Research on Vehicle Routing Optimization of Logistics and Distribution Bidirectional Transportation

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Abstract

In the fierce market competition environment, distribution cost has become a bottleneck for enterprises to achieve profit growth in production and operation. In order to reduce the economic cost, improve the operating efficiency and meet the needs of the customers, the enterprise should establish a vehicle distribution management system which meets its own characteristics. The core problem is the optimization of the vehicle routing. Based on the conventional vehicle routing optimization problem (VRP), this paper adds the research of reverse logistics, focusing on the logistics distribution routing optimization problem. First, it analyzes the research status of VRP problems at home and abroad, constructs an optimization model of two-way transport path problem (VRPSPD), selects C-W saving algorithm and optimizes it according to the actual application situation. Finally, according to the actual situation of A enterprise, the existing problems of vehicle routing in A enterprise are analyzed, and the vehicle distribution path model of A enterprise is constructed. According to the eight distribution customers of A enterprise, according to the distance of distribution path between each customer point and the weight limit weight of distribution vehicles, the best distribution scheme of A enterprise is used. Three distribution vehicles were allocated for the three distribution routes, and finally the feasible improvement suggestions for A enterprises were put forward.

Keywords

Distribution path; two-way transportation; C-W covenant.

1. Introduction

Under the sweeping of economic globalization and trade globalization, the increasingly fierce competition has become a huge challenge for the enterprises to survive in the market. The importance of logistics links in the development of enterprises is also getting more and more attention, and the efficiency of enterprise management is also affected by the logistics cost to some extent. The data show that at present, China's logistics cost accounts for about 18% of China's domestic production (GDP) value, and the logistics costs of two countries in the United States and Japan account for 9% and 11% of their country's GDP respectively. The cost of logistics in China is nearly two times that of the developed countries, and the average level of high departure countries is about 6.5 percentage points[1]. From the above data we can draw a clear conclusion: in the world, China's logistics cost is relatively high. Therefore, on the basis of guaranteeing a certain level of service, one of the important ways for enterprises to form core competitiveness is to effectively reduce logistics costs. And in each logistics link, transportation cost accounts for 2.88% of sales revenue, which is the largest proportion of logistics costs, accounting for about 40% of the total logistics costs. The rational optimization of distribution path can make the distribution procedure simplified, the efficiency of distribution is improved, the number of distribution is reduced, the utilization rate of resources is improved, and the logistics cost and customer service level can be effectively reduced. Therefore, in the new era of enterprise development trend, logistics distribution vehicle routing optimization problem has become a hot topic in the field of logistics at home and abroad has been an inevitable trend.

In many studies of the traditional logistics and distribution system, most of them involve the process of delivering goods from one or more supply directions to one or more requirements, and few are involved in reverse logistics. Due to the uncertainty of consumer demand forecasting and the dynamic changes of external factors, the two reverse logistics will inevitably involve the return logistics and the Recovery Logistics in the actual logistics distribution system. The Logistics Management Association (CLM) believes that reverse logistics is the activity and process of the product, information flow and capital flow at the end of the consumer side. The remedy for the defective goods, the value of the recovery of the goods, or the recovery of the value of the product are the important purpose of the proper treatment of the products. It includes defective goods, seasonal inventory, residual value handling, product recall, etc., including recycling of waste, disposal of hazardous materials, treatment of overdue equipment, and recovery of assets [2].

The production of reverse logistics inevitably makes the logistics cost of the enterprise rise very much, and in recent years, the research on the vehicle routing problem of logistics distribution is mostly a single direction distribution path. Therefore, it has become an urgent problem to study the problem of two-way distribution vehicle routing optimization.

