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Study on location selection of multi-objective emergency logistics center based on AHP

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Abstract

Due to the particularity of location selection in logistics center, a multi-objective location selection model is given based on AHP theory, and the interrupt delay constraint is applied on the basis of considering the environment, economy and technical factor, the time minimization objective is priority to cost minimization objective. Finally, the feasibility and effectiveness of this model are verified by MATLAB simulation results.

Keywords: AHP; multi-objective; location selection; interrupt delay

1. Introduction

Recently, the disasters occur frequently, it is necessary to establish an effective emergency logistics system. The emergency logistics centers (ELC) should be established in a suitable place, which play a role of distribution center, therefore the location selection is paid more and more attention.

The traditional location selection is taking the cost minimization as objective [1], however, due to the particularity of emergency logistics, the time minimization is taken as the objective, and then the cost minimization is considered on this basis, and a multi-objective location selection model is given.

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2. Establishment of improved model

(1) Hierarchy structure model

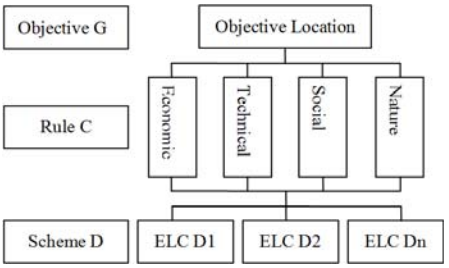

Fig.1 Structure of analytic hierarchy process

The objective hierarchy is an optimal location selection scheme, the rule hierarchy is the actual factor that affects the decision-maker, here the economic, technical, social and nature factors are considered, and the scheme hierarchy is the selected location of the logistics center.

(2) Judgment matrix and single sequence and its consistency checking

The judgment matrix and consistency checking please see literature [2].

(3) Hierarchy total sequence to obtain objective weight value

This process is carried out from highest hierarchy to lowest hierarchy. Its consistency checking is carried out by following formula, and the checking standard is the same as the above method:

$$CR = (a_1 CI_1 + a_2 CI_2 + \cdots + a_m CI_m)/(a_1 RI_1 + a_2 RI_2 + \cdots + a_m RI_m)$$

3. Model determined by multi-objective optimization

The objective optimization is a general method [3]. Firstly, assume that $N = \{1, 2, \cdots, n\}$ is the location set, $M = \{1, 2, \cdots, m\}$ denotes the emergency area set divided by geographical location, there are two possibilities for each location in division, whether the ELC is established in that location or not. For the decision variable x_i in location i, '1' denotes it should establish the ELC, and '0' denotes it should not.

$\omega = \{\omega_1, \omega_2, \cdots, \omega_n\}$ is the weight vector obtained by AHP. The model objective function is:

(1) The shortest starting time and emergency conveyance time;

(2) The lowest cost of budget.

In multi-objective, the first consideration is time, and the cost is considered when the time is ensured. The constraint condition takes the following objective: $P_1 >> P_2 >> \cdots >> P_n$ denotes the priority level, and the constraint related with time is arranged in the front position in P_i to realize the objective.

Constraint condition analysis

According to AHP method, assume that the weight vector is taken as the constraint object, and d_n^-, d_n^+ denote the positive and negative deviation variable under weight constraint condition:

$$\sum_{i=1}^{n} \omega_i x_i + d_n^- - d_n^+ = 1$$

In order to determine where to establish a ELC, the considering fixed cost can not be exceeded the budget cost. In multi-objective optimization, the positive and negative deviation variable d_c^-, d_c^+ of fixed cost constraint condition are allowed, and c_i denotes the fixed cost of logistics center establishment in location i, C denotes the budget of total fixed cost, the constraint condition is established:

$$\sum_{i=1}^{n} c_i x_i + d_c^- - d_c^+ \le C$$