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Research Article

Planning and Layout of Intelligent Logistics Park Based on Improved Genetic Algorithm

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Based on the intelligent logistics park layout planning project, this article systematically studies the layout planning of intelligent logistics park from all aspects by combining research and analysis with investigation. This article discusses the principles and methods of location and layout of logistics parks and studies the location and layout decision of logistics parks. Based on the analysis of the functional design and regional layout of the logistics park, the location and layout of the logistics park are modeled. The improved GA is added to the systematic layout design method, and the layout planning process of logistics park is established according to the characteristics of logistics park design and planning. When determining the objective function, on the basis of the original fixed cost of logistics park construction, the logistics distribution cost is introduced into the planning and layout. Moreover, different from the facility layout planning, the goal of improving the layout also increases the operating cost. Finally, based on the improved GA, the layout of intelligent logistics park is planned, and a satisfactory layout scheme is obtained. Experiments show that the error of this algorithm is only 0.54, which is 0.6 lower than that of traditional planning methods. It can provide theoretical support and decision-making basis for the planning and layout of intelligent logistics parks.

1. Introduction

The rapid development of the global economy has brought opportunities to the rise of the logistics industry and provided soil for the vigorous development of the logistics industry. Logistics park, as a new format of modern logistics, has become one of the research hotspots in the field of logistics [1]. Logistics park is an infrastructure construction with large public welfare investment and a wide range. It is a relatively concentrated area of logistics organization activities and a carrier of new logistics activities with large scale and various service functions. As an extremely important part of the logistics infrastructure, the logistics base and center of the park have become the focus of construction and development in the development of the modern logistics industry [2, 3]. The success of its operation directly affects the formation and development of the regional logistics system. However, because the construction of a logistics park needs to occupy a large amount of land resources, the capital investment is large, and the relative risk is also very huge. Therefore, in order to build a large-scale logistics park, we should combine the local actual situation and make a practical logistics park construction plan. The logistics park will bring together a variety of logistics functions and run specialized and large-scale operations, all of which will help to maximize the overall benefits of logistics resources by promoting the advancement of logistics technology and service levels, sharing related facilities, lowering operating costs, and improving economies of scale [4]. Many cities, as strategic key logistics cities, must urgently optimize and upgrade logistics parks in order to reduce logistics costs and increase cluster effect [5]. Port logistics parks have been built in a number of locations. A key issue at the moment is how to develop and transform logistics parks, maximize cluster economic benefits, and ensure good operation and long-term development. The layout of each functional area is the first problem to solve in order to effectively realize logistics park functions. The logistics park's planning and layout have a direct impact on the system's logistics and information flow, so studying the park's layout is critical.

Currently, there is fierce competition among enterprises in the logistics park, and logistics resources cannot be effectively allocated, limiting the logistics park's healthy development. As a result, logistics park planning and construction, building logistics parks that meet market requirements, designing reasonable internal park planning, and building logistics parks that meet the needs of local economic development and the development of industrial enterprises have all become urgent problems to solve [6]. The foundation of logistics park planning and construction, as well as the premise of further internal layout design of each functional area, is the use of appropriate methods to achieve the optimal layout of each functional area. It is critical to plan and design a practical, economical, and developmental scheme to avoid repeated construction and future development restrictions; reduce waste of environmental resources; and meet the construction of economic, social, and technical benefits [7]. The genetic algorithm (GA) is a probabilistic search method that is based on natural selection and population genetics mechanisms and is highly adaptable. GA iteratively optimizes the population and produces the optimal population through selection, replication, crossover, and mutation. It is useful, efficient, and durable. In GA, coding is the process of describing a problem's feasible solution, or of transforming a problem's feasible solution from its solution space to the search space that GA can handle. When it comes to solving complex optimization problems, GA is unrivaled. GA supports information composition and exchange in these directions while performing a multidirectional search by keeping a group of potential solutions. This article develops an intelligent logistics park planning and layout model based on the improved GA. The following are the article's innovations:

(1) On the basis of summarizing the related concepts of intelligent logistics park, this article establishes the plane layout model of intelligent logistics park by combing and summarizing related literature research. This article improves the traditional planning and layout problem, which only considers the fixed cost of logistics park construction. The layout planning method of this article considers the multi-objective optimization problem of logistics distribution cost and operation cost at the same time. According to the flow of GA, the fitness function, coding and decoding methods, GA operators, and related parameters are designed.