Reverse logistics leads to the growth of logistics costs, making the optimal distribution of two-way vehicles an important link in reducing logistics costs, making the enterprises in an invincible position in the fierce market competition must pay attention to its importance and key. However, there are few researches on the two-way vehicle routing optimization of logistics distribution from the actual national conditions of China's logistics development. Starting from this idea, this paper studies the optimization of two-way distribution vehicle including the forward logistics and reverse logistics. Through the description of the two-way vehicle routing optimization problem and the establishment of the model, the relevant theories and characteristics, according to the model established, the C-W method is chosen to solve the model. Because of the different constraints, in order to solve and get the best route, the improved C-W saving method is used to solve the model. In this way, the optimal scheme of the enterprise logistics distribution vehicle scheduling is formulated, and the problems existing in the distribution of two-way vehicle scheduling in the distribution of A enterprises are analyzed, and the corresponding conditions of the A enterprises are established. The model is used to solve the mathematical model of A enterprise with the improved C-W saving method mentioned above, to make the best distribution path for the A enterprise, reduce the cost of distribution, improve the efficiency of distribution and improve the service level of the customer, so as to achieve practical effect, and provide feasible development suggestions and suggestions for the A enterprise.

2. Research Status on Two-Way Distribution Vehicle Routing

In 1959, Dantzig and Ramsert proposed the vehicle routing problem VRP (Vehicle Routing Problem) or VSP (Vehicle Scheduling Problem) from the angle of space and time respectively, which is generally called the VRP problem of transportation vehicle scheduling[3]. The VRPSPD problem was first proposed by Min in 1898 to abolish the order of distribution and recovery. The customer can have the demand of distribution and recycling at the same time. It solves the problem of sending and returning the library of 1 Central libraries and 22 local libraries under the constraints of the number of vehicles and vehicle capacity[4]. VRPSPD Problem Description: assuming that all customers can not only have distribution and recovery requirements, distribution center vehicles access the path of all customers, and can only be accessed once on one node on each path, and the total amount of the customer does not exceed the weight of the vehicle on the path, so as to achieve the optimal target function[5]. Compared with forward logistics vehicle distribution, two-way distribution is complex and difficult. This is due to the uncertainty of the customers' dispersion of the recovery requirements and the time and place of the occurrence, such as the number of distribution centers, the number of vehicles, the vehicle load limit, the customer service time and the number of customers. In foreign countries, many scholars have studied the subject, in which Fermi Alfredo Tang Montane[6] proposed distribution vehicle travel constraints. The tabu search algorithm and the mixed local optimization algorithm were used to simulate 50 to 400 node cities. For the first time, Catay Biilent[7] improved the ACS algorithm and applied to VRPSPD problem. The constraint condition is that the vehicle loading capacity is limited.Lang Maoxiang[8], a scholar, establishes a VPRSPD mathematical model with multiple constraints and the shortest transport distance as the objective function, and uses the improved new simulated annealing algorithm to solve the model, and compares the results of one-way distribution and two-way distribution. It shows that the two way distribution is more advantageous to solve the problem of hybrid vehicle routing problem. Obviously, it can effectively reduce the distribution cost and improve the economic efficiency. Through the study of domestic and foreign research papers, we know that the scholars on the VRPSPD issue have made great achievements and progress, and also provide a lot of theoretical knowledge for the practice and distribution process of each enterprise. At the same time, we also find that the models used by the existing research institutes are different, and the model algorithms adopted are different. In this paper, the C-W section method is used to solve the VRPSPD problem.

The problem of vehicle routing optimization (VRP) is difficult to be solved by accurate algorithm, but the traditional partial theory of heuristic algorithm can not solve the actual vehicle routing problem[9]. Therefore, it is particularly important to adopt a new algorithm or improved algorithm to study this kind of problem. The C-W covenant is first proposed by Clark and Wright in 1960s. The advantage of this algorithm is that the principle is simple and easy to understand and the calculation process is not tedious. It is suitable for small and medium sized enterprises to solve small and simple problems[10].

3. C-W Saving Method with Time Window Two-Way Transportation

The VRPSPD problem of the time window should consider the customer's request for the delivery time in the planning, and take into account the demand of the customer's goods to ensure that the freight vehicle is not overloaded, and the two-way flow between the distribution center and the customer is the process[11], which includes the return and the recovery of the goods. Compared with the one-way transportation route optimization problem without time window, this problem is more difficult and complex, but it is also an important research content in VRP.

