MODELING A DECISION SUPPORT SYSTEM FOR BUILDABLE DESIGNS

YANG YI QING

[B.Eng. (Cons. Eng.); M.Sc. (Bldg. Mgt. & Eco.), Chongqing University]

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SUMMARY

The construction industry is fragmented in nature. Buildable designs have been regarded as an important strategy to enhance overall performance in the fragmented industry. However, this objective has been difficult to realize due to the lack of buildability knowledge and the shortcomings of formal decision-making methods in the early design process.

The purpose of this study is to develop an integrated design approach to decision-making in buildable designs based on the principles and methods of concurrent engineering.

To develop such an approach, the House of Quality for Buildable Designs (HOQBD) was constructed to support the integrated decision-making of buildable designs by adapting matrices of the conventional HOQ. The algorithms and inference mechanisms of the HOQBD were then developed by fuzzy set theories. In the fuzzy HOQBD, triangular fuzzy numbers were used to intuitively represent the linguistic and imprecise nature of decisions and judgments of buildable designs so as to objectively and realistically reflect the process of buildable design decision-making. Fuzzy inference mechanisms and algorithms were established to automatically process the design-relevant QFD information. To further extend the fuzzy HOQBD for buildable designs, a hybrid QFD system was proposed by incorporating the knowledge-based system into the fuzzy HOQBD. In the hybrid QFD system, three knowledge bases, namely, knowledge of buildability attributes, knowledge of buildable design features and knowledge of relationships between

buildability attributes and buildable design features, were integrated into the process of HOQBD implementation to facilitate the transfer of design-relevant construction knowledge and experience. The Linguistic Order Weighted Average (LOWA) operator was used to process design-relevant buildability information.

A prototype software, named a Decision Support System for Buildable Designs (the BD-DSS), was developed to demonstrate and test the proposed concurrent design approach in Singapore. The system analysis of the BD-DSS was carried out by the unified modeling language (UML). The BD-DSS was developed using Microsoft Visual Basic (Professional version 6.0) for Windows. The prototype was implemented and tested by two real-life cases, namely, an industrial project and a residential project. The BD-DSS has demonstrated its ability in quantitative buildability evaluation through a cooperative multi-functional project team in two aspects. Feedback from practitioners also showed that the proposed approach is a viable decision-support tool for buildable designs.

The BD-DSS developed based on the fuzzy HOQBD advanced the traditional QFD for buildable designs in two aspects. Firstly, it can provide a structured and systematic way to support the decision-making process of buildable designs. Secondly, it can create an information-centered environment to aid the transfer, acquisition and utilization of buildability knowledge and relevant information. The possible directions for future research include provision of a supportive environment, assessment and improvement of the concurrent information representation model, automated acquisition of the integrated design and

construction knowledge, development of intelligent software tools, and extension and combination of QFD with research efforts.