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Case-based reasoning and text mining for green building decision making

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Abstract

There are great benefits to be obtained by sharing previous experiences in meeting the needs of the standard evaluation systems for green building around the world. To date, there are no existing methods available that enable this to take place in a systematic way. This paper addresses the issue by developing a green building experience-mining (GBEM) model that enables previous green building solutions to be adapted for a new situation. A database of 10 cases is used to demonstrate and evaluate the effectiveness of the GBEM model. The results confirm the model's potential to facilitate users in the selection of the solutions when addressing new green building challenges.

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1. Introduction

Green building is attracting increasing attention for its role in environmental preservation as well as the economic benefits involved. The popular concern for green building reflects the potential importance of construction for environmental conservation [1]. Small improvements in the sustainability of buildings, or in the energy efficiency of their design and construction, have a significant influence on the amount of their energy consumption. Therefore, the implementation of green building is significant because it has become an increasing important attribute of economic activities concerning methods of production [1]. The development of green buildings has a large effect on city development, as evidenced by several studies of the relationship between green building and urban development [2-4].

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Given the significance of green building, the promotion of sustainability principles for building has resulted in numerous associated practices. Most significant are the various rating systems that now exist in many parts of the world today, the main ones of which are the UK Building Research Establishment's (BRE) Environmental Assessment Methodology (BREEAM) established in 1990 and now used in more than 50 countries around the world; the U.S. Green Building Council's (USGBC) Leadership in Energy and Environmental Design (LEED) Green Building Rating System, instigated in 1994 as the nationally accepted benchmark for the design, construction and operation of high performance green buildings; the Australia Sustainable Energy Development Authority's (SEDA) Australian Building Greenhouse Rating Scheme (ABGRS) launched in 1998 as the first Australian comprehensive green building assessment system, which evaluates energy consumption and carbon dioxide emissions; and the Ministry of Housing and Urban-Rural Development of China's 2005 national "Green Building Evaluation Standard", which covers all types of civil buildings from previous residential buildings and public from the design phase thru to building operation. The German sustainable building council (GeSBC) was formed in 2007 and developed a certification system tool for new office buildings, which covers more than fifty criteria with quantification rules and target values for new construction office buildings. The French eco-building rating system known as High-Quality Environment (HQE) was established by the non-profit Association HQE in 1992. The first Italian association of architects promoting green building awareness, the Associazione Nazionale Architettura Bioecologica (ANAB), was founded in 1989. In March 2008, the building energy certificates have been issued throughout the country for new buildings and for property transfer of existing medium and large buildings in Italy. Besides the Europe, several hot climate countries have made effort to attempt to follow the international green movement. For example, the Green Building Standard SI 281 (Israel) was founded in 2005 and issued the Israeli Green Building Standard IS 5281, a point scoring system. Pearl Building Rating System (PBRS) (UAE) is developed by The Abu Dhabi Urban Planning Council (UPC) for new construction buildings in 2007. Qatar Sustainability Assessment System (QSAS) is a green building certification system developed for the State of Qatar by the T.C. Chan Centre for Building Simulation and Energy Studies at the University of Pennsylvania.

One outcome of the application of these standard criteria ranking or evaluation systems is a large amount of experience with their use. This is a common situation in the construction industry, where experience-oriented practitioners are accustomed to addressing issues and problems by utilizing their accumulated experience and knowledge [5]. Previous experience is therefore highly important because it provides a valuable reference for current construction problems [6]. Applying this process to green building in an organized way involves establishing a database of associated experiences and developing a means of systematically reusing the information contained therein. The national standard evaluation system provides a model of the structure of the database. The system's requirements for each ranking level can be used to divide the experiences of building green construction into similar levels. Therefore, the aim of this paper is to build a green building experience-mining (GBEM) model with case-based reasoning and text mining. Case-based reasoning (CBR) is a method providing decision-makers with a framework to solve current problems by recalling and reusing previous knowledge and experience [7]. The term 'case' refers to a previous concrete situation, including problems, solutions and outcomes [7]. In order to turn the experience in the format of text to be systematically descriptive, this paper utilizes the text mining techniques that enable to translate the semantic questions involved into theoretical problems. Text mining is an emerging technology that attempts to extract meaningful information from unstructured textual data[8]. It can be seen as an extension of data mining to textual data. The remainder of this study is comprised as follows: first, in the literature review section, the background of CBR and green building are introduced respectively as well as the methodologies used for the model are explained. Second, the GBEM model is proposed using the aforementioned methodology. Thirdly, a case study is conducted to validate the model's effectiveness. Lastly, the findings and contribution of this research are discussed in the contribution section.

2. Literature Review

2.1. Case-based reasoning

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