3.1 Model Description

A distribution center, m customers, distribution center and customer distribution route is directed graph $V=(P,L)$. Set $p=(p_i\,|\,i=0,1,\ldots,m)$. For the distribution center p_0 (i =0), (= 1,2 m) , $p_i(i=1,2,\ldots,m)$ (i =1,2⋯,m)means the collection of customer points i (i =0), and customer points i (i = 1,2 m) is M and $M \subseteq P$. Then it is assumed that the distance set is $L=\{(l_i,l_j)\,|\,l_i,l_j \subseteq V, i\neq j\}$ and a subset of the customer and the inter – distance is $L_{ij}=\{l(i,j)\,|\,i,j=1,2,\ldots,m\}$, the distance between the distribution center p_0 and the customer i is L_{0i} , the cost C_{ij} of the customer point i to the customer point j , the quantity required Q_k for the vehicle, the load, q_i (i =1, 2⋯, m) for the first customer. The other requirements of the method are probably similar to the one way distribution model without time windows. The difference is that the model emphasizes the complete delivery of goods on time.

In order to solve this problem, a relatively deserved mathematical model is established to solve it. First, set the relevant variables and explain them in detail. See Table 1.

Table 1. Implicature of related variables

Variable	Variable meaning
p_0	distribution center
D_i	Customer demand of point i for goods
p_i	collection of customer points i
C_{ij}	the cost of the customer point i to the customer point j
$P_i - D_i$	Vehicle load increase after customer point i service is completed
T_i	The total time required to complete the customer point i task (loading and unloading).
ET_i	The earliest time for a task i to start
LT_i	The time that the task i can start at the latest
S_i	The time when the vehicle goes to the customer's point i
t_{ij}	Time used to drive customer points i from a customer point j
EF_j	The time saved (delay or advance quantity) after connecting customer points and customer points j

From the parameters of the model above, we can know the time range $[EF_i, LT_i]$ of the start time of the task i, and $EF_i \le S_i \le LT_i$; If the time of delivery of the vehicle to the customer point i is earlier than that of the vehicle, the vehicle can not be delivered immediately and must wait at the customer point i; in the same way, the task should be delayed. The above variables show that $EF_j = S_i + T_i + t_{ij} - S_j$, at that time $EF_j < 0$, the vehicle arrived at the customer point j ahead of time; when $EF_j > 0$, the vehicle arrived at the delay; when $EF_j = 0$, the vehicle arrived at the same time. In addition, transportation costs $s(i,j) = C_{i0} + C_{0j} - C_{ij}$ can be reduced after point i to point j connection.

In order to explain the problem conveniently, we need to define several parameters: the earliest advance time allowed Δj^- for the arrival point j, $\Delta j^- = \min_{r \ge j}\{s_r - EF_r\}$. The last allowed delay Δj^+ for the arrival point j, that is $\Delta j^+ = \min_{r \ge j}\{LF_r - s_r\}$.

When connecting customer points i and customers j can not violate the time window constraint. Therefore, the principle of setting up the inspection is as follows:

At the time $EF_j < 0$, the vehicle arrived in advance. If $|EF_j| > \Delta j^-$, the task behind the customer j needs to wait.Thus, it is possible to know the situation of $EF_j > 0$.

In the VRPSPD problem, if the time window is not considered, the algorithm is similar to the C-W saving algorithm. When the customer is connected to the customer in different places, the load limit of the vehicle must be considered. When the delivery process reaches a customer point, it may be larger than the amount of recovery.

3.2 Set up Mathematical Model

(1) Consider the starting point p_0 to connect the customer point i and the customer point j to reduce the transportation cost $s(i,j) = C_{i0} + C_{0j} - C_{ij}$. Order $M = \{s(i,j) \mid s(i,j) > 0\}$, when it appears $(i,j) \ne s(j,i)$, it is possible because there is a single line, but as long as $s(i,j)$ or $s(j,i)$ in the verification process is verified and two points are connected, then the other does not need to be verified again, directly from the set M.

(2) The analysis of $s(i,j)$ rank from the big to the small.

(3)Stop calculation when $M=\varnothing$, and now it is the best path. On the contrary, at that time $M\neq\varnothing$, it was also necessary to verify whether or not to meet any of the following conditions.

Point and point are not online;

The point and point are on line, but they are connected to the yard;

Point and point are on two different routes, one is the starting point and the other is the destination.

