowledge sources is not proven. Knowledge engineers are required to test this usability because public knowledge sources (public search engines) will be the most prosperous future knowledge sources. Furthermore, the knowledge map in the domain of construction scheduling, such as a hierarchy for project scheduling and monitoring proposed by Ahuja and Thiruvengadam [1], is insufficient for

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knowledge learners. One important functionality of a knowledge map is to enhance the quality of learning materials for potential learners. This study tried to compensate for the lack of variety in a single type of knowledge map for construction scheduling techniques.

The rest of this paper is organized as follows. Section 2 presents a review of literature in the knowledge management and construction management domains to collect and summarize information on knowledge maps and construction scheduling techniques. Section 3 describes the data sources used for developing a knowledge map for construction scheduling techniques. Section 4 presents the novel approach for rapidly constructing a knowledge map. A knowledge map for construction scheduling techniques, including a knowledge framework with a contour map, and several trend and density charts, is organized on web pages with pictorial representations. Section 5 presents conclusions and future research directions.

2. Literature review

2.1. Construction scheduling

Scheduling, as loosely defined by Sule, involves defining priorities or arranging activities to meet certain requirements, constraints or objects [2]. Scheduling is a vital tool for successful project management. For a construction project, project planning, particularly schedule planning, is at the heart of good project management because it provides the central communication coordinating the work of all parties [3]. How to optimally schedule a project is a basic skill of construction management professionals.

Betts and Lansley [4] reviewed all of the articles published in the journal of Construction Management and Economics (CME) from 1983 to 1992. They indicated that these articles published by CME are mainly concerned with production-related issues in the construction industry. The topic of "project planning, scheduling and systems" is hot all through the analyzed time. Pietroforte and Stefani [5] reviewed all of the articles published in the ASCE Journal of Construction Engineering and Management (CEM) between 1983 and 2000. They determined that the issue of time scheduling (including the subjects and topics of cost/time scheduling, critical path method, line of balance technique, linear and vertical scheduling, network planning and analysis, other deterministic time scheduling techniques, other nondeterministic time scheduling techniques, PERT and GERT, and time duration estimate, variability) were common during the investigation period. Simultaneously, Abudayyeh et al. [6] analyzed the research trends in the construction domain in the CEM journal from 1985 to 2002. They identified "scheduling" as the leading research topic. This topic has received considerable attention internationally with 4.65% of the 879 articles analyzing scheduling-related problems.

The domain of construction scheduling is an important research topic. Furthermore, courses in construction planning and scheduling focus on construction scheduling techniques and are core courses in construction management graduate programs at universities worldwide. Learners must be given a clear picture of learning courses in the beginning of their studies. That is, comprehensive knowledge is a requisite during learning and studying. Application of knowledge management using a knowledge map meets this requirement.

2.2. Knowledge management

The Longman Dictionary of Contemporary English defines knowledge as the facts, information, skills, and understanding that one has gained, especially through learning or experience [7]. Alavi and Leidner [8] considered knowledge from the following five perspectives: state of mind; an object; a process; a condition of having access to information; and, a capability. Managing knowledge depends on the viewpoints of knowledge engineers and end-users. Davenport and Prusak defined knowledge as a fluid mix of framed experience, values, contextual information and expert insight [9]. Knowledge exists when different transformative processes, such as comparison, consequence, connection and conversation works. They also asserted that knowledge management is much more than technology; however, "techknowledge" is clearly a part of knowledge management. Technology can diversify knowledge management. With the rapid renovation of Information Technology (IT), knowledge of how to best manage knowledge by IT is an important issue in academic and industrial domains. Recent studies examining knowledge management technologies, applications and systems have been reviewed in detail elsewhere [8,10].

In the construction industry, engineering/management consulting firms are knowledge-based companies whose primary product is knowledge. Knowledge management in such firms is identical to that in general manufacturing or service enterprises, and has recently attracted intensive study. Other firms regard knowledge management as a competitive advantage rather than a survival tool. This circumstance results in an industry crisis. The major difficulty in implementing knowledge management in the construction industry is formulation and implementation of a strategy [11]. Although previous studies attempted to select or to develop an appropriate strategy for the construction industry [11,12], managerial courage is required to face this challenge and achieve changes.

Knowledge management associated with learning construction scheduling techniques in this study is an issue of how to best provide access to required knowledge via a user-friendly interface. Several accepted methods exist for knowledge representation, including rules, frames, semantic networks, concept diagrams (concept mapping) and knowledge maps (knowledge mapping) [13,14]. The knowledge map method, a navigation aid to explicit and tacit knowledge [15], meets this study's requirements.

2.3. Knowledge map

Davenport and Prusak defined a knowledge map as a knowledge yellow pages or a cleverly constructed database [9]. A knowledge map, which can be used to point to knowledge,