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Research Article

Optimization of a Logistics Transportation Network Based on a Genetic Algorithm

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In order to solve the problem of genetic algorithm, the author proposes a research on optimization of a logistics transportation network. First, combined with the distribution characteristics of logistics, starting from the relevant research theories of vehicle routing problems, the vehicle travel distance is considered in the basic model of vehicle routing optimization, a vehicle routing model with soft time window is established to minimize the total cost, respectively, and a vehicle routing model with multiple distribution centers. Second, on this basis, according to the actual problems and model needs of the research, using the basic principle of genetic algorithm, the solution algorithm design of the built model is carried out and we use MATLAB for programming, so that the solution of the built model is finally realized. We set $T = 100$, $S = 50$, $Pc = 0.95$, $Pm = 0.1$. $\beta 1 = 0.005$, $\beta 2 = 1$, and $\beta 3 = 0.005$. Finally, the actual distribution data of the *G* supermarket chain in the region are used as the experimental data; by picking two shipping instances, the two constructed models and the designed genetic algorithm are verified, respectively.

1. Introduction

With the economic globalization, the logistics industry has become an important force in promoting economic development. In recent years, the logistics business has grown rapidly, customers' requirements for distribution efficiency and service quality are also constantly improving, and traditional single transportation methods cannot meet the needs of various aspects of the market. As an advanced transportation mode of logistics transportation, multimodal transportation fully considers the characteristics of various transportation methods; by combining them reasonably, the transportation cost is reduced to the greatest extent and the transportation efficiency is improved, so as to promote the healthy development of transportation. In view of the current situation of logistics distribution based on multimodal transport in my country, the author analyzes the demand for logistics and distribution based on multimodal transport, combined with the basic characteristics and organizational forms of multimodal logistics transportation. Considering the cost factors such as transportation cost, transit cost, and penalty cost in the process of multimodal logistics distribution, and on the basis of time factors such as the transportation time of the goods in transit and the transit time of the goods on the transportation node, a multimodal intermodal logistics distribution network optimization model is established; aiming at the total cost of logistics distribution and the total transportation time, a genetic algorithm was designed to solve the model, using a simulation case to verify the practicability of the established optimization model as shown in Figure 1.

2. Literature Review

The author, on the basis of analyzing the research of a logistics transportation network optimization problem, an exploratory study is carried out on the node optimization problem of the logistics transportation network. Although many experts and scholars have carried out research on the optimization of distribution nodes, however, there are relatively few studies from a global perspective based on the complex network theory [1]. Through the case, using the complex network theory, aiming at the transportation network in the logistics transportation network, based on the

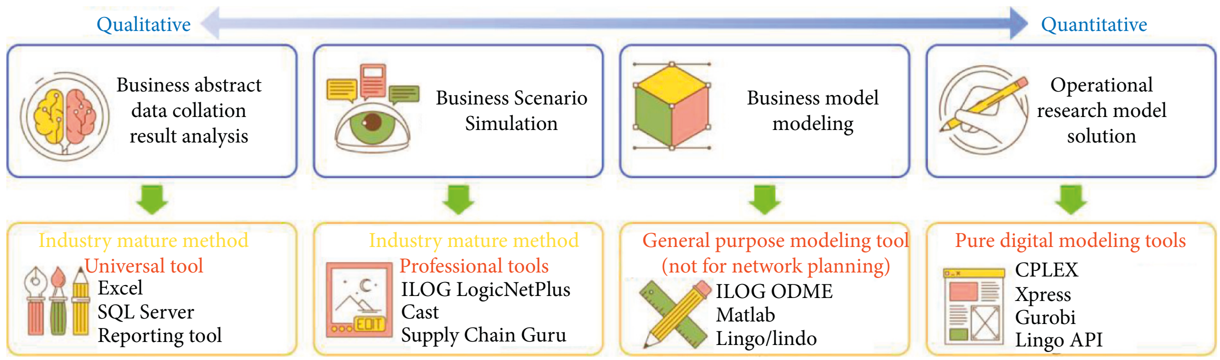

Figure 1: Genetic algorithm (ga).

cargo transportation network of air and railway, an unweighted network model and a weighted network model are constructed. UCINET is used to analyze the network properties and use it as an indicator to measure urban traffic performance. Regarding the logistics and transportation network, taking the logistics and transportation network in the Bohai Rim region as an example, through the analysis of the comprehensive logistics capacity of each city, and combined with the geographical location structure of the cities in the region, clustering is carried out; finally, the logistics transportation network composed of multilevel logistics distribution nodes in the Bohai Rim region is determined.

