

RESEARCH BRIEF

2005/01

Knowledge-based Decision Support System (KBDSS) for Management of Variation Orders for PRIME Buildings in Singapore

This research project was a collaborative effort of the Project Development and Management (PDM) Branch, Ministry of Education and Department of Building, National University of Singapore. The study described an extensive investigation into the development of a knowledge-based decision support system (KBDSS) for the effective management of variations in school building projects in Singapore. The objectives of this research study were to investigate the root causes, effects and controls for variations and to develop a KBDSS for management of variation orders for school building projects in Singapore.

METHODOLOGY

To achieve the study objectives, questionnaire surveys and interviews with the developers, consultants and contractors, and in-depth analyses of the information collected from source documents of the school building projects were carried out to build up a strong base for developing the KBDSS. As part of this study, 80 school building projects that were completed under the Programme for Rebuilding and Improving Existing Schools (PRIME) were thoroughly examined for data collection. In-depth interviews with the professionals, who were involved in these school projects, were also analyzed.

The analyses suggested that the design phases were the most potential areas in which to focus to reduce potential variations in future school projects. Sufficient time for design activities should be allocated so that the designer would be able to develop a more detailed design. This may assist in reducing variations arising from inadequate design, ambiguities and errors in design and non-compliance of design with government regulations. The study further presented a time-line based checklist for implementing controls for variations. The checklist would assist professionals in implementing controlling strategies at the appropriate time.

Finally the study presented the KBDSS developed based on the data collected from these 80 school projects, for effective management of variations. The KBDSS consisted of two main components, i.e. a knowledge-base and a decision support shell for selecting appropriate controls. The main components of the KBDSS are shown in Figure 1. The knowledge-base was developed through initial sieving and organisation of the data from the database. The knowledge-base was divided into three main segments, namely, macro layer, micro layer and effects/controls layer. The system contained one macro layer that consisted of the major information gathered from source documents,

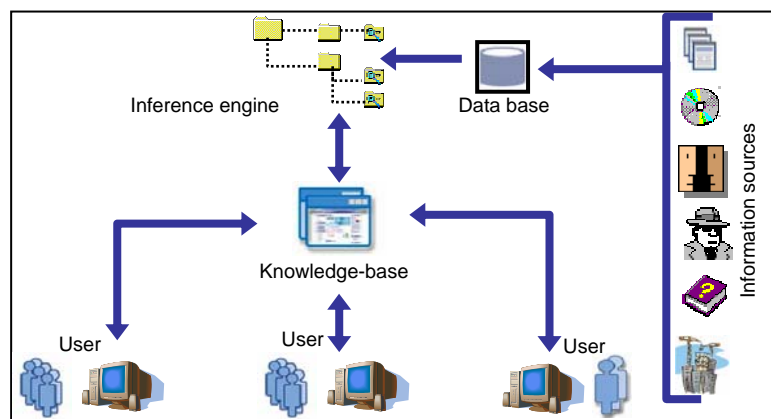


Figure 1. The main components of KBDSS.

and 80 micro layers that consisted of detailed information pertinent to variations and variation orders for each project. Overall the system contained 155 layers of information. The segment that contained information pertinent to possible effects and controls of the causes of variation orders for institutional buildings was integrated with the decision support shell. The shell contained 53 layers based on each of the causes of variations and their most effective controls. The decision support shell provided decision support through a structured process consisting of building the hierarchy between the main criteria and the suggested controls, rating the controls, and analyzing the controls for selection through multiple analytical techniques. The system validation process was carried out using two real-time case studies where the professionals from the PDM Branch were asked to use the KBDSS for managing variations. The feedbacks from the professionals were encouraging and affirmative.

BENEFITS

The KBDSS will assist the professionals by providing accurate and timely information for decision making, and a user-friendly system for analyzing the variation orders for school buildings. A few sample screenshots of the KBDSS are shown in Figures 2 and 3. Furthermore, the KBDSS will also assist the professional team (decision makers) to select the appropriate controlling method to minimize variations and their effects. The KBDSS will be able to display variations and their relevant details, a variety of filtered knowledge, and various analyses of available knowledge of past projects. This would eventually lead decision makers to the various suggested controls for the variations and assist in selecting the most appropriate solutions. The KBDSS will provide an excellent opportunity to the professionals to learn from past experiences, garner a better understanding of the root causes of variations and how they impact the construction projects, a better understanding of the corrective measures for reducing variations and when these should be implemented.

With further generic enhancement and modification, the KBDSS will also be useful for the management of variation orders in other types of building projects, thus helping to raise the overall level of productivity in the construction industry. The system developed and the findings from this study would also be valuable for all building professionals in general.

Findings from this research project presented to the Project Management Institute (PMI) in the United States won the PMI's Donald S. Barrie Award (2005). The award was presented at the PMI Global Congress held in Toronto, Canada, in September 2005.

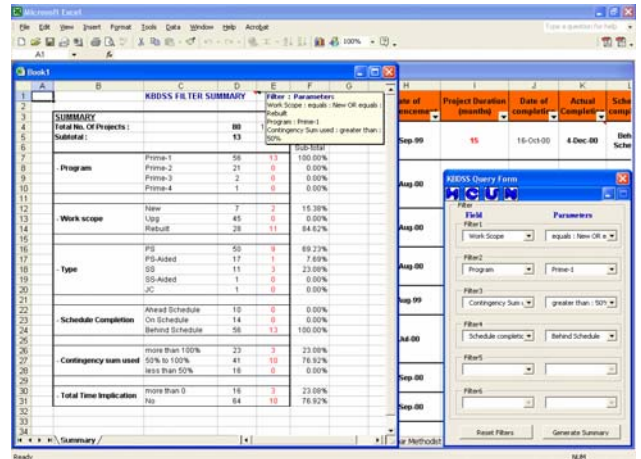


Figure 2. Summary section displaying results of the filters applied on the macro layer.



Figure 3. The suggested controls sorted according to contributions by criteria.

CONTACT DETAILS

Professor LOW Sui Pheng
 Department of Building
 School of Design and Environment
 National University of Singapore
 4 Architecture Drive
 Singapore 117566
 Fax: (65) 6775 5502
 Tel: (65) 6516 3439
 E-mail: bdglowsp@nus.edu.sg