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## Modeling Multi-Product Multi-Stage Supply Chain Network Design

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### Abstract

Supply chain network makes it possible to create an effective and helpful context for managing supply chain. This network is a series of equipments that play roles in the supply chain development. In this network exist producers of raw materials and product-making factories, centers of distributing products and customers. The aim of the network is minimizing the total cost so that customer's demands might be answered. In this paper, three-phase multi-product supply chain network model is presented. The super-innovative method of genetic algorithm is used to solve these problems since they are classified into NP-Hard problems. Encoding of this presented. The super-innovative method of genetic algorithm is used to solve these problems since they are classified into NP-Hard problems. Encoding of this genetic algorithm is based on priority-centered encoding. In this method, the network nodes are developed according to their priority. Some types of problems are posed that are solved by means of genetic algorithm and mathematic programming problem solving software (LINGO) and then the results are compared. Moreover, this algorithm is shown to give acceptable answers and is therefore suitable for solving the problems in three-phase multi-product supply chain network.

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*Keywords:* supply chain; genetic algorithm; NP-Hard problems; LINGO

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### 1. Introduction

Supply chain network makes it possible to create an effective and helpful context for managing supply chain. This

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network is a series of equipments that play roles in the supply chain development

In this network exist producers of raw materials and product-making factories, centers of distributing products and customers. The aim of the network is to minimize the total cost so that customer's demands might be answered. The costs in the network are of two types. The first type of costs includes the costs of building factories and distribution centers and the second type includes the costs of buying, producing, distributing and transporting the goods in each phase of supply chain network

Suppliers are providers of raw materials which have well-defined capacity and also specified numbers. Plants are the factories of product generating which their maximum number for establishing them is definite and are of importance in finding which factories are to be made to answer the demands of distribution centers with minimum cost. DCs are distribution centers which as factories have limitations in their establishment and have to be determined in the problem. Customers are those buyers whose demand is definite and buy all of their products from just one center. In fig 1, the network has the nodes  $s$  for suppliers of raw materials,  $K$  for factories,  $J$  for distribution centers and  $I$  for customers. Arcs in network indicate the relationship between nodes and represent the transportation rout of products.

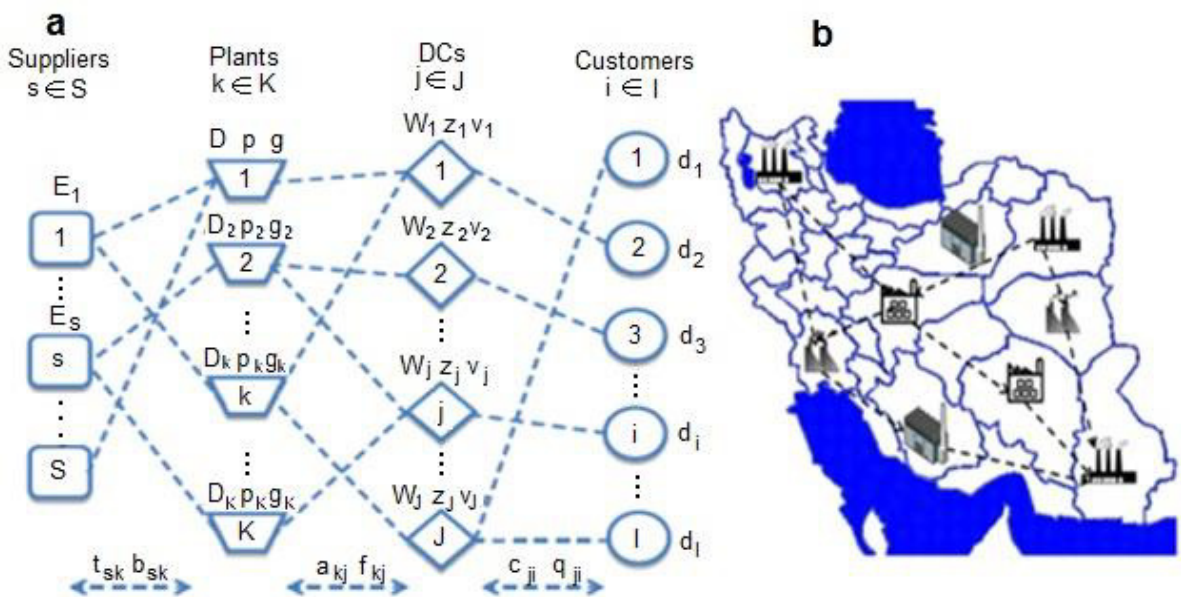


Fig 1.(a) three-phase single-product supply chain network;.(b)A of supply chain network

The problems of MSCN Design are a type of Mixed-integer programming problems which can not be solved in great scales by definite algorithms and are so classified in NP-Hard problems. Therefore, in order to solve these problems, innovative and super-innovative algorithms are used. One of the efficient super-innovative methods for solving these problems is the genetic algorithm which has been frequently applied to this sort of problems successfully and led to good results.

1.1. Review of literature

In a problem of supply chain network design, we look for the following outputs for the problem: 1- identifying the number of factories and distribution centers to be made in any phase of network 2- recognizing the optimal

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