

Similarity-Based Experts Weighting of CBR-Based Multi-experts System in Partner Selection

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Abstract: - With the development of supply chain collaboration in agile manufacturing (AM), outsourcing has become a focus, in which partner selection is an important problem. Outsourcing decision is often related with expertise. The decision of partner selection needs to take opinions of multi-experts from various departments of enterprise into consideration. Expert system (ES) is one of the main branches that focus on expertise, and case-based reasoning (CBR) is a methodology for problem solving in complex environments. In this research, a new approach of similarity-based experts weighting in CBR-based multi-experts system (MES) was proposed to integrate expertise in outsourcing of AM. Foundational issues of expert weighting in CBR-based MES, including the R^6 model, assumption of delaminating structure of case and similarity-based experts weighting, were firstly discussed. Based on the R^6 model and assumptions, experts weighting mechanism in CBR-based MES was then built up, including weighting founded on consensus-based similarity and that founded on case-based similarity. Finally, the application of multi-experts weighting approach in supplier selection carried out.

Key-Words: - Outsourcing; Experts weighting; Case-based reasoning; Multi-experts System; Partner selection

1 Introduction

The global trend of outsourcing has resulted in companies' more dependent on their suppliers in agile manufacturing (AM) which is believed to be the strategy for being more competitive [1], [2]. Companies are now adopting intensive relationships with their supply base when realizing AM [3], which is one of the common features shared by the so-called virtual enterprise [4], extended enterprise [5], and supply chain. In general, the lifecycle of multi-firms' cooperation has three stages: creation, operation, and dissolution. Firms always choose some key suppliers to develop collaborative relationships with them in creation stage. Partner selection in companies' outsourcing strategy of AM has called broad attention. Various theories, such as AHP [6], Goal Programming Model [7], Ant Colony Optimization [8], etc., have been introduced into this area. In recent years, the development of artificial intelligence techniques provides a new way to research outsourcing partner selection in AM. The introduction of artificial intelligence technologies into outsourcing management could lead to the management of supplier intelligence.

Case-based reasoning (CBR) was employed to development an expert system (ES) for outsourcing operations [9]. In fact, partner selection in

outsourcing strategy of AM is a typical multi-experts decision problem. When deciding which supplier is important and suitable for the supply chain cooperation in the framework of CBR-based ES, several departments of various firms in the same supply chain, such as outsourcing department, financial department, etc. should be involved in the decision process. Because outsourcing partners selection in AM is not just a one person decision. When a partner taking part in the AM strategy of a firm, there are always transactions and trades between it and the firm and its cooperators. That is to say, CBR-based ES in outsourcing management of AM, which is an expert system build-up in the framework of CBR, is always in the form of group decision. Hence, CBR-based multi-experts system (MES), which is an expert system build-up in the framework of CBR and multi-experts decision, is a more applicable way to realize outsourcing partner selection of AM.

Multi-experts decision is usually understood as the reduction of different individual preferences by knowledge. Its main goal is to get a final group consensus from individual preferences. CBR in outsourcing decision of AM carries on based on the group consensus. When a situation involves multi-experts, each with different knowledge, the final

consensus will be integrated between this expert's preferences and those of others. In the integrated process, expert weighting is an inevitable problem that had to be studied in MES. Hence, when CBR is employed into the building-up of partner selection in companies' outsourcing strategy of AM, experts weighting in the framework of CBR-based MES is an inevitable research problem.

In this research, similarity-based experts weighting approach in CBR-Based MES is proposed to tackle expertise problem in outsourcing management of AM. The new approach can truly utilize experts' knowledge. The rest of the paper is divided into 4 sections. Section 2 is a discussion on several foundational issues of CBR-based MES in experts weighting of outsourcing partner selection, following by the building up of experts weighting mechanism in section 3. Section 4 is an application of similarity-based experts weighting process into supplier selection. Section 5 makes conclusion.

2 Foundational Issues of Experts Weighting in CBR-Based MES

2.1 Experts Weighting in MES

ES was developed in the mid-1960s, whose traditional basic idea is that expertise is transferred from a human to a computer and called on by users for specific advice as needed [10]. The development of such a knowledge-base system involves: identifying a real world problem solving task, representing key components, and implementing the inference process, the last two of which are involved in knowledge engineering process [11]. The task of developing a reasoning mechanism would be simpler, if the mechanism of producing a construction of the real-world knowledge is perfect. Whereas, expert knowledge is always qualitative and quantification value of experts' knowledge is subject to imprecision, uncertainty, and

inconsistency, which is hard to be represented perfectly by knowledge engineering.

Case-based reasoning (CBR), which was firstly proposed by professor Schank, is one of the main problem solving methodology employed in ES [12], [13]. It is able to utilize the specific knowledge of previously experienced, concrete problem situations, instead of relying solely on general knowledge. As a result, CBR-based ES has called broad attention [14], [15], [16]. It is a feasible way to employ CBR-based MES in outsourcing partner selection. To enhance the efficiency of reasoning, implementing knowledge reasoning in the presence of experts had to be introduced as a supplementary of traditional reasoning implementation in the absence of experts. The parameters of experts' weights are a key to reasoning process in the situation of MES. Common methodologies traditionally used in experts weighting are those exiting ones of criterion weighting process such as directly giving weight, Analytic Hierarchy Process (AHP), Simos' procedure, etc., on the assumption of introducing a supra-actor [17], [18], [19]. Nevertheless, experts weighting and criterion weighting are not two sides of the same icon. Thus, some new methods of expert weighting must be developed in the situation of CBR-based MES.