(2) This article introduces GA, expounds on the rationality of its application in logistics service combination optimization, and improves GA. The model applies improved GA to solve the planning and layout problem and reduces redundant coding, which improves the calculation efficiency. Experiments show that the optimal layout of an intelligent logistics park can be obtained objectively and in a short time by using this method.

2. Related Work

The development of the logistics industry to a certain stage necessitates the establishment of a logistics park. Logistics park planning and operation is an important part of logistics planning. The construction of a logistics park can not only help the logistics industry grow, but it can also benefit the city and region in which it is located. The traditional layout planning of a logistics park was primarily based on experience at the time, and the park facilities layout and plane design were completed through extensive practical layout experience. Some advanced design methods emerged in the later period as a result of the continuous development of various technologies.

Elmaraghy et al. used the systematic layout method combined with the neural network algorithm, took the logistics park as an empirical analysis, calculated the relevant logistics flow, calibrated the best geographical location suitable for the construction of the logistics park, and established a model [8]. On the basis of analyzing the connotation of logistics node configuration, Pan proposed an optimization model of logistics park layout considering the scale economy of logistics park and the uncertainty of logistics demand [9]. Song et al. proposed a hybrid GA based on the minimum cost flow of the extended network and applied it to the planning and layout of logistics parks [10]. Song et al. used the logistics relationship between the operating units to make a mutual relationship diagram, and after correction and adjustment, a feasible layout plan was obtained, and then weighted evaluation and other methods were used for optimal evaluation [11]. Considering the agglomeration efficiency and scale effect of logistics parks, Yu et al. studied the optimal allocation of logistics parks and logistics distribution centers in a region, established corresponding mathematical models, and proposed corresponding solving algorithms [12]. Khatib and Barco analyzed the function, business process, and macro-distribution of the container terminal as a logistics center and discussed the importance of some logistics node planning from the perspective of logistics strategic planning and management [13]. Igathinathane et al. improved the systematic layout method to build a spatial layout model, designed a solution method, and proposed the process of the logistics park functional layout system design method [14]. Chen et al. proposed a multi-objective optimal decision-making method for logistics park location selection based on the ambiguity of decision-making data [15]. Wen et al. proposed that, in addition to the fixed facility size, a certain range of aspect ratios can be given according to the actual situation when considering the issue of facility layout [16]. Guan uses a discrete model to design a circular layout that minimizes logistical congestion. However, the discrete model cannot provide accurate facility coordinates, nor can it reflect issues such as handling entry and exit points, facility orientation, etc. [17]. Bruns and Twiefel proposed a multi-objective layout optimization model with the goal of minimizing logistics costs and maximizing functional area correlation [18]. Yaqiong et al. focused on the analysis of the operation process of the logistics distribution center and the layout and planning of the logistics center, which has important reference value and practical significance for the design and planning of the logistics distribution center [19]. Zhang et al. used the method of dynamic programming to solve a dynamic layout problem with the same shape and size of each facility [20].

This article analyzes the current state of the logistics industry, digs into the need for an intelligent logistics park, and conducts a thorough investigation into the planning and layout of an intelligent logistics park using relevant literature. In this article, the improved GA is used to create an intelligent logistics park layout model during the optimization layout stage. It effectively describes constraints such as the general layout area limitation and the problem of road access by using the optimal allocation of logistics, process, and environment among functional blocks in the general layout of the logistics park as the target design objective function. The improved GA is used to optimize and select the service combination in order to improve the accuracy and objectivity of the selection evaluation. Finally, using an intelligent logistics park as an example, a park layout planning simulation experiment is conducted, demonstrating the rationality and applicability of the intelligent logistics park layout planning method system developed in this article.

3. Methodology

3.1. Logistics Park Planning and Layout and GA Theory. Logistics park is a new format of modern logistics development, and it is an organic whole composed of interrelated functional elements of logistics. It is a physical assembly place with certain scale logistics facilities and logistics operators. The construction of logistics park is not only the need of logistics development, but also the requirement of urban construction and development. At present, there are some problems in the planning and construction scheme of logistics park, such as chaotic planning steps and principles, vague understanding of the functions of logistics park, blind enclosure, and so on [21]. Studying the basic concept, characteristics, classification, and functions of logistics parks is the basis for in-depth research and analysis of many issues including the layout planning theory of logistics parks. Whether the layout of the logistics park is scientific or not directly determines whether the functions of the park can be effectively realized and directly affects the production management and operation efficiency of the park. In logistics parks, there are a variety of service modes, which can be classified into four categories based on service scope: city logistics, regional logistics, national logistics, and international logistics. Different logistics service modes have different characteristics and functions. Logistics park construction frequently entails logistics operations, transportation organization, information organization, industrial integration, resource integration, development and adjustment of urban functions, and other broad aspects, which serves as a valuable reference point for determining the logistics park's location and is also a necessary condition for determining the logistics park's scale. Freight volume and freight composition indicators are the main indicators that reflect logistics park demand, while warehouse capacity, commodity inventory, and other indicators reflect inventory demand.