As early as the 1960s, Shen, Z., etc., established a mixed integer programming (MixedInteger Linear Programming, MILP) model, the simulated annealing algorithm using a special neighborhood search mechanism is used to solve [2]. Zhang et al. proposed a mixed integer programming (MIP) model that considers recycled products, recycled modules, and product mix ratios at different quality levels [3]. Da Varzani and Norrman others designed a logistics network with the characteristics of multiperiod, scalable facility capacity, variable operating costs, and limited demand in the secondary market with the goal of maximizing profits [4]. Considering economic, environmental, and social objectives at the same time, Li et al. solved the mixed integer multiobjective programming problem by using the set partition formula [5]. Liu et al. integrated network design, capacity planning, and vehicle routing problem of the reverse logistics system, aiming at the minimum cost, established network design/capacity planning and vehicle routing problem model, hierarchical, and integrated tabu search algorithms are developed to solve [6]. Possel et al. constructed a fuzzy multiperiod, multiobjective MILP model and used the Epsilon constraint method and particle swarm optimization algorithm to solve the model [7]. Wilson et al. predicted the number of scrapped cars in Ankara (the second largest city in Turkey) from 2012 to 2022; eleven scenarios are generated to demonstrate the rationality and effectiveness of the model [8]. Mansouri et al. constructed a two-layer hybrid MILP model, where the upper layer includes the distribution of waste to various centers and the lower layer includes the location and construction cost of solid waste collection stations [9].

On the basis of the current research, the author proposes a research on logistics transportation network optimization. The optimization of logistics transportation network is an important part of creating a logistics system. When calculating the model, considering the complexity of the model calculation is mainly realized based on the genetic algorithm. From the results of the case simulation solution, in the optimization of the regional logistics transportation network, this computational model and theoretical algorithm are relatively accurate and effective.

3. Research on the Optimization of a Logistics and Transportation Network Based on a Genetic Algorithm

3.1. Basic Concepts of Genetic Algorithms. Genetic algorithm (GA) is an intelligent algorithm and is the main method used by scholars at home and abroad to solve VRP. Its idea, developed by Professor Holland in 1975, is a global search method based on natural selection and genetics, the evolution process of organisms is simulated by genetic operators such as selection, crossover, and mutation, and the fitness function is used to represent the excellence of chromosomes [10]. The genetic algorithm simulates Darwin's natural evolution theory and genetic variation theory and has strong robustness and global optimization ability; it is suitable for solving complex multiextremum optimization problems and combinatorial problems and has a wide range of application values; the corresponding concepts are shown in Table 1.

3.1.1. Basic Elements of Genetic Algorithms. The components of genetic algorithm include chromosome coding, initial population setting, fitness function design, genetic operator design, control parameter setting, and evolution algebra.

(1) Chromosome coding. The genetic algorithm cannot directly process the data in the solution space, and the problem needs to be encoded into chromosomes. Chromosome coding is the first step of the genetic algorithm, where the problem to be solved is expressed in the form of chromosomes through coding and chromosomes are formed by a certain arrangement of structures. In the process of coding, any solution in the problem space should have a

Table 1: Concept correspondence.

Biological genetics concept	Concepts represented in optimization problems
Individual	Feasible solution
Chromosome	Decoded code
Gene	The characteristics of each component in the connection
Individual fitness	Solve the objective function
Population	Set of feasible solutions

chromosome corresponding to it. The commonly used chromosome coding methods mainly include binary coding, integer coding, floating-point coding, and hybrid coding.

(2) Initial population setting. Population refers to the set of all numbers of chromosomes in each generation. Individuals in the population continue to generate new individuals through the iterative process, but the size of the population will not change due to the iterative process, which is fixed [11]. When determining the size of the group, its size should be determined according to the actual situation of the research question. If the group size is too large, the search time will be too long and the running speed of the algorithm will be reduced. If the size of the population is too small, the population will mature prematurely and reduce the diversity of the population. The most common way to generate an initial population in a genetic algorithm is to generate it randomly or through a heuristic program. Generally speaking, the value range of population size should be moderate.

