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An intuitionistic fuzzy linear programming method for logistics outsourcing provider selection

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ABSTRACT

In order to reduce costs and enhance their core competitiveness, many companies tend to choose the logistics outsourcing. The selection of logistics outsourcing provider plays an important role for the success of outsourcing. In this paper, we formulate the logistics outsourcing provider selection as a kind of group decision making (GDM) problems with intuitionistic fuzzy preference relations (IFPRs). A new intuitionistic fuzzy linear programming method is proposed for solving such problems. First, we construct an intuitionistic fuzzy linear programming model to derive priority weights from IFPRs. Depended on the construction of non-membership functions, this intuitionistic fuzzy linear programming model is solved by the developed three kinds of approaches including the optimistic, pessimistic and mixed approaches. Then by the idea of TOPSIS (technique for order preference by similarity to ideal solution), the experts' weights are determined objectively. Combining the experts' weights with the derived priority weights, the corresponding method for GDM with IFPRs is presented. An example of logistics outsourcing provider selection is provided to illustrate the proposed method. Finally, the intuitionistic fuzzy programming method is further generalized to the case of more general membership and non-membership functions.

1. Introduction

With the development of economic globalization, more and more companies have realized that they cannot solve all the affairs depending on their own strength and meanwhile maintain competitive advantage in the industry. In today's socio-economic environment, companies are searching for any edge that can make them more successful. Outsourcing is an approach that can lead to greater competitiveness [1]. Using the outsourcing, companies only need to retain most competitive core resources and integrate other resources by means of the external specialized ways. Outsourcing can save costs, improve profitability, enhance their core competitiveness and increase the environmental resilience.

Logistics outsourcing or third party logistics (3PL) is the use of external companies to perform logistics functions which have traditionally been performed within an organization. The third-party company can perform all or some functions in the whole logistics process [2]. Logistics outsourcing can make the companies focus more resources and energy on their core business, which can produce more profit and increase customer satisfaction.

However, the advantages of outsourcing do not always work effectively in practice. For example, ineffective outsourcing activities, derived from improper strategies or methods, can lead to unexpected risk and a loss of core competencies and capabilities [3]. Therefore, a rational and scientific decision method is very important to choose the proper outsourcing provider. This paper pays close attention to the selection of outsourcing providers in logistics outsourcing.

1.1. The process of logistics outsourcing

The process of logistics outsourcing was firstly formalized by Sink and Langley [4] in 1997. In order to adapt to the current market environment, we reformulate the process of logistics outsourcing shown in Fig. 1. The logistics outsourcing process mainly includes the following five phases:

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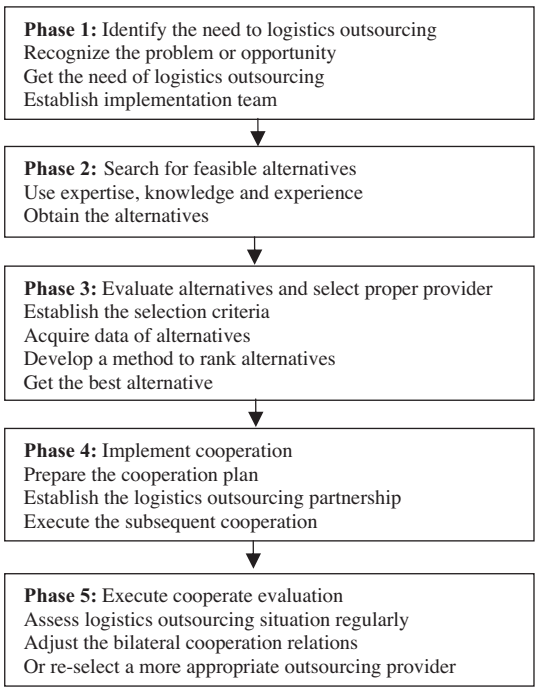

Fig. 1. The logistics outsourcing process.

