Choice of Distribution Mode of Medical Logistics Based on Anylogic Multi-Distribution Center

TAO ran*, XU Xin-yi

School of Economics and Management, Anhui University of Science and Technology, Huainan, China

e-mail:taoran202104@ahstu.edu.cn

*Corresponding Author

Keywords: Multi-distribution center, Medical logistics, Anylogic simulation, Distribution mode selection

Abstract: According to the development of the recent epidemic situation and the urgency and demand of medical supplies distribution, according to the distribution process and planning of the medical distribution center, Anylogic simulation technology was used to simulate and analyze the choice of medical distribution mode from the distribution center to various pharmacies. The dynamic simulation model of medical logistics distribution is established, and the simulation process and evaluation index of distribution mode selection are designed. By simulating the shortest path distribution and emergency time distribution, the priority distribution under the same conditions is found out, which provides a powerful solution and basis for the actual situation in life.

1. Introduction

For this link of medical logistics distribution, the biggest difference between medical supplies and other distribution products lies in the fact that medical supplies pay great attention to the timeliness and urgency of drugs under the current epidemic situation [1]. Therefore, in the process of distribution of medical supplies, on the one hand, we should try to shorten the distribution time and reduce the transshipment link in the distribution process. On the other hand, it is necessary to control the cost consumption in the distribution process on the premise of ensuring the distribution efficiency as much as possible.

The Anylogic simulation technology is used to simulate the distribution mode of pharmaceutical products. Compared with the traditional analysis method of distribution mode selection, the model is easier to build, the numerical simulation is more accurate, and it has stronger practical reference value. At present, most references use genetic algorithm to select the route of multi-distribution center, Ant colony algorithm and other methods for analysis and solution. In this paper, the Anylogic simulation tool is used to solve the problems that need to be solved. by modeling the choice of distribution mode of Beijing pharmaceutical logistics, the simulation of the activities of distribution vehicles picking up goods from different distribution centers for distribution is described. Finally, the different results of the two distribution methods are analyzed. Setting various simulation variables in the simulation experiment can effectively check that the change of a certain variable has different influences on the simulation results, thus bringing powerful reference value to the choice of distribution mode in reality.

2. Distribution Characteristics of Pharmaceutical Logistics

Medical drugs have the characteristics of timeliness, low temperature and vulnerability, strict production environment from the production point of view, and no timely mass production. From the perspective of patients and doctors, they are an indispensable treatment way for doctors to treat patients. Of course, patients also have the characteristics of severe and mild diseases [2-3]. Therefore, The distribution of medical articles is quite different from that of other products. It has strict distribution requirements, which requires fewer loading and unloading times of medical articles in

  DOI: 10.25236/iiiece.2022.025

distribution, requires more accurate distribution methods and reduces various costs in the distribution process. It is embodied in the following aspects:

(1)The types of medical articles are complex, the supply and demand are scattered among cities, and the demand of pharmacies and hospitals is relatively large. China has become the fastest country in the world to control the development of the COVID-19 epidemic, which is closely related to the country's great investment in the construction of medical system, perfect drug distribution mode and the unremitting efforts of medical staff.

(2)China's current logistics network is broad and there are many outlets. Due to the scattered distribution centers of pharmaceutical products, regional hospitals and pharmacies, their transportation and distribution needs are more complicated. In order to better provide medical supplies for hospitals and pharmacies, multiple distribution centers are set up to distribute near demand points.

(3)The distribution technology and risk of medical logistics have high requirements. Some specific drugs for viruses and medical instruments for rescuing patients may have invisible losses in distribution, which requires extremely high logistics distribution. In logistics and transportation, keeping low temperature can keep the activity of drugs better and prolong the efficacy of drugs; In order to avoid the damage of medical instruments, the handling and transportation of medical instruments should be reduced as much as possible in the distribution process. Therefore, for the distribution of medical supplies under the epidemic situation, it is necessary to design a reasonable distribution method, standardize the operation process and improve the distribution efficiency of medical supplies.

3. Design of Anylogic Model for Medical Distribution

3.1 Simulation Mechanism of Anylogic System

Anylogic is a modeling tool widely used in modeling and simulation of discrete, continuous and hybrid systems. Based on the latest complex system design method, it is the first original tool to introduce UML language into the field of model simulation, and it is also the only commercial software that supports hybrid state machine, which can effectively describe discrete and continuous behaviors[4]. The system supports multi-agent simulation, discrete event simulation and system dynamics simulation, and can be used in control system, power system, computer system, manufacturing, military, transportation, logistics and other fields.

Anylogic’s analytical simulation mainly simulates different things (such as machines, factories, workstations, etc.) in real systems through moving objects. The active object is the main diagram for building Anylogic model. The active object has its own attribute and behavior state, and the attribute of the object is expressed by setting variables and parameters. Set the behavior state of the object by setting the state diagram and writing functions. Objects can encapsulate other objects downward, and objects can interact and transmit messages through ports to simulate the movement and information transmission of objects in the real world. In fact, design analysis model is to design active objects and define their relationships, Running model is to show the dynamic activities of active objects. For Anylogic, dynamic simulation is a 100% JAVA program, so it can be accessed through the network and displayed on the Web page [5].

3.2 Assumed Conditions

The simulation model of pharmaceutical logistics distribution needs to abstract and simulate the practical measures under certain assumptions [6].In this paper, the warehousing department of a pharmaceutical company in Beijing during the epidemic was investigated and studied for multi-regional medical supplies distribution. Now the following assumptions are made in the simulation software:

(1)Set the values of per-Hour Cost and delay Cost to 100 and 200 when creating distributor agent.

