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Dissertation
"Decision Support Expert System for Process Selection"

Abstract

This thesis presents a new methodology to automate decision making in engineering. Decision making for the selection problems in the field of engineering has become more complex due to larger number of alternatives and multiple goals that sometimes conflict with each other. As a decision aid for engineers, it is necessary to design a decision support expert system for the engineering selection problems. For the case study, we apply our framework to the domain of chemical engineering, specializing in the domain of microencapsulation process selection.

The proposed system incorporates Expert System (ES) module and Multiple Attribute Decision Method (MADM) module that consists of three submodules, i.e. Analytical Hierarchy Process (AHP), Base Reference Analytical Hierarchy Process (BR-AHP) and fuzzy Base Reference Analytical Hierarchy Process (fuzzy BR-AHP) modules. The ES module provides a list of feasible alternatives and then the MADM module is used to rank the alternatives.

The Analytical Hierarchy Process (AHP) is a MADM approach that utilizes structured pairwise comparisons. Although pairwise comparisons have been seen as an effective way for eliciting qualitative data, a major drawback is that the exhaustive pairwise comparison is tiresome and time consuming when there are many alternatives to be considered. We propose a new approach to improve this limitation, the so-called Base Reference Analytical Hierarchy Process (BR-AHP).

Since many real-world engineering systems are too complex to be defined precisely, there exist imprecisions or approximations. The available information for making a decision may also be vague and uncertain. Thus, a more realistic approach is to incorporate fuzzy theory. Therefore, we propose a new approach to cope with imprecision, uncertainties and vagueness in the judgments of the decision makers, the so-called fuzzy Base Reference Analytical Hierarchy Process (fuzzy BR-AHP). In many cases, data in the MADM problems are imprecise and easy to change. Therefore, the framework proposed in this thesis also incorporates sensitivity analysis for handling changeable data.