(3) Fitness function design. The size of the fitness function can evaluate the pros and cons of the distribution plan and play a decisive role in the genetic algorithm; each distribution scheme can be represented by a chromosome. Genetic algorithms solve optimization problems, it is to rely on the fitness function to distinguish the pros and cons of the individuals represented by each chromosome. The method of evaluating the distribution plan is as follows: According to the chromosome of the initial population formed, the fitness value of the chromosome is calculated. The larger the individual fitness value is, the better the individual is, and the higher the probability of the delivery plan being selected. In general, the fitness value function is obtained by formula-transforming the objective function.

3.2. Design of Genetic Operators. The genetic operator is an important tool of genetic algorithm, in its running process, continuously optimizing the individuals in the population. There are three types of genetic operators in the genetic algorithm: selection operator, crossover operator, and mutation operator [12].

(1) The purpose of a selection operator is to select excellent individuals from the current population and make the individuals with high fitness in the group more likely to reproduce to the next generation as a parent. The main idea of selection is that by setting a suitable selection strategy method, individuals with larger chromosome fitness values have a higher probability of being selected; it will continue to be retained, and the remaining individuals with smaller chromosome fitness values are used for crossover and mutation operations, and these two operations are used to change the fitness value of the population, until the maximum fitness value is selected. The commonly used selection methods are as follows: Roulette selection, tournament selection, random traversal sampling, and local selection.

(2) The purpose of a mutation operator is to randomly select a chromosome in the population and make changes to certain genes on the gene string of the selected chromosome. In the genetic algorithm, mutation operation can effectively avoid premature convergence and maintain the diversity of the population. The mutation operator according to a certain probability can replace certain gene values in the chromosome code with other alleles to form new chromosomes. The mutation operator generally ranges from [0.01, 0.2], and the commonly used mutation methods include swap mutation, site mutation, and reverse mutation [13].

(3) Setting of genetic parameters.

Common influencing parameters of genetic algorithms include population size, crossover probability, and mutation probability. The population size is generally a linear multiple of the individual code length. In the genetic algorithm, crossover and mutation operate on chromosomes according to a certain probability. Therefore, as control parameters, the selection of crossover probability and mutation probability will have a great influence on the performance of the genetic algorithm. The greater the probability of crossover, the faster the speed of generating new individuals, but if the probability of crossover is too large, the structure of individuals with high fitness will be destroyed quickly. The crossover probability is too small and the search process is too slow. If the mutation probability is too small, it is difficult to generate new individual structures; if the mutation probability is too large, the search mechanism of the genetic algorithm will have problems [14]. In order to make the execution of the genetic algorithm get the optimal result, it is necessary to set the appropriate control parameters.

3.3. Overview of the Logistics and Transportation Network

3.3.1. Logistics Network Optimization Content. Logistics network optimization is an evolving field of research. Since 1997, Fleischmann et al. first outlined the characteristics and quantitative models of logistics systems, the logistics research is subdivided into three areas: Production planning for logistics network optimization, inventory control, and reuse of parts and materials. Moreover, it is proposed that the reasonable construction of the logistics network model needs to be considered from four dimensions: That is, the driving factors of network construction, network types, network participants and their functions, and the relationship between logistics and forward logistics, these four issues also constitute the content of logistics network optimization.

3.3.2. The Driving Factors of Constructing the Network. Different network design motivations determine different network optimization goals. Currently, given the increasing global attention to the environment, some countries have implemented environmental legislation that requires producers to be responsible for the entire product life cycle [15]. For example, Germany's "Packaging Regulations" in 1991 required the industry to take back all sales packaging materials; in 1992, the Netherlands required the automotive industry to be responsible for recycling all used cars and the 1996 "Electronic Waste Regulations" required manufacturers to recycle electronic products. These legislations put a lot of pressure on producers, it is required that while ensuring the economic benefits of the enterprise, environmental benefits are also set as one of the network goals.

3.3.3. The Types of Logistics Networks. Different types of recycled items determine different recycling methods, which affect the structure and construction of the entire network. The classification of the logistics network is based on the processing form of recycled items; the existing classification standard is derived from the classification standard determined by Thiery et al. in 1995, including five forms of direct reuse, recycling, remanufacturing, repair, and commercial return.

3.3.4. Participants of the Network and Their Functions. In order to design an effective logistics network, it is necessary to determine the participating members of the network and the functions that the network needs to achieve. The participants in the logistics system include the following: original manufacturers, sellers, third-party logistics, fourth-party logistics, second-hand product distributors, recycling companies, remanufacturing companies, etc. The functions that the logistics system needs to achieve include the following: transportation, collection, detection, disassembly, classification, warehousing, maintenance, remanufacturing, redistribution, disposal, etc., and they also need to consider the facilities that implement these functions.

