Web-Based Decision Support for Knowledge Sharing and Management in Intelligent Buildings Assessment

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INTRODUCTION

This article presents the knowledge-oriented information visualization (KIV) approach to facilitating the utilization of building rating systems at post-assessment stage. The KIV approach is introduced by using a Web-based decision support model. The model consists of several toolkits, including a case base of intelligent buildings to support the application of sustainable technologies, a Web-oriented information visualization toolkit for intelligent buildings assessment, and a geographical information system (GIS) toolkit for knowledge reuse in buildings variations. A case study is used to demonstrate how the KIV approach can be applied to support decision making at the post-assessment stage of intelligent buildings.

BACKGROUND

For building assessment, the currently most popular way is to use rating method. For example, the U.S. Green Building Council (USGBC, 2005) has developed the **LEED** Green Building Rating System for developing high-performance, sustainable buildings. Regarding the assessment of intelligent buildings, the authors have reviewed six specially developed intelligent buildings assessment systems adopted or to be adopted across the world, including the IB Index method developed by the Asian Institute of Intelligent Buildings (AIIB, 2005), the Matool method developed by the Building Research Establishment Ltd. in the UK (Bassi, 2005), the Building IQ method developed by the Continental Automated Building Association in North America (CABA, 2004), the ABRIT method developed by the Architecture and Building Research Institute in Taiwan, China (Wen, 2003), the IBSK method developed by the Intelligent Building Society of Korea in Korea (IBSK, 2002), and the SCC method developed by the Shanghai Construction Council in China (SCC, 2002). Among these intelligent buildings assessment systems, the AIIB method is identified as the most comprehensive one with more potential utilizations in intelligent buildings assessment.

However, it is also noticed that nearly all rating systems currently used in building assessment end at achieving a score of buildings. As to the rest, the current practice of building assessment does not cover issues about how to improve buildings. For example, designers or decision makers have to go through all indicators or aspects in accordance with the building assessment to find exact gaps between current status and further improvement in building design or building utilization. They have to study building appraisal reports for detailed information regarding which part of the building needs to be altered so as to get a higher score. Actually, this is time consuming and confusing for either designers or decision makers to work accurately, effectively, and efficiently. As mentioned by Rafiq, Packham, and Beck (2005) there is an urgent need for systems that allow proper visualisation of the information in an understandable manner particularly at the building design stage. Regarding how to effectively improve building designs based on assessment results, there is still lack of adequate skills and information available at the utilization level. In this regard, toolkits to support decision making at the post-assessment stage of intelligent buildings are in demand.

In the building professions, the drawing of buildings is engineers' language, information visualization is therefore an inherent means in their daily work no matter whether a computer is used or not; and it is always used by designers in various formats such as drawings, diagrams, maps, photos, and so forth. However, research for the innovative use of modern information visualization technology other than the traditional way of information expression in the building professions has been rapidly evolving over the past decade (Malkawi, 2004). For example, Bouchlaghem, Sher, and Beacham (2000) introduced an application of digital imagery and visualization materials to aid building technology related modules in higher education; the Arup (2002) adopted an "umbrella" to show the results of sustainability assessment of buildings; the Japan Sustainable Building Consortium (JSBC, 2004) used radar charts to illustrate the results of building assessment. Intelligent buildings are different from each other, and different buildings have different features in both design and utilization. It is reasonable to believe that the experience and expertise of building designers and end users are developed over time through their continuous interaction with particular building spaces for either imaging or using, and their expertises can be accessed by means of visualization technologies (Carvajal, 2005). The evolving research of applied information visualization technology in the building professions reveals a developing trend from which information visualization and decision support, integrated applications are required.

There are two tasks for decision making at the post-assessment stage of intelligent buildings including active gap identification and reliable decision making. As mentioned previously, building rating systems can give scores to each building under assessment, but they can not give definite explanations regarding where their specific weaknesses are and what necessary variations are. In this regard, this article takes an initiative to integrate information visualization with decision support so as to facilitate making accurate variations for buildings at the post-assessment stage. To undertake these tasks, this article will introduce a knowledge-oriented information visualization (KIV) approach. It comprises several toolkits including a case base for the knowledge management of intelligent buildings; a radar chart made in Microsoft Excel to illustrate current and gap scores of intelligent buildings based on their rating; an Internet-enabled portal for intelligent buildings information navigation based on the radar chart; and a GIS for spatial information management of intelligent buildings. On the other hand, the information available in multiple languages is significantly increasing, and knowledge reuse for decision making on buildings variations at their post-assessment stage have to rely on information from multilingual information resources in a global perspective. From this point of view, it is also the authors' initiatives to engage in the language alternation of these KIV toolkits as mentioned previously for further research and development in order that multilingual information can be delivered to users speaking multiple languages. A case study will be finally conducted to demonstrate how to use the KIV approach at the post-assessment stage of intelligent buildings.

MAIN FOCUS

Methodology

The methodology adopted in this research comprises several methods focusing on detailed objectives mentioned previously. First of all, an extensive literature review is required to explore achievements in the areas of information visualization, knowledge management, decision support, building assessment, and so forth. After that, system analysis will be used to develop a prototype for applying the KIV approach to the assessment of intelligent buildings. For each toolkit of the KIV approach, system analysis and development techniques will be adopted to realize their various functions. In addition, software tools such Microsoft Office will be used to make toolkits easy to be used in the building professions.

The KIV Model

The KIV model is a prototype to describe the theory of the KIV approach for intelligent buildings assessment. Figure 1 illustrates a conceptual KIV model.