(4) Judge the connection point i and j the post route every hour Q, if so $Q\leq q$, turn it around;

(5)If $EF_j=0$ turn 6;otherwise turn; if $EF_j>0$, further calculation Δj^+, if $EF_j\leq\Delta j^+$, further turn 6, otherwise turn(7); if $EF_j<0$, further calculation Δj^-, if $|EF_j|\leq\Delta j^-$, further turn 6, otherwise turn(7);

(6)Connect customer point i and customer point j, calculate the new time of vehicle arrival.

(7) $M=M-s(i,j)$,turn(3);In order to find the optimal delivery path, the above six steps are carried out to calculate the saving values $s(i,j)$ of all paths.

As a result, we build see Table 2.

Table 2. Validation step table

(i,j)	Two points	Vehicle load at each point	$EF_j=S_i+T_i+t_{ij}-S_j$	Δj^- or Δj^+	Whether or not to connect	$S_k=S_k+EF_j$
…	…	…	…	…	…	…

Drawing fig.1, describe the algorithm flow chart of the saving algorithm under the VRPSPD problem, and clearly describe the calculation process.

4. Example Analysis

The beer industry belongs to the fast selling industry. It is a seasonal product. There is a significant difference between the off-season and the peak season. The consumption of medium and low grade beer mainly concentrated in summer, late spring and early autumn and late winter, while the consumption of high grade beer did not fluctuate much throughout the year. Generally speaking, beer has broad market prospects and good development trend. As the world's largest beer producing country, the average annual growth rate is more than 20%, but the logistics distribution of the beer industry in our country has a large problem, which leads to the failure of the enterprise to obtain the maximum operating efficiency.

4.1 A Company Brief Introduction

As a well-known enterprise in China, Company A is a large beer producer, ranking fifth in the mainland of China, with 13 branches. In Harbin, the market share is sixty-six percent, accounting for five percent of the national market. A was founded in 1900 and has been in the beer market for other companies. It evolved from the U Lou Bbu Levski brewery, and the predecessor was the earliest Brewery Company in China[12]. Since its inception, through constant change and expansion, from the original small and weak warehouse gradually developed into now large and strong well-known enterprises. Even if the time is constantly advancing, the quality of beer and the taste of the enterprise remain pure, which has brought different experiences for many people who like beer, which has also made it a high-end brand of beer in the pursuit of many consumers in our country. A company's beer has gone to the north and south of the river, especially in Heilongjiang, Liaoning and Jilin, the market share is rising, and is also sold to the country, gradually moving towards the whole world.