3.3.5. The Relationship between Reverse Logistics and Forward Logistics. American scholar Stock et al. defined reverse logistics as follows: The flow of goods in the opposite direction to the normal flow of most goods; this definition distinguishes forward and reverse logistics in terms of the flow of goods. According to the relationship between the two networks, it can be divided into an independent logistics network and forward and a reverse integrated logistics network [16]. The former does not consider the node setting and transportation route planning of the forward logistics network, while the latter systematically considers the forward and reverse logistics flow and facility construction.

3.4. Logistics Network Optimization Methods. Due to the diversity of recycled products and the complexity of the recycling process, the methods of logistics network optimization mainly include case analysis methods, mathematical programming methods, and simulation methods.

3.4.1. Case Analysis Method. The research method based on case analysis refers to the optimization research on the concept or framework of the logistics network, or the research on the optimization of the recycling processing method and recycling mode of a certain product. The early case analysis method is often used to describe the structural characteristics and design principles of logistics, and Brito et al. describe various definitions of reverse logistics; the research scope of logistics is analyzed, and the decision-making framework of logistics is proposed. The current case analysis method mainly focuses on a certain product, for example, Lau et al. summarized the obstacles encountered in China's current electronic industry logistics development [17]. Achillas and others collaboratively considered the construction and working capacity of recycling and treatment facilities, studied and optimized the logistics network of the Greek electronics industry, and provided a reference for the government to make decisions on the construction of the e-waste logistics network.

3.4.2. Mathematical Programming Method. Mathematical programming method is the main method to solve the optimization problem of the logistics network; according to the different optimization variables, it can be divided into various mathematical programming models, such as: integer linear programming (ILP), NLP, MILP, MMILP, stochastic mixed integer linear programming (SMILP), and fuzzy mixed integer linear programming (FMILP). ILP is often used in relatively simple facility location planning models and is optimized through multiple iterations and successive approximations to obtain the most optimal location plan. MILP and MMILP are the two most commonly used models. The difference between the two is that the latter has multiple optimization objectives, while SMILP and FMILP are suitable for uncertain environments.

3.4.3. Simulation Method. The simulation method is mainly suitable for the problem of random uncertainty. By setting different parameter values of logistics facilities, the possible results of network operation are displayed on the computer, evaluate, and analyze the layout plan to determine the optimal network layout. Establishing a simulation model requires a large amount of data investigation on actual cases to ensure that more realistic simulation results are obtained.

In 2009, Acar et al. proposed a general hybrid simulation analysis modeling method that can be used for various combinatorial optimization problems. In 2014, Suyabatmaz et al. solved the optimization problem of the logistics network in the uncertain environment, based on the research results and the combination with the analysis model and simulation.

4. Experiments and Analysis

4.1. Genetic Algorithms. The genetic algorithm starts from an arbitrarily initialized population, uses a random selection mechanism, and according to the principle of survival of the fittest in nature, provides outstanding individuals with greater opportunities to enter the next generation; Through crossover operation, new offspring with stronger adaptability can be generated. Genetic mutations are used to ensure population diversity. Population, after several generations of "evolution," the optimal state is gradually reached or approached until the algorithm converges [18]. A large number of chromosomes get optimized results through a series of repeated operations, the larger the fitness value, the better the quality of the solution. Therefore, when the genetic algorithm is used to optimize the vehicle logistics distribution network system, the genetic coding method is very demanding. Therefore, a chromosome represents a feasible solution to the LRIP problem. The chromosome uses the encoding method of natural numbers, and each chromosome consists of four segments as shown in Table 2.

Table 2: Chromosome coding design.

1 person	N bit	K Bit	1 person
OEM	Vehicle number	Dealer service	Objective function value

