Fuzzy topsis method

Business, Decision Making

Fuzzy TOPSIS method This is an approach based on the TOPSIS technique (Technique for Order Preference by Similarity to Ideal Solution) and the fuzzy set theory. The TOPSIS method is based on the concept that the optimum option has the least distance from the positive ideal solution. It is a linear weighting technique, which was first proposed, in its crisp version by Chen and Hwang(1992), with reference to Hwang and Yoon(1981). Since then, this method has been widely adopted to solve MCDM problems in many different fields. Because decision information is uncertain instead of certain in most environments, further extension for group decision making problems under fuzzy environment was published by Chengï¼ˆ2000ï¼‰ï¼Œknown as Fuzzy TOPSIS. The selection of the third-party provider is a typical MCDM problem. In this method firstly we screen out providers that have not minimal qualifications by the selection criteria. Then closeness coefficient of contractors to each proposal will be computed by Fuzzy TOPSIS method and finally these coefficients as successful indicators for each provider will be fed in to a linear programming to select most profitable projects and providers with respect to the constraints. The stages are described blow: Stage1: Eliminate contractors that haven't minimal qualifications. For the purpose of analysis, selection criteria need to be rationally selected at first. There are a lot of researches with respect to the decision criteria for evaluating the supplier. Such as the study of Dickson(1966), Ellram (1990), Weber et al. (1991), , Grupe (1997), and Akomode et al.(1998). According to an empirical survey, the top four selection criteria are responsiveness to service requirements, quality of management, track record of ethical importance, and ability to provide value-added services. The less important selection criteria are listed in a descending order as below: low cost, specific channel expertise, knowledge of market, personal relationship with key contacts, willingness to assume risk, investment in state-of- art technologies, size of firm, and national market coverage. Keeping the outcomes of the supplier selection literature review as a guideline, we derived the relevant factors to evaluate in the provider selection process based on the outsourcing view. However selection of criteria is totally industry specific and based on each case and the criteria are changed and replaced. Then opinions of decision makers on criteria were aggregated and weights of all criteria have been calculated by organizing the expert meeting. Meanwhile, the outcomes of the supplier selection literature review should be kept as a guideline. Stage2: Computing closeness coefficient (CC) for each project by fuzzy TOPSIS method So after we have obtained the important evaluation criteria and the qualified provider candidates to form the MCDM problemï¼Œthe ranking of the shortlisted vendor providers will be done using the fuzzy TOPSIS approach. Firstï¼Œchoose the appropriate linguistic variables for the importance weight of the criteria , asses the importance of each contractor in each project with respect to each criterion by DM, using linguistic variables. Convert these evaluation into triangular fuzzy numbers with fuzzy weight for each criterion. Fuzzy weight wj of criterion C j are obtained with regard to DM’s opinions. Then the importance of the criteria and the rating of alternatives with respect to each criterion and the aggregated rating Xij under criteria C j can be calculated as: Wj= 1K[Wj1+Wj2+…+Wjk] xij= 1K[xij1+xij2+…+xijk] Wjk is the importance weight of the kth decision maker. xijk is the rating of the kth decision maker. Construct the normalized fuzzy decision matrix. If we describe the linguistic variables by triangular fuzzy numbers, xij=(aij, bij, cij) and wij=(wj1, wj2, wj3)then we can get the fuzzy decision matrix denoted by R, and R= R=[rij]mÃ—n. rij=(aijcj, bijcj, cijcj) rij=(aj-aij, aj-bij, aj-cij) Next, the weighted normalized fuzzy decision matrix is constructed by : V=[vij]mÃ—n, i= 1, 2,…, m j= 1, 2,…, n Where vij= rij(.)wj After all of these analysis and calculation , a positive-ideal solution (PISï¼Œ A+) and a fuzzy negative-ideal solution (NISï¼ŒA-) as the criterion are chosen. The best alternative solution should be the closest to the Positive Ideal Solution (PIS) and the farthest from the Negative Ideal Solution (NIS). A+=(v1*, v2*,…, vn*) A-=(v1-, v2-,…, vn-) vj*= 1, 1, 1 vj-= 0, 0, 0 Calculate the total distance of each components from the fuzzy positive ideal and negative ideal: If A and B are two fuzzy numbers as follows, distance between these fuzzy numbers is calculated by equation below: A=(a1, b1, c1) B=(a2, b2, c2) Equation ï¼š DA, B= 13[a2-a12+b2-b12+c2-c12] Given the above description on how to calculate the distance between fuzzy numbers, the distance of components from positive and negative ideas can be derived respectively as: di*= j= 1nd(vij, vj*), i= 1, 2,…, m di-= j= 1nd(vij, vj-), i= 1, 2,…, m In the endï¼Œthe relative closeness coefficient (CC)of each contractor-project in each criterion can be calculated asï¼š CCi= di*di-+di+, i= 1, 2,…, m Stage3: Selecting the best projects and related contractors Select the best projects and related contractors by ranking options based on the descending cci. An alternative with index cci approaching 1 indicates that the alternative is close to the fuzzy positive ideal reference point and far from the fuzzy negative ideal reference point. A large value of closeness index indicates a good performance of the alternative. A case studyï¼š The proposed methodology for supplier selection problem, composed of TOPSIS method, consists of three Steps: (1) Identify the criteria to be used in the model; (2) weigh the criteria by using expert views; (3) evaluation of alternatives with TOPSIS and determination of the final rank. The case is that of a major company operating in the dairy products field. In the first phase, the project team operated mainly through roundtable discussions on developing their main selection criteria. After identity the criteria attributed under consideration, five alternatives suppliers are written in the list. There are several criteria need to be considered, and each vendor's information under each criteria are collected, calculating each vendor's overall rating weight, shown in Table 2. (Mohammad Saeed Zaeri, 2010) Finally, the closeness coefficient was calculated to rank alternatives. The results obtained are shown in Table 4ï¼š (Mohammad Saeed Zaeri, 2010) The order of rating among those vendors is Supplier3> Supplier 4> Supplier 1> Supplier2> Supplier5, the best vendor would be Supplier3. To conclude, the TOPSIS method had several advantages. First, TOPSIS makes it possible to appraise the distances of each candidate from the positive and negative ideal solutions. Second, it allows the straight linguistic definition of weights and ratings under each criterion, without the need of cumbersome pairwise comparisons and the risk of inconsistencies. It evaluates the projects and each provider more precisely by expert decision makers in each stage of the whole process. Moreover, the method is very easy to understand and to implement. All these issues are of fundamental importance for a direct field implementation of the methodology by logistics practitioners. However TOPSIS is proved to be insensitive to the number of alternatives and has its worst performance only in case of very limited number of criteria. In order to apply fuzzy TOPSIS to a MCDM problem, selection criteria have to be monotonic. After all, this method is an useful tool in dealing with multi attribute or multi-criteria decision making in the real world. Bottani E, Rizzi A (2006) A fuzzy TOPSIS methodology to support outsourcing of logistics services. Supply Chain Management: An International Journal 11(4): 294—308 Rajesh Gupta, Anish Sachdeva, and Arvind Bhardwaj A Framework for the Selection of Logistic Service Provider Using Fuzzy Delphiand Fuzzy Topsisï¼›Chapter 15 Y. C. 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