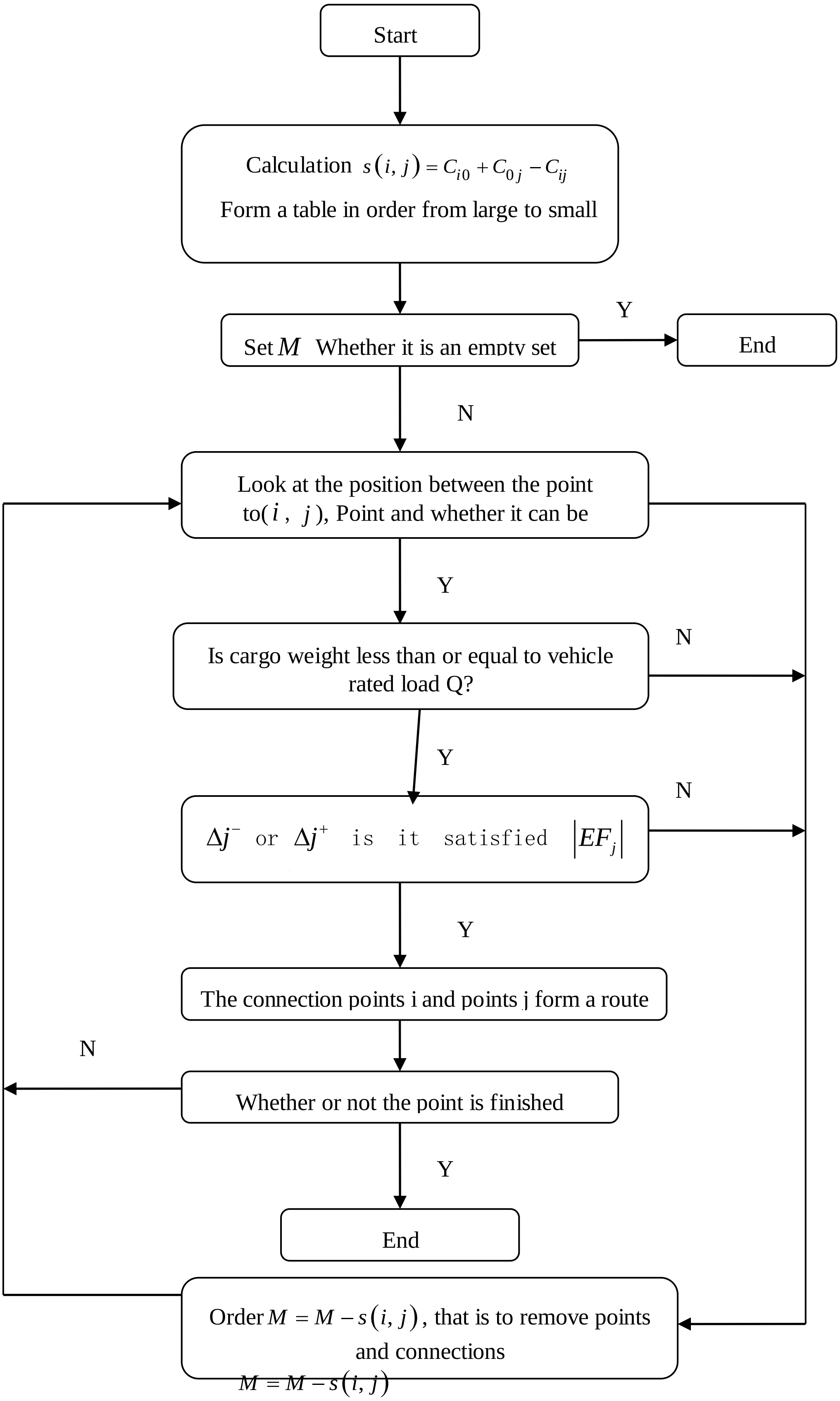

Fig 1. Time window node reduction model operation process

4.2 The Problem of Vehicle Distribution in 2.2 A Company

A company has developed more and better in the beer industry in recent years. It has made a lot of proud achievements and has won great recognition among the consumers. However, because of the increasingly fierce market, A company still has a lot of problems in the transportation of beer, which is to be solved.

The delivery of goods is low in time. Because of the number of customers and the different requirements for the distribution and distribution time of different customers, the company uses traditional methods to plan the distribution path. It can not consider all the constraints, which leads to the unreasonable path planning, which not only leads to the increase of distribution cost, but also reduces the satisfaction rate of the customers.

The vehicle has many non full loads. Because of the particularity of distribution in beer industry, we should not only distribute beer to customers, but also recycle empty beer bottles left by customers. Therefore, when delivering to multiple customers, the vehicles are often under-loaded because they can not combine the demand and recovery of each customer.

Ineffective and circuitous transportation. A's distribution of customers is timed. Different customers have different differences in the demand time and demand quantity of the goods, so each time the distribution path is changed to a certain extent when it is delivered to the customer. However, due to various reasons of the distribution system, such as the planning is unreasonable, unfamiliar with geographical location, etc. can cause this situation.

It is not reasonable to manage the staff. The company is unable to monitor the operation of vehicles and personnel in real time because of the unqualified technical training of the staff, especially the driver, free and undisciplined management, not delivery according to the prescribed route.

Table 3. Point between the shortest distance tables

j i	0	1	2	3	4	5	6	7	8
0	0	40	60	75	90	200	100	160	80
1	40	0	65	40	100	50	75	110	100
2	60	65	0	75	100	100	75	75	75
3	75	40	75	0	100	50	90	90	150
4	90	100	100	100	0	100	75	75	100
5	200	50	100	50	100	0	70	90	75
6	100	75	75	90	75	70	0	70	100
7	160	110	75	90	75	90	70	0	100
8	80	100	75	150	100	75	100	100	0

From the table 3 point to the shortest distance table, we can see that the shortest travel time of each point is shown in Table 4.