(1) Model solution based on genetic algorithm

(2) Network deformation

The above logistics transportation network selection model is compared with the conventional model, which has an additional dimension of logistics transportation mode. Therefore, it is impossible to solve the problem smoothly by using the traditional mathematical programming method, the three-dimensional variables in the model must be adjusted into two-dimensional variables and converted into traditional models before the solution can be successfully solved. Therefore, we refer to the deformation mode of the shortest path network of multimodal transport, so that each logistics transport mode corresponds to different sides, then the bases (except the start and end points) are transformed, and the start and end points of each logistics transportation mode maintain a certain independence. At the same time, the start and end points of each transportation mode represent a brand new base. Specifically, as shown in Figure 2, there are three types of transportation modes from the starting point S to the ending point *D* through the base I, namely, waterway, highway, and railway [19]. The graph on the right represents the graph after the transformation; after the transformation and deformation of the stronghold 1, it is divided into 6 strongholds, the dotted line between the strongholds can represent the mode of transportation, and using the selection edge is the selection of the mode of transportation. On the right side of the graph, $L(1,4)$, $L(1,5)$, and $L(1,6)$ refer to railways, highways, waterways, and so on, which can determine the conversion of different transportation modes at the base form. It is worth noting that at the end of the transportation mode, that is, the logistics transportation mode when entering the 4, 5, and 6 bases is the same as the logistics transportation mode when going out.

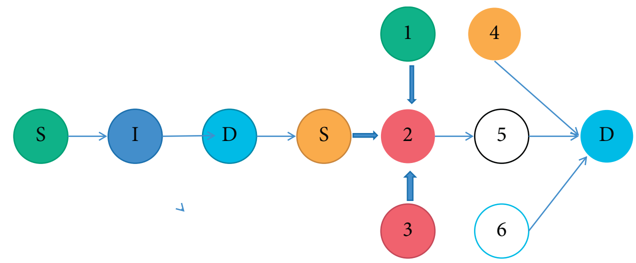

Figure 2: Network conversion diagram.

(3) Genetic algorithm model solution.

Genetic algorithm is an intelligent algorithm, which is generally used to solve the main method of VRP (full name Vehicle Routing Problem, that is, vehicle routing problem). In 1975, Professor Holland first proposed a global search method based on natural selection and genetics, the evolution process of organisms is simulated by genetic operators such as selection, crossover, and mutation, and the fitness function is used to represent the excellence of chromosomes [20]. The genetic algorithm simulates Darwin's natural evolution theory and genetic variation theory and has strong robustness and global optimization ability; it is suitable for solving complex multiextremum optimization problems and combinatorial problems and has a wide range of application values. Figure 3 shows the workflow of the genetic algorithm.

4.2. Optimization Analysis of the Logistics Transportation Network. According to the index measurement of the urban logistics capacity, the traffic capacity of the logistics city nodes in the large regional logistics transportation network can be analyzed, and the steps are as follows:

(1) The indicators of different dimensions are normalized, and the Z-Score normalization formula is used for dimensionless processing. The formula is as shown in formula (1).

$$Z_i = \frac{X_i}{X_i}. \tag{1}$$

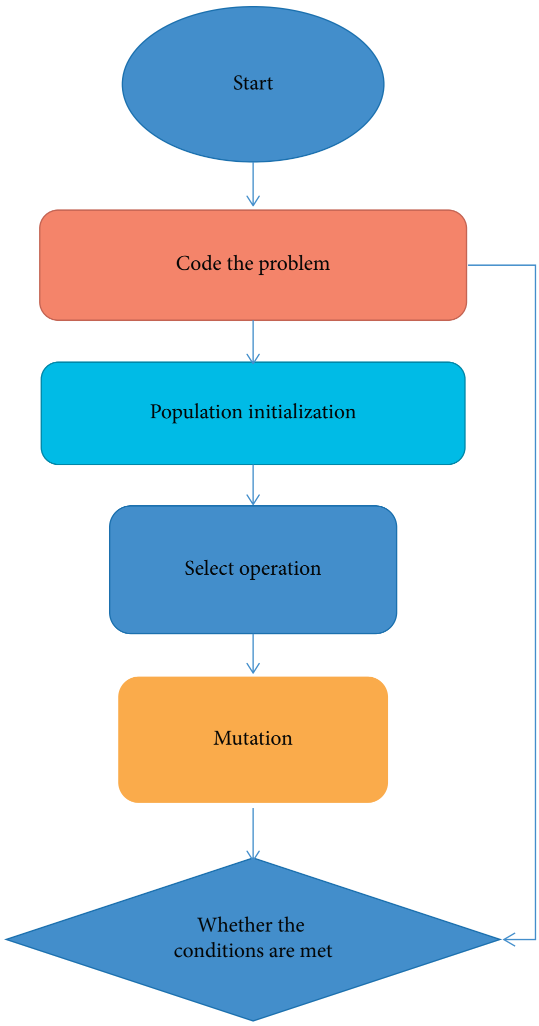

FIGURE 3: The workflow of the genetic algorithm.

In the formula: Xi, the observed value corresponding to the index i.

Xi, the mean of the index *i*. δi, - standard deviation of indicator *i*.

