

# Research on Distributed Material Vehicle Path Planning Based on AnyLogic

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## Abstract

With the development of computer technology, people gradually began to study the material problem with resource constraint control. Since then, distributed materials have received extensive attention. The vehicle path planning technology of distributed materials is an important research aspect. For the problem of vehicle path planning, it is very important to take all factors into consideration and carry out a weighted analysis. This paper studies the vehicle path planning by establishing a distributed material vehicle path planning model, compare and analyze the four situations of single distribution center and multiple distribution centers, considering the time window and not considering the time window, simulate the real path planning in the geographic information system, and get the corresponding shortest path planning plan and the cost information of vehicle distribution, which plays an important role in reducing the transportation cost of the enterprise..

## Introduction

Vehicle routing problem (VRP) is an important research aspect in distributed technology management. In foreign countries, the solution of vehicle path planning problem is mainly through modern heuristic algorithm, including genetic algorithm, ant colony algorithm and tabu search algorithm. However, domestic research on path planning, including vehicle path planning, etc., started relatively late which began in the 1990s.

With the rapid development of express logistics and other industries in the future, as well as the constant changes in the social and natural environment, the route planning of vehicles also needs to be adjusted in time. Dynamic path planning is helpful to improve the service efficiency of enterprises, but it also easily increases the distribution cost. Therefore, the establishment of a reasonable path planning method has extremely far-reaching significance for the benefit of the entire enterprise.

This paper establishes a distributed material vehicle path planning model based on Anylogic software, studies the shortest path of vehicles under multiple distribution centers, and calculates the time and distance of vehicle delivery to obtain vehicle costs, delay costs and total costs, reduces the company logistics transportation cost.

## Materials

In the research process, the random variables of the path planning problem include the distribution center and each material yard. Each material site is the location where various materials need to be placed. However, due to the inconsistency of the demand time for materials and the inconsistency of the required material types, each material site needs to send out demands from time to time. At the same time, the urgency of material requirements is also inconsistent, so it is necessary to set a path planning program with time window restrictions and a path planning program without time restrictions. The distribution center is the location where materials are distributed to each material site. The distribution center stores a variety of materials, and after the company purchases materials, the delivered materials are placed in the distribution center, and the distribution center is used to distribute materials to each material site. The distribution center can realize centralized and unified management of various materials. There can be one or multiple distribution centers. Therefore, this study will discuss the path planning schemes of one distribution center and multiple distribution centers.

## Methodology

### ESTABLISHMENT OF SIMULATION MODEL FOR DISTRIBUTED MATERIAL PATH PLANNING

Geographical coordinates and information of each material yard

Name	Latitude	Longitude	Material reqmt (tons)	Service time (hours)	Time window (hours)
Material yard 1	38.88563	117.65087	2	0.3	[0.5,2]
Material yard 2	38.88342	117.67276	2.5	0.5	[1,3]
Material yard 3	38.89049	117.58765	4	0.7	[3,6]
Material yard 4	38.98277	117.57578	1.5	0.3	[0.5,5]
Material yard 5	38.81712	117.53114	3	1.2	[1,4]
Material yard 6	38.83488	117.52877	4.5	1.5	[2,7]
Material yard 7	38.94861	117.53183	2	0.8	[1.5,5]

Truck information of each distribution center

Belonging	Distribution Center A				Distribution Center B			
	A1	A2	A3	A4	B1	B2	B3	B4
Numbering								
Load	3	4	3	5	2	4	3	6
Stand-by cost	10	12	10	15	8	12	10	18

### DISTRIBUTED MATERIAL VEHICLE PATH PLANNING SIMULATION

According to the GIS map that comes with Anylogic, the path planning problem of only one distribution center is the first to be simulated. And then use the input plug-in in the Anylogic software to insert the Excel table into the software Simulation.

After the model is completed, the delivery cost can be obtained through the statistics of the vehicle delivery time and distance in the main interface. Continue to record the relevant cost information and summarize it into a table.

After simulating the shortest path plan of a single distribution center, a simulation of the shortest path plan of multiple distribution centers is carried out. At this time, the distribution center B is also taken into consideration, and other conditions remain unchanged.

In the main interface, through the statistics of the vehicle delivery time and distance, the vehicle cost, delay cost and total cost can be obtained.

## Results

According to the cost statistics shown in Table below, it can be concluded that in the simulation process of this example model, the total cost of considering the time window is lower than the cost without considering the time window. The total cost of the two distribution centers is The cost is lower than the cost of a single distribution center. And in the construction of this large-scale module, the total cost of the construction process considering the time window was reduced by 37.8% and 31.9%, respectively, compared with the total cost without considering the time window, the total cost of the two distribution centers was reduced by 35.7 % and 29.7%.

Cost statistics	Regardless of time window limit (yuan)	Consider the time window limit (yuan)
Vehicle cost	2075.21	2305.026
Delay cost	1161.321	114.1
total cost	3557.21	2419.126

From the above analysis, it can be seen that the cost of multi-distribution center vehicle path planning is less than that of a single distribution center, regardless of whether the time window limit is considered, and when the time window limit is considered, the multi-distribution center can more effectively provide for each material site Materials, so that the cost of delays is very low. The large-scale modular construction process material distributed model built in this chapter can also be analyzed differently according to different enterprise conditions, such as the different locations and quantities of distribution centers and material sites, different time window restrictions, and different material types and requirements.

## Conclusion

By studying the problem of vehicle path planning in the case of distributed materials and comparing and analyzing the shortest path plan without considering the time window and the shortest path plan considering the time window, the optimal path selection plan is obtained. It provides a great reference value for the practical application of specific path planning in the future.