Table 4. Point shortest travel schedule

j i	0	1	2	3	4	5	6	7	8
0	0	0.8	1.2	1.5	1.8	4	2	3.2	1.6
1	0.8	0	1.3	0.8	2	1	1.5	2.2	2
2	1.2	1.3	0	1.5	2	2	1.5	1.5	1.5
3	1.5	0.8	1.5	0	2	1	1.8	1.8	3
4	1.8	2	2	2	0	2	1.5	1.5	2
5	4	1	2	1	2	0	1.5	1.8	1.5
6	2	1.5	1.5	1.8	1.5	1.4	0	1.4	2
7	3.2	2.2	1.5	1.8	1.5	1.8	1.4	0	2
8	1.6	2	1.5	3	2	1.5	2	2	0

4.3 Transportation Route Structure and Solution of A Company

The distribution center P of A company has to distribute to 8 customers, and the customer's delivery volume D_j, the amount of recovery P_j. The service time of each customer T_j, and the time range of each task that can be started $\left[ET_j, LT_j\right]$. A company is 8 tons of load limit, and the speed is 50 km / h. The distance between the distribution center and the 8 users is known, see Table 3.

Table 5. Detailed list of customer needs information

Task j	1	2	3	4	5	6	7	8
D_j	2	1.5	4.5	3	1.5	4	2.5	3
P_j	1	1	0.5	2.5	3	1.5	0.5	2.5
$P_j - D_j$	-1	-0.5	-4	-0.5	1.5	-2.5	-2	-0.5
T_j	1	2	1	3	2	2.5	3	1.8
$\left[ET_j, LT_j\right]$	[1，4]	[4，6]	[1，2]	[4，7]	[3，5.5]	[2，5]	[5，8]	[1.5，4]

According to the specific situation of A company, the model is verified and solved.

The distribution of vehicles p from the distribution center to the task i, when $ET_i \le t_{0i} \le LT_i$, take $S_i = t_{0i}$; if $t_{0i} < ET_i$, take $S_i = ET_i$. For convenience t_{0i} compare with the same table, see Table 6.

Table 6. Service time range table

i	1	2	3	4
t_{0i}	0.8	1.2	1.5	1.8
$\left[ET_j, LT_j\right]$	[1，4]	[4，6]	[1，2]	[4，7]
i	6	7	8	-
t_{0i}	2	3.2	1.6	-
$\left[ET_j, LT_j\right]$	[2，5]	[5，8]	[1.5，4]	-

According to table6, the initial table 7 can be clearly drawn.

Table 7. Initial table S_j

S_1	S_2	S_3	S_4	S_5	S_6	S_7	S_8
1	4	1. 5	4	4	2	5	1. 6

According to the formula $S(i, j) = L_{i0} + L_{oj} - L_{ij}$ in the improved saving method above, we calculate the distance savings between each pair of points, as shown in Table 8.

Table 8. Connects two point distance savings

j i	1	2	3	4	5	6	7	8
1	—	35	75	30	190	65	90	20
2	35	—	60	50	160	85	145	65
3	75	60	—	65	225	85	145	5
4	30	50	65	—	190	115	175	70
5	190	160	225	190	—	230	270	205
6	65	85	85	115	230	—	190	80
7	90	145	145	175	270	190	—	140
8	20	65	5	70	205	80	140	—

Because the distribution distance of the model is symmetrical, there are $S(i, j) = S(j, i)$. Figures8 in the lower left corner and the upper right corner.

The distance savings in Table 8 are arranged in order from large to small, as shown in Table 9.

Table 9. Distance saving scale sequence table

(i,j)	(5,7)	(5,6)	(3,5)	(5,8)	(1,5)	(4,5)	(6,7)
$S(i,j)$	270	230	225	205	190	190	190
(i,j)	(4,7)	(2,5)	(2,7)	(3,7)	(7,8)	(4,6)	(1,7)
$S(i,j)$	175	160	145	145	140	115	90
(i,j)	(2,6)	(3,6)	(6,8)	(1,3)	(4,8)	(1,6)	(2,8)
$S(i,j)$	85	85	80	75	70	65	65
(i,j)	(3,4)	(2,3)	(2,4)	(1,2)	(1,4)	(1,8)	(3,8)
$S(i,j)$	65	60	50	35	30	20	5

According to the distance savings in order 9 from large to small, the connection between points is investigated one by one. Since it is a symmetric distance, when two points are not the points on the route, if they can not be connected (i,j), they should continue to be tested (j,i). Two pairs of points in accordance with the location requirements EF_j in the case of considering the load of each point and solve. The solution process of the specific point to point connection is shown in table 10.