To design the layout of the logistics park, it is first necessary to define the functional services of the logistics park, take the content of the logistics functional services as the design goal, and rely on the functional goal to measure whether the design of the park is reasonable or not. The principles that should be followed in the planning process of the Logistics Bureau are as follows: (1) the principle of short distance; (2) layout optimization principle; (3) principle of system optimization; (4) flexibility principle; and (5) principle of the meeting process, production, and management requirements. The storage function of the logistics park should be fully considered during the planning process, and the park should be equipped with high-efficiency storage equipment. The logistics park should have the function of loading and unloading, which is a necessary function of the logistics park [22], in order to speed up the circulation of goods. To improve the utilization rate of resources in the park and make the area of each functional area of logistics operations reach a reasonable proportion, a reasonable layout of functional areas should be divided into internal land resources, traffic resources, and supporting facilities and equipment. We should also think about the park's externality and create a convenient, safe, and comfortable working environment. The overall design goal is to efficiently allocate logistics equipment, transportation systems, personnel, logistics, business flow, capital flow, and information flow in the park in order to reduce future operating costs and maximize benefits. Logistics demand is important not only for determining the feasibility of logistics park construction, but also for determining the overall scale of the park. The logistics park's candidate location is limited due to the overall scale restriction. Whether the candidate location has enough suitable space for the logistics park to be built must be determined on the spot in conjunction with the current local situation. The GA process is shown in Figure 1.

In GA, the population in the process of biological evolution represents the set of multiple solutions of the problem. Each individual chromosome represents a feasible solution to a problem, and the genes in the chromosome describe the characteristics of the feasible solution. Struggle for existence and survival of the fittest in the biological world represent the process of screening feasible solutions in various groups through the given evaluation method of problems. The specific process of solving the GA model is as follows: an initial population is randomly generated, which is composed of random chromosome codes, and the fitness value is calculated to judge the adaptability in the initial population. The individuals in the population are selected, copied, crossed, and mutated by the operation of the survival of the fittest, and a new population is repeatedly generated, and finally the offspring with the strongest adaptability is evolved, and the optimal solution is obtained. Function optimization is a classic application field of GA, and it is also a common example of GA performance evaluation. Especially for nonlinear, multi-model, and multi-objective function optimization problems, other optimization methods are difficult to solve, but GA can get better results. Selection is made by the fitness function set according to the problem. In the selection operation, the fitness function of each individual in the population should be calculated first. The fitness function of GA is mainly divided into two