2.2 R⁶ Process-Oriented Model in CBR-Based MES

The traditional process-oriented model of CBR-based ES is the R⁴ model proposed by Aamodt and Plaza [20], [21] i.e. Retrieve, Reuse, Revise, and Retain. Because CBR is heavily dependent on the structure and content of case collection, Finnie and Sun [22] integrated case construction into the R⁴ model and proposed a R⁵ model. Hence, core problems addressed by CBR research society can be grouped into five areas, i.e. knowledge representation, retrieval methods, reuse methods, revise methods, and retain methods. The two R^x models can be shown in Fig. 1.

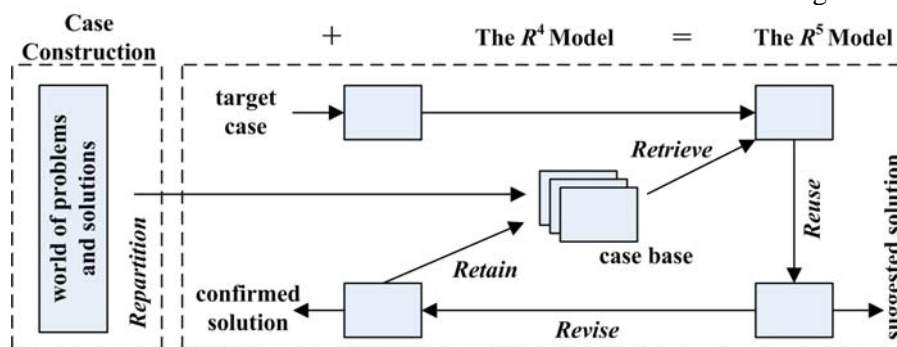


Fig. 1. The two R^x process-oriented models in CBR-based ES

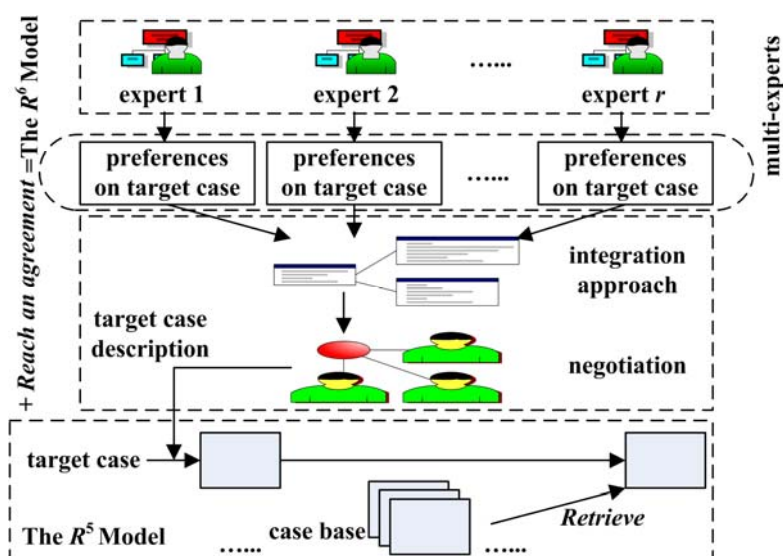


Fig. 2. The R^6 process-oriented model in CBR-based MES

In the situation of CBR-based MES, multi-experts are introduced into the traditional process-oriented model to strengthen retrieval methods. Thus, Reach an agreement is another R process. In many domain problems, especially in related areas of outsourcing management in AM, descriptions on target case are a hard job that involved lots of qualitative factors. Taking the sub-feature, promotion, of the feature, market mix, as an example [16], different experts may have different opinions on promotion of a firm. When dealing with these types of features, multi-experts decision is a feasible way to reduce individual preferences based on their knowledge and make the retrieval process more reasonable and effective. The difference between process-oriented model of CBR-based MES and the R^5 model is mainly on retrieval process. In the retrieval process, multi-experts firstly draw out individual opinion on target case on the foundation of their expertise. In the following step, preferences on target case of each individual expert are integrated to form group consensus through integration approach, in which experts weighting is always employed. Then, multi-experts negotiate on the consensus. Finally, multi-experts' preferences on target case are formed. The R^6 model can be shown in Fig. 2.

2.3 Assumption of Delaminating Structure of a Case

Taking case structure in CBR based marketing plans system [16] into account, there are lots of features of a case, including case name, case company, status analysis, objective, marketing mix, and so on. While, there are some sub-features of a feature, e.g. there

are three sub-features, i.e. company name, business target, and market position, in the feature of case company. And there are four sub-features, i.e. price, product, channel, and promotion, in the feature of market mix. At the same time, the feature of product also has three sub-features, i.e. main product, sub product, and brand. Obviously, there are delaminating structures of a case. What we concerned in this research is the approach of experts weighting in CBR-based MES. Therefore, we can make the assumption that there is a two-level case structure in CBR-based MES. And experts weighting in this assumption can be extended to the situation of multi-level case structure easily, and can also be simplified to the situation of one-level case structure. The two-level case delaminating structure assumption is shown in Fig. 3.

2.4 Assumption of Similarity-Based Experts Weighting

Similarity-based experts weighting is a new weighting mechanism we proposed, in which an expert' weight is computed through the similarity between each expert's individual preference and the final decision result. The assumption of similarity-based experts weighting is that expert's decision accuracy is directly influenced by his or her domain knowledge. The more abundant his/her domain knowledge is the more accurate and reasonable his/her decision is, and the more heavily he should be weighted in multi-expert decision. While, traditional used experts weighting methods such as directly giving weight, AHP, and Simos' procedure, which can be called supra-actor-based expert weighting, is directly influenced by the assumptive