Zi, the value of index *i* after dimensionless processing.

After dimensionless using the Z-Score standardization formula, the mean value is 0 and the standard deviation is 1.

(2) After dimensionless processing, the comprehensive weight of each city's index is calculated and sorted, and the comprehensive logistics capability of each city is analyzed [21].

(3) Based on the unbalanced development among domestic cities, taking into account the fact that at least one logistics distribution center is set up in each of the nine major logistics areas, and according to the proportion of the total logistics distribution center not exceeding 10%, the city with high traffic is preliminarily determined as the logistics distribution network center.

4.2.1. Logistics and Transportation Network Optimization Model. From the factors that affect the optimization of the logistics and transportation network, it can be seen that there is a correlation between each factor. Therefore, the factor analysis method can be used to optimize the logistics and transportation network.

(1) Factor analysis model. Suppose an evaluation study is performed on n candidate samples and each sample has p observed variables. It is assumed here that the variables have been standardized, and the processed variables have a mean of 0 and a variance of 1. We denote the original observation and the transformed new variable by x, remember the original common factor variables as y1, y2, Ym, the corresponding standardized common variable factors are F1, F2, and Fm, and $m < p$. Assume.

(1) $x = (x1, x2, \ldots, xp)$ is an observable vector, its mean vector $E(x) = 0$, and the covariance matrix is equal to the correlation matrix R, that is, $\text{Cov}(x) = E = R$

(2) $F = (\text{F1}, \text{E2}, \ldots, \text{Fm})$ $(m < p)$ is an unobservable vector, and its corresponding mean vector and covariance matrix are $E(\text{F}) = 0$, $\text{Cov}(\text{F}) = \text{I}$

(3) $\beta = (\beta_1, \beta_2, \ldots \beta_p)$, which is independent of F and has $E(\varepsilon) = 0$, and its covariance matrix is a diagonal matrix, which is recorded as shown in formula (2)

$$\text{Cov}(\omega) = \left[\alpha_{11}^2 0\right]. \tag{2}$$

In other words, the components of ε are independent of each other, and the factor model is shown in fd3.

$$\begin{bmatrix} x_1 = a_1F_1 + a_2F_2 + a_{1m} + F_m + \varepsilon \\ X_2 = a_2F_2 + a_2F_2 + a_{2m} + F_m + \varepsilon_2 \end{bmatrix}. \tag{3}$$

Its corresponding matrix form is shown in fd4.

$$\begin{aligned} x &= AF + \varepsilon, \\ X &= (X_1X_2X_3), F = (F_1F_2F_m), \varepsilon = (\varepsilon_1\varepsilon_2\varepsilon_3). \end{aligned} \tag{4}$$

(2) Research on optimization of logistics transportation network. According to the different delivery objects and delivery requirements, the selected delivery and transportation methods are different. The commonly used means of transportation and their characteristics are shown in Table 3 [22].

At present, most of the third-party logistics companies use multimodal transport mainly based on road transport, combined with railway and air transport. The author mainly from the perspective of third-party regional logistics and transportation, based on the large regional logistics and transportation network and freight status, the regional logistics, and transportation network with air and railway as the main means of transportation, studies the urban traffic capacity of the domestic regional logistics and transportation network.

Table 3: Commonly used transportation and its characteristics.

Way	Speed	Volume	Freight rate	Species suitable for transport
Air transport	Fastest	Least	Most expensive	Most expensive
Land transport	Faster	Less	More expensive	Small amount
Water transport	Slowest	More	Less expensive	Bulk
Pipeline transportation	Continuous	Many	Cheap	Gas

Table 4: Arithmetic column scale settings.

Arithmetic	Customer point	Recycling point	Creation center	Market
1	20	8	12	1
2	30	15	18	3
3	40	16	22	4
4	50	21	24	8

4.3. Solution of Numerical Examples and Analysis of Experimental Results in a Certain Environment

4.3.1. Example Design and Experimental Results

(1) Example design. Different regional service areas, different number of network nodes, and different layouts of logistics network node systems are also different. In practical problems, as the number of nodes increases, transportation costs will generally fall, while total fixed costs in a networked system will rise, and the optimal solution is the one that minimizes the sum of all these costs. The reverse logistics network of the scrapped automobiles of automobile manufacturers can be divided into districts, cities, provinces, or the whole country according to the level, starting from the actual situation; in order to verify the feasibility of establishing the optimization model of the reverse logistics network for scrapped vehicles, and the effectiveness of the designed algorithm, we design six examples of different scales with 10 customer points to 100 customer points in the area of 2500 square kilometers and 250,000 square kilometers, in order to verify different service areas, reverse logistics network planning and decision-making application of scrapped automobiles under different number of customer points [23]. In each calculation example, the location coordinates of customer points, recycling points, processing points, remanufacturing points, discarding points, and markets are randomly generated within their corresponding regions as shown in Table 4.

