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Research on Logistics Route Algorithm for Police Equipment Depot

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***Abstract*—Distribution is a link which is directly connected with the consumer in the logistics activities. The distribution cost accounts for a fairly high proportion in the logistics cost of the enterprise. Whether the distribution line arrangement is reasonable or not has great influence on the distribution speed, cost and benefit, especially the determination of the multi-user distribution line is more complex. This paper focuses on the logistics distribution vehicle routing problem of Chinese household electrical appliance distribution center, constructs the distribution model, optimizes the delivery route by saving mileage, and finds out the best delivery plan.**

Keywords-logistics; police equipment; algorithm; depot

I. INTRODUCTION

The ability of police equipment support is an important support to promote the stability of the army's fighting capacity. In the future information warfare, the equipment information level is high, the target strike accuracy is high, and the operational process is continuously shortened. The amount of equipment loss, equipment maintenance task and maintenance equipment demand will also increase by [1]. When the police perform operational tasks, once the equipment maintenance support equipment does not keep up with the operational needs, it has a significant impact on the continuing maintenance of the combat effectiveness. Therefore, under the premise of limited support force, the equipment support department needs to optimize the distribution plan of equipment maintenance equipment, so as to achieve the minimum cost to complete the distribution task.

II. LOGISTICS ROUTE MODEL

The decision problem of security maintenance equipment not only involves a number of units, a variety of resources, but also to meet the time, funding, resources, safety and other constraints, and get on for, for sure "based on the pursuit of equipment maintenance support equipment comprehensive quality and efficiency, so the decision problem of maintenance equipment with large-scale security multi objective and multi constraint etc.

A. Problem Description

It is assumed that a police equipment warehouse is responsible for all maintenance equipment in the unit under which it belongs. The existing m vehicle K_1, K_2,... K_m is used to transfer equipment maintenance equipment; set up N={1, 2,... n, n+1}, as the place set, 1 for equipment warehouse, other N demand points are numbered from 2~n+1; Def e f indicated the location and location of the distance between the total transportation needs w tons; equipment, demand for the j demand for W_j tons, the maximum load for each car Q, m* Q>w, the average running speed of V, the i vehicles in the equipment warehouse loading time t_i, vehicle arrival unloading time demand points t_j.

Distribution requirements: the orientation of each car is responsible for the corresponding demand point, the route and order are fixed, and the entire distribution task is completed at the minimum cost.

B. Model Building

From the point of distribution with multiple delivery devices for the distribution of multiple customers goods, distribution and customer position, delivery time required for each customer's delivery is known only by a delivery device, and distribution does not reach the hands of customers, can not perform a halfway exhumation task, in order to get a the most rapid distribution. The algorithm assigns the task to each delivery device, arranges the execution order of delivery equipment, and makes it complete the distribution task as quickly as possible. Each task has a cargo point and N delivery point, and each point has time window constraints. Therefore, we can regard the problem as a vehicle routing problem with time windows.

In order to facilitate the explanation of the problem, the collection point number is numbered 0, the delivery point number is 1,..., n. SP is the vehicle to reach the P point in time, the [ETp must be in a certain time range, LTp] (p=0,1,..., n), ETp said the vehicle arrives at the earliest time, P ETp'=ETp-ET0 LTp task; said vehicle reaches the latest time point P in the task (time limit), LTp' =LTp-LT0; SP'is the vehicle to reach the mission of P with respect to the set of goods at the time of 0, [ETp', LTp'] P said the task set point relative to the time windows 0 c0p for the goods; goods and 0 point connection tasks in P delivery distance, CPQ connection task delivery points P and a a delivery point distance of Q. In order to find a line with 0 hair points connected to all points once and only one time and the minimum total distance to meet the time window constraints, the following model is obtained.

$$Z_{\min} = \sum\sum c_1 c_{pq} x_{pq} + \sum c_{et}(ET_{p'} - S_{p'}) + \sum c_{lt}(S_{p'} - LT_{p'}) \qquad (1)$$

Logistics strategy: when the volume of no main delivery and delivery task is less than the executable delivery equipment, the distribution task is directly allocated to the idle delivery equipment. When the amount of delivery task is larger than the executable main delivery equipment, first, the time of each task from the distribution point to the customer address is arranged according to the order from big to small, and then the execution task is allocated according to greedy algorithm.

Step 1: Sort the task by time from large to small for tasks that need to be delivered

Step 2: Distribution tasks for prearranged tasks

Step 3: If the number of no main delivery equipment is larger than the number of tasks, the task is directly assigned to the non master delivery device in order. If the number of tasks is larger than the number of no main delivery equipment, the task is first ordered from large to small, and then the task is allocated for the non master delivery device.

To sum up, using the idea of algorithm, the task can be completed in the shortest time, save time effectively and make rational use of natural resources. The greedy choice it makes is to select the vertices with a shorter special path from the starting point to the end, so as to determine the shorter path from the starting point to the point.

III. EMPIRICAL ANALYSIS

The delivery of equipment from the warehouse of a total of 10 distribution tasks, each car delivery equipment known load is G=10, speed v=30, maximum travel distance is 180, and the start-up costs per unit mileage travel costs were divided into c0=3, c1=1, try to arrange equipment delivery routes, the minimum total cost. When solving the problem, it always makes the best choice at present, that is, the minimum time of the mileage is the minimum time required for the task to be judged.