(2)In the simulation experiment, we assume the geographical location of pharmaceutical distribution center, pharmacies with demand (A-H), the number of demand orders of pharmacies,

delivery time, and drug category (1 means emergency, 2 means ordinary). The specific parameters are as follows:

Table 1 Parameter Setting Of Pharmacy and Distribution Center

name	latitude	longitude	Number of orders	Product category	Delivery time
Distribution center a	39.99138	116.41951	-	-	-
Distribution center b	39.75257	116.59208	-	-	-
Pharmacy a	39.93335	116.3578	10	2	0
Pharmacy b	39.87118	116.4473	20	1	50
Pharmacy c	39.9624	116.4972	10	2	0
Pharmacy d	39.80018	116.4275	20	1	32
Drugstore e	39.91862	116.4648	30	1	25
Pharmacy f	39.85373	116.5395	12	2	0
Pharmacy g	39.98186	116.5763	24	2	0
Pharmacy h	39.74531	116.4824	22	2	0

(3)Force majeure that may occur during transportation is not considered.

3.3 Establish Simulation Objectives

In anylogic modeling, we follow the basic principle of focusing on the simulation target. under the precondition of ensuring that the simulation target can be accurately simulated, it is an essential step to simplify the model, which can reduce the workload in our modeling process. This paper mainly takes Beijing as an example to study the distribution route of medical supplies between distribution centers and pharmacies, Modeling and simulation, the specific simulation goal is: medical goods have the shortest path and emergency distribution in the delivery process.

3.4 Definition of Modeling Elements (See Table 2)

Table 2 Definition of Modeling Elements

name	type	explain
distribution	agent	DC
retailer	agent	drugstore
truck	agent	vehicle
main	agent	Main model agent
location	Gis point	Location of distribution center and pharmacy
Delay cost	double	Delay cost
Delay time	double	lose time
Per-Hour cost	double	Hourly fee
Product Num	int	Drug quantity
Product Type	int	Types of drugs
String00	Decimal format	Start distribution

4. Simulation Operation Analysis of Medical Logistics Distribution

4.1 Parameter Setting

System simulation time: Before running the whole model, it is necessary to set the simulation time of the model to run in minutes, and type the running code: initialize () in the intelligent weight of main; create_MyDynamicEvent(0.001); Used to start the operation of the model.

4.2 The Operation of the Model and the Results Show That

In the simulation experiment, we set two distribution modes to compare with each other. By studying the difference between the shortest path distribution scheme and the emergency time distribution scheme under the same conditions, we can better choose the applicable distribution mode and improve the distribution efficiency. After a period of simulation experiment, we get the following experimental results;

Shortest path distribution scheme:

a)Distribution Center a-Pharmacy c 16.64-Pharmacy e 35.19-- Pharmacy b 62.66-- Pharmacy a 97.19

b)Distribution center b-pharmacy h 21.61-- pharmacy d 51.50-- pharmacy f 92.10-- pharmacy g 114.47

Vehicle cost: 21658.642;Delay cost: 8470.063;Total cost: 30,128.605

Emergency time distribution scheme:

a)Distribution center a-pharmacy e 22.22-- pharmacy b 49.69-- pharmacy c 83.03-- pharmacy a 112.49

b)Distribution center b-pharmacy d 35.81-- pharmacy h 64.86-- pharmacy g 114.04-- pharmacy f 136.79

Vehicle cost: 23861.673;Delay cost: 762.689;Total cost: 24624.362

After running for a period of time, it will produce the route and total cost in two forms. When the distribution is completed in emergency distribution mode, the total cost is 24,624.366. However, the total cost of the shortest path mode distribution is 30,128.605, so under the same conditions, emergency distribution is more cost-effective.

5. Summary

The logistics distribution system of medical supplies is a dynamic and complex system composed of all kinds of discrete information in reality and modern intelligent logistics operations. Anylogic system simulation provides an effective simulation platform for the design, implementation and optimization of various dynamic complex systems. This paper expounds the distribution modes of different schemes in the logistics distribution of medical supplies, The logistics distribution system model of medical supplies is established based on Anylogic simulation modeling, which simulates the demand of pharmacies, the delivery mode of multiple distribution centers, the route selection of vehicles in transportation, and designs the cost problems in the whole distribution process. The discussion shows that, It is feasible to choose the distribution mode of multiple distribution centers in the process of medical supplies logistics distribution by using Anylogic simulation. Dynamic simulation is beneficial to better route selection in the real distribution process, thus improving the distribution efficiency of medical supplies.

REFERENCES

[1] Chai Liping. emergency medical logistics problem sorting [J]. marketing, 2019(32):214-215.

[2] Lin Zhenqiang, Zhao Jiaoyun. New development of pharmaceutical cold chain logistics [J]. Logistics Technology and Application, 2021,26(S1):40-41.

[3] Zhang Tingting, Kan Ankang, Lu Yan, Cao Dan, vilen Lily. Development status and trend of Chinese medicine cold chain logistics [J]. Refrigeration and Air Conditioning, 2021,21(02):13-19.

[4] Zhu Xin, yaoyao. Road-based medicine cold chain logistics distribution path optimization [J]. Science, Technology and Engineering, 2021,21(04):1548-1554.

[5] Wang Yubin, Lei Huaiying. Logistics simulation of distribution center of fruit and vegetable cold chain system based on AnyLogic [J]. Journal of Southeast University (Philosophy and Social Sciences Edition), 2018,20(S2):20-22+35.

[6] Yang Fang, Zou Yifeng, Dai Enyong. Logistics operation optimization of distribution center of fruit and vegetable cold chain system based on Anylogic [J]. Journal of Central South University of Forestry and Technology, 2016,36(07):141-148.