A hybrid evolutionary model for supplier assessment and selection in inbound logistics

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A R T I C L E   I N F O

A B S T R A C T

Business stability, quality, safety, supply chain flexibility and cost optimization have an increasing role in companies that strive to stay and survive in the market competition. A wise supplier choice becomes ever more important prerequisite for the success of any company. This paper presents a novel hybrid model for supplier assessment and selection, based on hybrid solution including genetic algorithm (GA) and harmony search algorithm (HSA). The chosen data set presents original data which is used for assessment in "Lames" company. The results show that HSA & GA value constraint model is slightly more restricted than other discussed models, and separates, much better and with greater precision, poor companies from the good ones in business environment.

1. Introduction

Dynamic market changes demand selection of business partners who are logistically and otherwise able to follow changes in company requirements, especially regarding phenomenon of globalization and rapid development of logistics which is in detail presented in [10] and, at the same time, the relationship among enterprises is more competitive than ever. In such circumstances a wise choice of suppliers in inbound logistics becomes increasingly important prerequisite for the success of any company. A firm's sourcing strategy is characterized by three key decisions [2]: (a) criteria for establishing a supplier base; (b) criteria for supplier selection, a subset of the base, which will receive an order from the firm and (c) the selected quantity of goods to order from each supplier.

The most popular intelligence optimization algorithms, such as genetic algorithm (GA) and particle swarm optimization (PSO) have been successfully applied to large-scale complicated problems of scientific and engineering computing. However, the harmony search algorithm (HSA) a meta-heuristic random

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optimization algorithm, inspired by the process of the musicians' improvisation of the harmony and proposed in [3] represents a new research field.

This paper presents a novel model for supplier assessment and selection based on hybrid evolutionary algorithm that is used in multinational company "Lames LLC" with operations in more than a dozen countries in the world as well as in Serbia. "Lames" company is part of automotive industry, and it produces electrical and manual car window lifters. The proposed model includes soft computing methods in general and harmony search and genetic algorithms in particular into the whole supplier assessment and selection in decision making system.

The rest of the paper is organized in the following way. In the following section, Section 2, similar available implementation in supplier assessment and selection domain is overviewed. Section 3 elaborates on a short part of a previous research. Section 4 describes the proposed hybrid genetic algorithm and harmony search performance value constraint model. Section 5 presents experimental results while Section 6 concludes the paper and offers notes on future work.

2. Literature review

It is proven that the application of soft computing (SC) has two main advantages. First, it made solving nonlinear problems in which mathematical models are not available, possible. Secondly, it introduced the human knowledge such as cognition, recognition, understanding, learning, and other skills into the fields of computing. The underlying paradigms of SC such as neural computing, fuzzy logic computing and evolutionary computing are known as powerful tools for almost any difficult and complex optimization problem.

In the past, some mathematical programming approaches have been used for supplier selection. A multiphase mathematical programming approach for effective supply chain design was presented in 2002 [9]. More specifically, a combination of multi-criteria efficiency models, based on game theory concepts, and linear and integer programming methods was developed and applied. Fuzzy goal programming approach was applied in 2004 to solve the vendor selection problem with multiple objectives [5]. According to recent research work conducted in 2009, the quantitative decision methods for solving the supplier selection problem can be classified into three categories: (1) multi-attribute decision-making, (2) mathematical programming models and (3) intelligent approaches [11].

Furthermore, in the latest literature survey conducted in 2010, it can be seen that the mathematical programming models are grouped into the following five models: (1) linear programming, (2) integer linear programming, (3) integer non-linear programming, (4) goal programming and (5) multi-objective programming [4].

Two implementations of fuzzy supplier selection models, which are critical in contemporary business and management, are presented in: (1) supplier selection strategies on fuzzy decision space [6]; (2) fuzzy logic method adopted in modelling supplier selection process [1]. A review, approach of fuzzy models and applications in logistics is in detail presented in [7].

Hundreds of criteria were proposed, and the most often criterion is quality, followed by delivery, price/cost, manufacturing capability, service, management, research and development, finance, flexibility, reputation, relationship, risk, and safety and environment. Various quality related attributes have been found, such as: "compliance with quality", "six sigma program or total quality management", "ISO quality system installed". The traditional single criterion approach based on lowest cost bidding is no longer supportive and robust enough in contemporary supply management.

3. Supplier assessment and selection in "Lames LLC"

Supplier assessment and selection mapping as an essential component of inbound logistics management is usually a multi-criteria decision problem which, in actual business contexts, may have to be solved in