TABLE I. TASK INFORMATION

Task No.	Freight Volume	Collection Point No.	Collection Point Coordinate	Delivery Point No.	Delivery Point Coordinate
T1	6	1	(68, 80)	11	(76,86)
T2	7	2	(46, 37)	12	(39,28)
T3	8.2	3	(30, 50)	13	(20,65)
T4	5.4	4	(72, 42)	14	(63,48)
T5	6.3	5	(90, 80)	15	(95,74)
T6	9.7	6	(64, 26)	24	(75,29)
				25	(66,15)
				26	(85,18)
T7	7.5	7	(10,69)	16	(24,78)
				17	(18,75)
T8	8	8	(16,24)	18	(15,38)
				19	(20,30)
T9	7.7	9	(2,26)	20	(4,40)
				21	(5,30)
T10	8.1	10	(86,67)	22	(91,57)
				23	(100,60)

1) The relative concentration of one to one and one to many instances of the set delivery point is indicated. The tasks 1, 2, 3, 4 and 5 are one to one. 7 7, 8, 9 and 10 are two pairs.

2) Establish the mapping between the task number and the collection point number, (1 to 1), (2 to 2), (3 to 3), (4 to 4), 5 to 5, (5 to 5), (to go up to), (to go to), (to go to), and to go to.

3) Use the virtual task to start the terminal (collection point number I, cargo location number i+ task number m): (1,11), (2,12), (3,13), (4,14), (5,15), (6,16), (7,17), (8,18), (6,16) and (x) operation.

4) The internal path calculation of the first stage is expressed as the number of the collection point, the number of the delivery points, and the number of the delivery points, and the number of the delivery points, and the number of the delivery points, The length of internal path is: (1,11,10), (2,12,11), (3,13,18), (4,14,11), (5,15,8), (6,17,16,17), (7,19,18,16), (8,21,20,15), (9,22,23,20), and (10,25,26,24,45).

For distribution routes, several different communities are given. The shortest time between the community and the community is obtained through the known time between the community and the community, which is equivalent to a weighted directed graph.

The solution steps:

Step 1: The time required for all cities and cities is recorded in the Map collection.

Step 2: Use a queue to traverse the set, if there are <V1, Vi>, D (V1, Vi) as <V1, Vi> arc weights, if no <V1, Vi>, D (V1, Vi) is infinity.

Step 3: The urban point of the shortest distance is added to the city point of the shortest distance from each of the traverses, and the city's forerunner city points are recorded. 3.

Step 4: Change the time value of the rest of the city points, if W is added to the middle value, and the time value from V1 to VI is shortened.

Step 5: Repeat the above steps 3 and 4 until all the city points are traversed.

Test data: 9 delivery points, numbered D1, D2, D3, D4, D5, D6, D7, D8, D9, through the streets of a total of 12, numbered S1=4, S2=3, S3=19, S4=5, S5=7, S6=9, S7=10, S8=1, S9=4, S10=6, S11=10, S12=2, iterative the process of the algorithm is shown in table D1, as a starting point, end point D9.

TABLE II. ROUTE ITERATIVE ALGORITHM PROCESS

No.		D2	D3	D4	D5	D6	D7	D8	D9
Precursor		1	1	1	3	5	6	5	7
Iteration	{1}	4	3	19	-	-	-	-	-
1	{1.3}	4	3	19	10	-	-	-	-
2	{1.3.2}	4	3	19	10	-	-	-	-
3	{1.3.2.5}	4	3	19	10	11	-	20	-
4	{1.3.2.5.6}	4	3	19	10	11	17	20	-
5	{1.3.2.5.6.7}	4	3	19	10	11	17	20	19
6	{1.3.2.5.6.7.9.4}	4	3	19	10	11	17	20	19
7	{1.3.2.5.6.7.9.4.8}	4	3	19	10	11	17	20	19

The algorithm of the strategy is to select a short path from the starting point to the special vertex end point, so as to determine the starting point to the short path of the point, the iterative process of algorithm shows that D9 is the precursor of D7, D7 and so on, the precursor is D6 D6, the precursor is D5, D5 precursor is D3, starting point for the D1, so the final route is D1-D3-D5-D6-D7-D9.

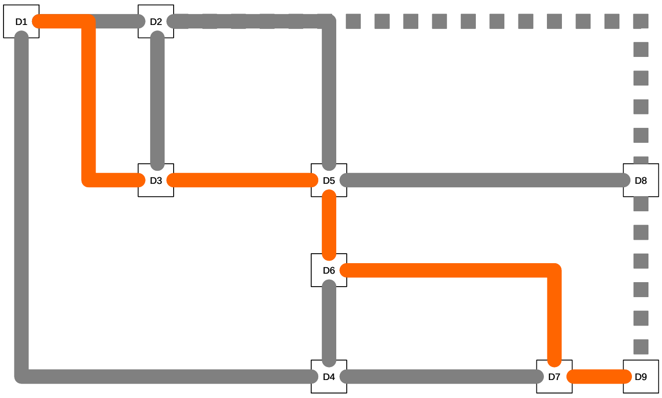

FIGURE I. ROUTE OPTIMIZATION

IV. Discussion and Future Work

For the domestic police equipment Distribution center, the lowest delivery cost and the high time requirement of customers are the urgent problems to be solved in distribution. All of them need to study logistics distribution routing optimization model to solve. Logistics from distribution center to customer location is a load scheduling problem in the field of distribution. It can achieve artificial scheduling and vehicle scheduling by using scientific logistics distribution route optimization method, making the logistics center itself operate efficiently.

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