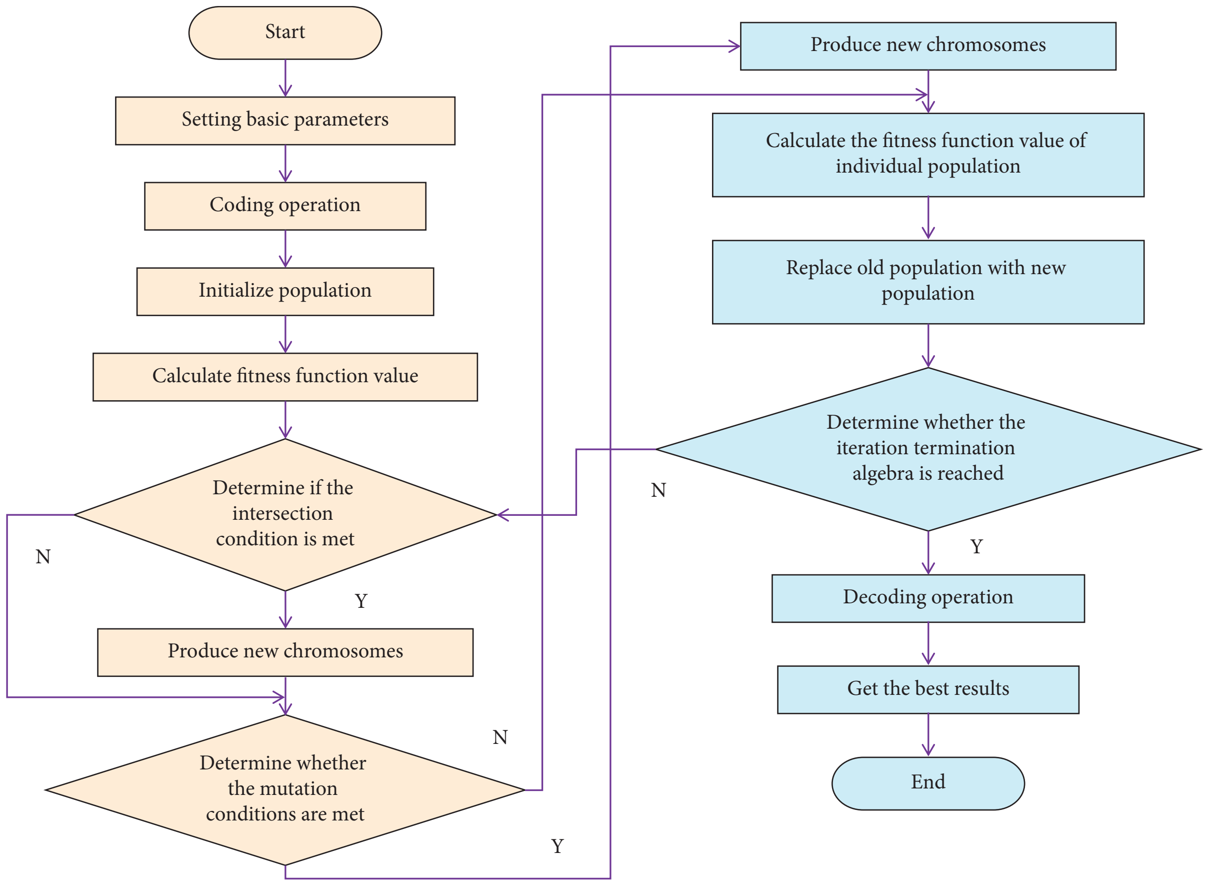

Figure 1: GA flow chart.

categories: fitness function based on proportion and fitness function based on ranking.

Despite the fact that both direct and random search methods are used, GA and random algorithms are not the same. When using GA, the primary problem to solve is coding, which is also a crucial step in GA design [23]. The efficiency of genetic evolution is largely determined by the operation methods of genetic operators such as crossover and mutation operators. Gene crossover and chromosome mutation are used in GA reproduction. The above steps will be repeated by new individuals obtained through crossover and mutation until certain conditions are met, at which point the GA will be terminated. The approximate optimal solution to the problem is the optimal individual in the population. Many trials are often required in the practical application of GA to determine the appropriate value size or range of parameters. The optimization can be done in an uncertain space by using GA's probability transition rule. In contrast to the general random optimization method, GA does not search along a line from a single point, but instead searches the entire solution space simultaneously. As a result, it has the global optimal searching property and can effectively avoid falling into the local minimum point.

3.2. Improve the Planning and Layout Model of Intelligent Logistics Park Based on GA. The planning and design of a logistics park uses a multichannel equidistant layout to make the formation of a traffic network and transportation easier. The logistics and non-logistics relationships of functional areas are all represented by the relationship diagram before joining GA, when the layout of functional areas is completed. A functional area plan is created that includes a logistics and non-logistics relationship diagram. To begin, a logistics park construction scheme is established, and the flow distribution problem between the logistics park and the distribution center is solved using the initial logistics park scheme, yielding an initial flow solution. Then relocate the logistics park, reallocate the flow, and repeat the iterative solution process. GA is combined with the iterative process to find the best solution at random. In each GA generation, the most suitable individuals are chosen based on their fitness in the problem domain, and the population representing the new solution set is generated using natural genetic operators such as combination, crossover, and mutation. This process will mimic natural evolution in the population. The offspring population is more environmentally adaptable than the previous generation, and the best individual in the previous population can be decoded as the problem's approximate optimal solution. Work unit sequence coding and work unit spacing coding are the two main components of single-row layout chromosome coding. The workshop is recorded using the work unit sequence code, which records the arrangement order of each work unit from left to right, and the work unit spacing code, which records the distance between work units. Work unit sequence coding and work unit spacing coding are the two main components of multirow layout chromosome coding. A schematic diagram of logistics park planning and layout based on improved GA is shown in Figure 2.

