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An Intelligent Scheduling Strategy of Collaborative Logistics for Mass Customization

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Abstract

To improve the scheduling optimization of mass customization collaborative logistics, a scheduling solution developed based on the novel particle swarm optimization algorithm was proposed. A mathematic model based on scheduling strategy of mass customization logistics was designed. The novel dynamic particle swarm optimization algorithm framework was given. And simulation experiments were done to validate algorithm. Experiment results show that the proposed algorithm effectively improves the scheduling optimization of mass customization collaborative logistics, which has direct applications for Logistics scheduling

Keyword: Particle swarm optimization algorithm; Mass customization collaborative logistics; Logistic scheduling

1. Introduction

Optimization of logistics support aims to reduce operation costs for the service providers without sacrificing the quality of services to customs. With the influence of enterprise size, specialty of the product and other factors, clients had different needs and expectations for logistics services, such as reducing stock levels, quick response markets etc. Logistics service providers therefore seek for improved scheduling, and customized solutions to meet a wide range of customer demand. The goal of logistics optimization of mass customization is to incorporate modern logistics and information technology and advanced logistics management concept, through the optimal allocation of limited resources of network

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members, in order to reduce large-scale operation cost and to increase the efficiency for providing customized logistics services to customers. In recent years, scheduling optimization of logistics supply had the great attention and received considerable development by the domestic and international logistics industry. Logistics scheduling optimization also attracted wide attention from scholars. Previous studies [1] proposed a hybrid multi-objective optimization algorithm; literature [2] proposed a modified particle swarm algorithm, which combines the mutation operation to improve the performance of particle swarm algorithm. Literature [3] analyzing the status of food logistics, proposed the optimal scheduling of logistics based on an ant colony algorithm to realize the dynamic process of food distribution. Literature [4] proposed an improved ant colony algorithm to solve the logistics problems of route optimization.

2. The mathematical model of Mass customized logistics scheduling

To elucidate the theoretical background of the model, we used supplier coordination of multiple logistics nodes together as an example. The goal here is to demonstrate how mathematically the model is able to effectively accomplish a number of customized logistics tasks. Suppose a main supplier received N task within a time domain, $R = \{r_i \mid 1 \le i \le N\}$ such as purchasing,supply, distribution etc; each task r_i composed by the sequence of activities that constitute theirs. $r_i = \{a_{ij} \mid 1 \le i \le N, 1 \le j \le L_i\}$, such as Order processing, packaging, handling, transportation, storage, sales return processing, etc. each task r_i Have a deadline d_i . Each activity a_{ij} by different nodes performed in logistics network $p(1 \le p \le M)$, Since each node to use different resources and costs, Each activities has a set of execution mode U_{ij} , One element of u_{ijp} express activity a_{ij} excused by node p ; node p execute activities a_{ij} the cost denoted by c_{ijp} , Consumption of times denoted by t_{ijp} , the start time is s_{ijp} . Since each logistics node can be process for different tasks at different times, the goal of coordinated decision is to determine that the Order of execution, execution mode and start time in network node of the logistics activities and Make collaborative logistics network is optimal for the total cost of implementation of the activities and the total time.

In the Task r_i the Time constraints l_i square matrix of between the various logistics activities $K^i = (k^i_{gh})_{L_i \times L_i}, k^i_{gh}$ See Equation (1).

$$k^i_{gh} = \begin{cases} 1, \text{ if } a_{ig} \text{ before } a_{ih} \\ 0, \text{ otherwise} \end{cases} \tag{1}$$

Logistics network nodes to perform activities as u_{ijp} , See Equation(2)

$$u_{ijp} = \begin{cases} 1, \text{if node } p \text{ run activity } a_{ij} \\ 0, \text{otherwise} \end{cases} \tag{2}$$

In this paper, the mathematical model of large-scale customized logistics scheduling problem as follows,

$$\min y = w_1 \sum_{i=1}^{N} \sum_{j=1}^{L_i} \sum_{p=1}^{M} c_{ijp} u_{ijp} + w_2 \sum_{i=1}^{N} \sum_{j=1}^{L_i} \sum_{p=1}^{M} t_{ijp} u_{ijp} + v \sum_{i=1}^{N} \max\left(\sum_{j=1}^{L_i} \sum_{p=1}^{M} t_{ijp} u_{ijp} - d_i, 0\right) \tag{3}$$

$$\sum_{i=1}^{N} \sum_{j=1}^{L_i} \sum_{p=1}^{M} u_{ijp} = \sum_{i=1}^{N} L_i, \quad u_{ijp} \in \{0,1\} \tag{4}$$