Table 10. Point pair connection process table

1	2	3	4	5	6	7
(i,j)	Two points	Vehicle load at each point	$EF_j = s_i + T_j + t_{ij} - s_j$	Δj^- or Δj^+	Connection or not	$S_k = S_k + EF_j$
(5,7) ①	It's not the point on the line	point0: $1.5+2.5=4\le 8$ point5: $4+1.5=5.5\le 8$ point7: $5.5-2=3.5\le 8$	$EF_7 = s_5 + T_5 + t_{57} - s_7$ =2.8	Δj^+ =3	Connect 5, 7	
(6,5)	Points and points on non route	point0: $4+1.5+2.5=8\le 8$ point6: $8-2.5=5.5\le 8$ point5: $5.5+1.5=7\le 8$ point7: $7-2=5\le 8$	$EF_5 = s_6 + T_6 + t_{65} - s_5$ =1.9	Δj^+ =1.5	N	
(3,5)	Points and points on non route	point0: $4.5+1.5+2.5=8.5\ge 8$			N	
(8,5) ②	Points and points on non route	point0: $3+1.5+2.5=7\le 8$ point8: $7-0.5=6.5\le 8$ point5: $6.5+1.5=8\le 8$ point7: $8-2=6\le 8$	$EF_5 = s_8 + T_8 + t_{85} - s_5$ =-0.1	Δj^- =1	Connect 8, 5, 7	

(7,6) ③	Point and point on non route	point0: $3+1.5+2.5+4=11\geq 8$			N	
(7,4) ④	Point and point on non route	point0: $3+1.5+2.5+3=10\geq 8$			N	
(7,2) ⑤	Point and point on non route	point0: $3+1.5+2.5+1.5=8.5\geq 8$			N	
(7,3) ⑥	Point and point on non route	point0: $3+1.5+2.5+4.5=11.5\geq 8$			N	
(7,8)	Point and point on non route	point0: $3+1.5+2.5+3=10\geq 8$			N	
(4,6)	It's not the point on the line	point0: $3+4=7\leq 8$ point4: $7-0.5=6.5\leq 8$ point6: $6.5-2.5=4\leq 8$	$EF_6=s_4+T_4+t_{46}-s_6$ =6.5	Δj^+ =3	N	
(6,4)	It's not the point on the line	point0: $4+3=7\leq 8$ point4: $7-2.5=4.5\leq 8$ point6: $4.5-0.5=4\leq 8$	$EF_4=s_6+T_6+t_{64}-s_4$ =2	Δj^+ =3	Connect 6、4	s_4 =6
(7,1) ⑦	Point and point on non route	point0: $3+1.5+2.5+2=9\geq 8$			N	
(2,6)	Points and points on non route	point0: $1.5++3+4=8.5\geq 8$			N	
(3,6)	Points and points on non route	point0: $4.5+3+4=11.5\geq 8$			N	
(8,6) ⑧	Points and points on non route	point0: $3+4+3=10\geq 8$			N	
(1,3)	It's not the point on the line	point0: $2+4.5=6.5\leq 8$ point1: $6.5-1=5.5\leq 8$ point3: $5.5-4=1\leq 8$	$EF_1=s_3+T_3+t_{31}-s_1$ =1.3	Δj^+ =0.5	N	
(3,1)	It's not	point0: $4.5+2=6.5\leq 8$	$EF_3=s_1+T_1+t_{13}-s_3$	Δj^+ =4	Connect	s_1 =3.3