(1) Identify the need to logistics outsourcing

The logistics outsourcing process begins with recognizing that outsourcing is a viable management option to solve a problem or enhance an opportunity. Companies firstly should analyze their internal and external environments, give the need of logistics outsourcing, and establish implementation team simultaneously. The implementation team is organized in a certain way and intellectually supported by high-level experts. The members of implementation team come from all kinds of departments, such as management, investment, logistics, legal, information, marketing and customer service. Selecting logistics outsourcing providers is one of the main tasks for the implementation team. Then the team is dissolved by itself after the completion of its all tasks, thereafter the members go back to their original departments.

(2) Search for feasible alternatives

The initial task of the implementation team is to substantiate the viability of outsourcing logistics, which must involve a make-or-buy analysis that includes all relevant costs [4]. The members of implementation team can judge the costs and benefits by using their expertise, knowledge and experience. At the same time, the implementation team should collect the specific information (such as the demands of logistics outsourcing in its own company) and transmit the relevant information to some logistics providers. After received the outsourcing information, those providers who will be willing to provide service become the potential alternatives that can be further analyzed and compared in the later period.

(3) Evaluate alternatives and select proper outsourcing provider

The evaluations of alternatives are based on the establishment of selection criteria [4], such as quality, cost, capacity, and delivery capability. The experts give the assessment information of the potential alternatives with respect to the chosen criteria. It is a very complex process to select the proper logistics outsourcing providers on the basis of the assessment information. Selection of outsourcing providers is the key factor for the success of logistics outsourcing.

(4) Implement cooperation

After selecting the appropriate provider, the company should establish the logistics outsourcing partnership according to the actual situation of the company and industry competition. The company and logistics provider need to prepare the cooperation plan, which can be used to execute the subsequent cooperation. Formal meetings between the partners are frequently held to solve some unpredictable problems during the implementation of logistics outsourcing.

(5) Execute cooperate evaluation

By assessing regularly logistics outsourcing situation, some problems are discovered and improved in time. With the market competition and the different market demand, the company can adjust the bilateral cooperation relations according to the specific circumstances, or re-select a more appropriate logistics outsourcing provider in the process of cooperation.

This paper focuses on the Phase 3, namely, how to select proper logistics outsourcing provider. At present, some decision methods of selecting outsourcing providers have been proposed. We make a brief review in Section 1.2.

1.2. Review for decision methods of selecting outsourcing providers

Early work on outsourcing decisions most commonly adopted transaction cost theory (TCE) [5]. TCE provides a basic framework for understanding the client side rationale in outsourcing and also the behavioral dimensions of service providers that determine the transaction cost to clients. It is fundamentally concerned with the question of whether it is advantageous, in terms of cost, for transactions to occur within the hierarchy of an organization or externally in the open market. However, there are a number of disadvantages in the TCE models [6]. For example, on the one hand, TCE only focused on cost minimization. On the other hand, TCE assumes that an industry is stable and does not deal adequately with dynamic situations [7].

After that, when evaluating and selecting logistics outsourcing provider, a variety of commonly qualitative methods, including intuitive judgment method, bidding method and negotiation selection method, are appeared. The above three methods based on qualitative evaluation are relatively simple and suitable for provider selection in earlier single-function logistics outsourcing projects. In recent years, aspects of strategy, such as core competencies, risk analyses, and organizational flexibility, have been more and more important for the company. This trend has attracted the attention of researchers and practitioners to apply the decision making methods for outsourcing logistics. The existing achievements of the decision making methods about logistics outsourcing can be roughly divided into two classes.

The first class is multi-attribute decision making (MADM) methods, such as analytic hierarchy process (AHP) [8,9], analytic network process (ANP) [10–12], preference ranking organization method for enrichment evaluations (PROMETHEE) [13], balanced score card [12], and Technique for order preference by similarity to ideal solution (TOPSIS) [13]. For example, Yang et al. [8] identified factors affecting the business process outsourcing decision and then structured a decision model by using AHP. Wang and Yang [9] proposed the method by using AHP and PROMETHEE in making information system (IS) outsourcing decisions. Jharkharia and Shankar [10] applied ANP to select the final logistics provider. Combining the decision making trial and evaluation laboratory as