Experimental results. The parameter settings of the genetic algorithm are shown in Table 4, the data are substituted into the models in Section 3.1, respectively, the CPLEX 12.6.3 optimization software and the genetic algorithm program written in MATLAB R2016a were used to solve the problem. The experiment was calculated on a computer with Intel(R), Core(TM) i5-4200M, CPU 2.5 GHz, memory 4.00 GB, and Windows 10 operating system and obtained the experimental results of the example in a certain environment [24]. The construction cost, maximum processing capacity, number of new jobs of different levels of recycling points, disposal points, and remanufacturing points are shown in Figure 4 [25].

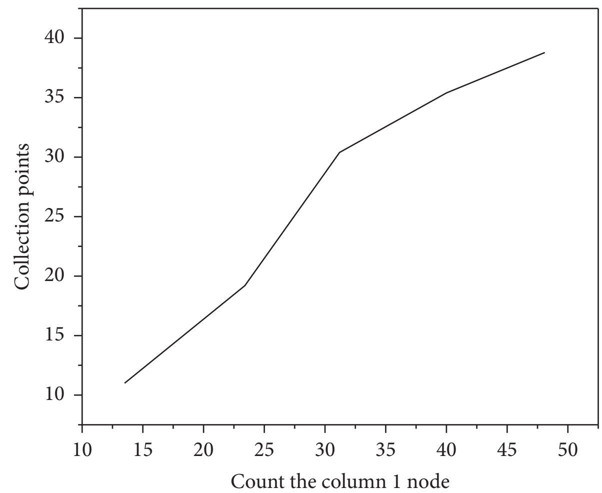

Figure 4: Node diagram.

5. Conclusion

The author mainly analyzes the optimization problem of logistics transportation network and constructs a two-layer optimization model based on complex network; the first layer is mainly to optimize the large regional logistics transportation network, analyze the urban transportation capacity in the large regional logistics transportation network from a global perspective, and provide data support for the optimization of small area logistics and transportation network; The second layer is mainly aimed at the comprehensive logistics capabilities of each city in a small area, the regional logistics transportation network optimization model is constructed, combined with factor analysis and cluster analysis, to optimize the small regional logistics transportation network. From the results of the case simulation solution, in the optimization of logistics transportation network, this calculation model and theoretical algorithm are relatively accurate and effective and have a certain role in promoting the development of logistics.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

References

[1] J. Luo, "Research on energy optimization of multimodal transportation for automobile logistics based on genetic algorithm," *Energy education science and technology, Part A. Energy science and research*, vol. 31, no. 3, pp. 1519–1524, 2013.

[2] Z. Shen, "Integrated supply chain design models: a survey and future research directions," *Journal of Industrial and Management Optimization*, vol. 3, no. 1, pp. 1–27, 2017.

[3] R. Zhang, W. Y. Yun, and I. Moon, "A reactive tabu search algorithm for the multi-depot container truck transportation problem," *Transportation Research Part E*, vol. 45, no. 6, pp. 904–914, 2009.

[4] H. Da Varzani and A. Norrman, "Toward a relevant agenda for warehousing research: literature review and practitioners' input," *Logistics Research*, vol. 8, no. 1, p. 1, 2015.

[5] J. Li and L. Li, "Study on optimization of coal logistics network based on hybrid genetic algorithm," *International Journal of Innovative Computing Information and Control*, vol. 15, no. 6, pp. 2321–2339, 2019.

[6] D. Liu, S. Zhao, W. Jiang, and J. Liu, "Research of intermodal integrated optimization model of total logistics cost based on economies of scale," *Computer Engineering & Applications*, vol. 50, no. 14, pp. 255–312, 2014.

[7] B. Possel, L. Wismans, E. Berkum, and M. Bliemer, "The multi-objective network design problem using minimizing externalities as objectives: comparison of a genetic algorithm and simulated annealing framework," *Transportation*, vol. 45, no. 2, pp. 1–28, 2018.