⑨	the point on the line	$point3: 6.5-4=2.5\leq 8$ $point1: 2.5-1=1.5\leq 8$	=2.3		3, 1	
(4,8)	The end and the starting point	$point0:$ $4+3+3+1.5+2.5=14\geq 8$			N	
(1,6)	The end and the starting point	$point0:$ $4.5+2+4+3=13.5\geq 8$			N	
(2,8)	Points and points on non route	$point0:$ $1.5+3+1.5+2.5=8.5\geq 8$			N	
(4,3)	Point, point	$point0:$ $4+3+3+4.5+2=13.5\geq 8$			N	
(2,3)	Points and points on non route	$point0:$ $1.5+4.5+2=8\leq 8$ $point2: 8-0.5=7.5\leq 8$ $point3: 7.5-4=3.5\leq 8$ $point1: 3.5-1=2.5\leq 8$	$EF_3=s_2+T_2+t_{23}-s_3$ =6	Δj^+ =0.5	N	
(4,2)	Point and point on non route	$point0:$ $4+3+1.5=8.5\geq 8$			N	
(1,2)	Point and point on non route	$point0:$ $4.5+2+1.5=8\leq 8$ $point3: 8-4=4\leq 8$ $point1: 4-1=3\leq 8$ $point2: 3-0.5=2.5\leq 8$	$EF_2=s_1+T_1+t_{12}-s_2$ =1.6	Δj^+ =2	Connect 3, 1, 2	s_2 =5.6
(1,4)	Position is not conformed				N	
(1,8)	The end and the starting point	$point0:$ $4.5+2+3+1.5=13.5\geq 8$			N	
(3,8)	Position is not conformed				N	

After the connection table between tables 10 points, the optimal solution is obtained: three vehicles are required, and the distribution routes are:

Point 0 - point 8 - point 5 - point 7 - point 0;

Point 0 - point 6 - point 4 - point 0;

Point 0 - point 3 - point 1 - point 2 - point 0;

The distribution distance of the first path is 80+75+90+160=405; the distribution distance of the second path is 100+75+90=265; the distribution distance of the third path is 75+40+65+60=240; the total distribution distance is 405+265+240=910. Figure 4-1 below is an optimized distribution path.

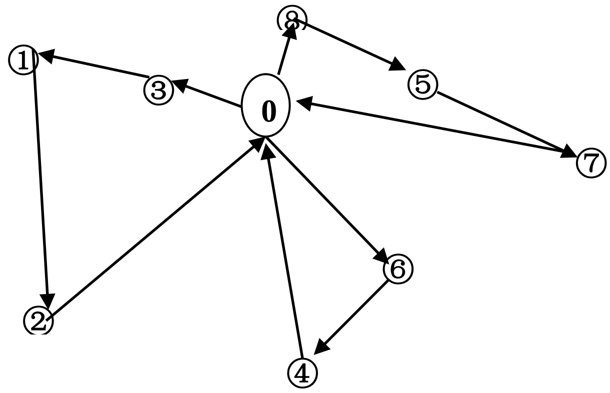

Fig 2. Transport route map obtained by improved saving method

By optimizing the vehicle distribution path of A company by the improved method, three distribution paths are obtained, which greatly reduces the cost of distribution and improves the efficiency of distribution.

5. Conclusion

Vehicle routing problem (VRP) is a kind of combinatorial optimization problem which is difficult to solve, but it is also an important part of logistics system optimization. Vehicle routing optimization can reduce the cost of distribution, improve the efficiency of distribution and improve the service level of customers. Therefore, the problem of vehicle routing optimization has been paid more and more attention by enterprise managers in recent years, and has become a hot topic in various industries.

The main conclusions of this paper are as follows:

On the basis of one-way vehicle routing optimization based on logistics distribution, the necessity of two-way transportation is put forward, and the two-way transportation routing optimization problem is emphatically studied.

According to the example of A company, the existing distribution path of A company has the problems of low delivery on time rate, non full load, invalid and circuitous transportation, and unreasonable management of the staff. In view of the problems mentioned by the A company and the distribution mode of A company, the mathematical model of A company is constructed and the C-W saving algorithm of the improved two-way time window is used to solve the model. Finally, it is concluded that the A company needs to use three distribution vehicles to distribute three different paths, namely, point 0, point 8, point 5, point 7 to 0, respectively. Point 0, point 6, point 4 to point 0, point 0, point 3, point 1, point 2, point 0, three paths, only distribution from three paths can achieve the best effect, so it puts forward feasible suggestions for the development of A company.

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