A TWO-PHASE HYBRID APPROACH TO SUPPLIER SELECTION THROUGH CLUSTER ANALYSIS WITH MULTIPLE DIMENSIONS

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Abstract. *To effectively segment and select suppliers, a two-phase hybrid model was developed in this study for that purpose. Phase 1 developed a genetic simulated annealing k-means algorithm (GSKA) integrating genetic algorithm (GA), simulated annealing algorithm (SA) and k-means algorithm, and suppliers were clustered using this algorithm according to the characteristics for customer needs including multiple dimensions – product cost, product quality and manufacturing time. In phase 2, a multi-criterion optimization mathematical model on supply partnership characterizing quality, cost and time was constructed based on the clusters from phase 1, and then the proposed Genetic Simulated Annealing Algorithm (GSA) was used to solve the optimization model to find the optimum supplier combinations. To prove the efficiency of the proposed model, a case study concerned with notebook computers was introduced in this study. According to the analysis results, the GSKA produced in phase 1 proved to be superior to k-means model and genetic k-means algorithm (GKA) model, while the multi-objective optimization model GSA proposed in phase 2 still proved better than GA. Moreover, by selecting suppliers after cluster analysis, unwanted candidate suppliers could be effectively eliminated, and the resulting supplier combination could still meet customer needs.*
Keywords: Supplier selection, Cluster analysis, K-means algorithm, Genetic algorithm, Simulated annealing algorithm

1. **Introduction.** Supply chain management refers to the integration methodology dealing with the planning and control of materials from suppliers down to end-users. It is based on the interests of all members making up the path, and resources and capacity can be utilized to their fullest potential while satisfying customer service standards on the path through collaborative management and planning among the members on the path [1]. Vrijhoel and Koskeia [2], Tominaga et al. [3], Zhao et al. [4] and Flint [5] also stated every member in the supply chain system played both the role of a customer and a supplier, and the major purpose of supply chain management was to integrate upstream and downstream suppliers to enhance the overall efficiency of the supply chain and meet customer needs.

For the products to meet various configurations of customer needs, suppliers must be segmented according to product characteristics before making preliminary planning for supplier management. Dillon et al. [6] referred to cluster analysis as an efficient and commonly used method among the segmentation methods. Li et al. [7] proposed a local-clustered network model for cluster analysis, which is based on the evolving phenomenon. Anil et al. [8] considered k-means a commonly used method for cluster analysis, which could rapidly segment a large body of data. According to Bandyopadhyay and Mauliks' [9] study, k-means are commonly used in cluster analysis, but k-means is largely affected