[8] D. T. Wilson, G. I. Hawe, G. Coates, and R. S. Crouch, "A multi-objective combinatorial model of casualty processing in major incident response," *European Journal of Operational Research*, vol. 230, no. 3, pp. 643–655, 2013.

[9] S. A. Mansouri, D. Gallear, and M. H. Askariazad, "Decision support for build-to-order supply chain management through multiobjective optimization," *International Journal of Production Economics*, vol. 135, no. 1, pp. 24–36, 2012.

[10] S. N. Kumar and R. Panneerselvam, "A survey on the vehicle routing problem and its variants," *Intelligent Information Management*, vol. 4, no. 3, pp. 66–74, 2012.

[11] N. Lahrichiac, T. GabrielCrainicab, M. Gendreauac, R. Walter, G. CeraselaCrişanae, and T. Vidalad, "An integrative cooperative search framework for multi-decision-attribute combinatorial optimization: application to the mdpvrp sciencedirect," *European Journal of Operational Research*, vol. 246, no. 2, pp. 400–412, 2015.

[12] J. G. Villegas, F. Palacios, and A. L. Medaglia, "Solution methods for the bi-objective (cost-coverage) unconstrained facility location problem with an illustrative example," *Annals of Operations Research*, vol. 147, no. 1, pp. 109–141, 2006.

[13] L. Y. Chu, "Distribution center optimization of waterborne petroleum logistics based on genetic algorithm," *Computer Engineering and Applications*, vol. 43, no. 12, pp. 224–227, 2007.

[14] P. Wang, X. Zhang, H. E. Jie, B. Han, and H. Yang, "Research on hierarchical and dynamic location optimization for railway automobile logistics bases under business mode of "forward stocking"," *Journal of the China Railway Society*, vol. 39, no. 9, pp. 1–9, 2017.

[15] S. Khalifehzadeh, M. Seifbarghy, and B. Naderi, "Solving a fuzzy multi objective model of a production–distribution system using meta-heuristic based approaches," *Journal of Intelligent Manufacturing*, vol. 28, no. 1, pp. 1–15, 2014.

[16] S. W. Ji, K. D. Sun, and K. Lv, "The research on transportation modes combinatorial optimization model in multimodal transportation system," *Applied Mechanics and Materials*, vol. 744-746, no. 2, pp. 1915–1918, 2015.

[17] J. L. Moura, A. Ibeas, and L. Dell'Olio, "Optimization simulation model for planning supply transport to large infrastructure public works located in congested urban areas," *Networks and Spatial Economics*, vol. 10, no. 4, pp. 487–507, 2010.

[18] X. Bai and Y. Liu, "Robust optimization of supply chain network design in fuzzy decision system," *Journal of Intelligent Manufacturing*, vol. 27, no. 6, pp. 1131–1149, 2016.

[19] B W. Thomasa and C.W. Chelsea, "The dynamic shortest path problem with anticipation," *European Journal of Operational Research*, vol. 176, no. 2, pp. 836–854, 2007.

[20] M. Saddoune, G. Desaulniers, I. Elhallaoui, and F. Soumis, "Integrated airline crew scheduling: a bi-dynamic constraint aggregation method using neighborhoods," *European Journal of Operational Research*, vol. 212, no. 3, pp. 445–454, 2011.

[21] H. X. Liu and A. Danczyk, "Optimal sensor locations for freeway bottleneck identification," *Computer-Aided Civil and Infrastructure Engineering*, vol. 24, no. 8, pp. 535–550, 2010.

[22] Y. Jin, Z. Li, Y. Han et al., "A research on line loss calculation based on bp neural network with genetic algorithm optimization," *IOP Conference Series: Earth and Environmental Science*, vol. 675, no. 1, Article ID 012155, 2021.

[23] V. Ba Tanovic, D. Petrovic, and R. Petrovic, "Fuzzy logic based algorithms for maximum covering location problems," *Information Sciences*, vol. 179, no. 1–2, pp. 120–129, 2009.

[24] A. Fallahpour, E. U. Olugu, S. N. Musa, D. Khezrimotlagh, and K. Y. Wong, "An integrated model for green supplier selection under fuzzy environment: application of data envelopment analysis and genetic programming approach," *Neural Computing & Applications*, vol. 27, no. 3, pp. 1–19, 2016.

[25] D. Aksen, N. Aras, and A. G. Karaarslan, "Design and analysis of government subsidized collection systems for incentive-dependent returns," *International Journal of Production Economics*, vol. 119, no. 2, pp. 308–327, 2009.