The selected mutation in this article is the positional mutation method for gene values at chromosome loci. That is, the random position on the chromosome is selected and then exchanged. The objective consists of three parts: the transportation cost between the logistics distribution center and the logistics park; the fixed cost of logistics park construction; and the operating cost of logistics park. The fitness function is used to judge the merits of individual population. The better the new individual population, the greater the fitness. The fitness function directly affects the time and effect of the algorithm. Generally, the objective function is transformed into the fitness function, and the design should meet the principles of continuity, non-negativity, and maximization. After the objective function is designed, the fitness of all individuals in the algorithm must be positive or zero, not negative, due to genetic requirements. Therefore, it is necessary to transform the objective function into a fitness function. Under the condition that both the logistics distribution center and the logistics park are determined, the original problem is transformed into an extended network minimum cost flow problem with capacity constraints at the edges and nodes in the network. With the improved GA solution, the flow distribution of the whole distribution network can be obtained, and the objective function value can be calculated and taken as the fitness value of the chromosome. The main goal of logistics park layout is to minimize the cost of material handling among functional areas, to maximize the degree of adjacency among functional areas, or to combine these two goals in a certain proportion. In this model, the coordinates of the center point of the operation block are also the starting point and the end point for measuring the flow of goods. Therefore, the first problem to be solved is to use mathematical formula to determine the coordinates of the center point of the block. In this article, it is assumed that the general layout block is a regular rectangle, and the layout form of the operation block in the general layout is a straight-line multichannel layout. Because the centerline of each row is consistent, the determination of the ordinate depends on the number of rows arranged in the operation block in the general plane.

Considering the scale benefit and agglomeration effect of the logistics park, the processing cost in the logistics park, and the transportation cost between the logistics parks, the cost function is a concave function with the marginal transportation cost decreasing with the increase of logistics volume, and its first derivative is greater than zero, and its second derivative is less than zero, which is expressed by a mathematical expression as follows:

$$c_j(x) = a\left(\sum_i x_{ij}\right)^{\theta}, \tag{1}$$

where a and θ are undetermined constants. In general, the smaller the θ, the greater the agglomeration effect. And $0 \leq \theta \leq 1$. Let:

$$x_j = \sum_i x_{ij}. \tag{2}$$

Then the following inequality holds:

$$\frac{dc_j(x)}{dx_j} > 0 \qquad \frac{d^2\left(c_j(x)\right)}{dx_j^2} < 0. \tag{3}$$

The calculation of the objective function of logistics park planning is as follows:

$$F(x) = \sum_{i=1}^{n} w_i \int (x_i). \tag{4}$$

The objective function is as follows:

$$F(x)_{\max} = w_1 \int (x_1) + w_2 \int (x_2) + w_3 \int (x_3). \tag{5}$$

If the score is the highest, the layout is the best. Then the objective function of the logistics intensity relationship is as follows:

$$\int (x_1)_{\min} = \gamma_1 \sum_{i=1}^{m}\sum_{j=1}^{n} M(x)x_{ij} + \gamma_2 \sum_{i=1}^{m}\sum_{j=1}^{n} N(x)x_{ij}, \tag{6}$$

where γ_1 and γ_2 represent the weight of importance, $\gamma_1 + \gamma_2 = 1$; $N(x)$ is the degree of relatedness to the flow of goods; and $M(x)$ is the degree of storage capacity. The objective function of the business process is as follows:

$$\begin{aligned}\int (x_2)_{\max} = \beta_1 \sum_{j=1}^{n}\sum_{i=1}^{m} P(x)x_{ij} + \beta_2 \sum_{j=1}^{n}\sum_{i=1}^{m} Q(x)x_{ij} \\ + \beta_3 \sum_{j=1}^{n}\sum_{i=1}^{m} R(x)x_{ij}.\end{aligned} \tag{7}$$

The objective function of environmental protection is as follows:

$$\int (x_3)_{\max} = \sum_{j=1}^{n}\sum_{i=1}^{m} H(x)x_{ij}, \tag{8}$$

where $H(x)$ is the degree of environmental impact.

Common GA coding methods include binary coding, gray coding, floating-point coding, and symbolic coding. By comparing the applicability of various methods, this article adopts symbolic coding and binary coding as chromosome coding mechanism. Engineering decision-making and design optimization are primarily multi-objective optimization problems in practice. The Pareto optimal solution of optimization problems with multiple objectives and constraints can be solved using GA. When each node's traffic is distributed, the original problem is transformed into an extended minimum cost flow problem that fictitious origin and destination must solve. To meet the requirements of convergence speed and diversity, adaptive GA dynamically changes the probability of crossover and mutation based on the state of the population and individual. When population diversity is low, adaptive GA can boost crossover and mutation rates, preventing the population from settling into

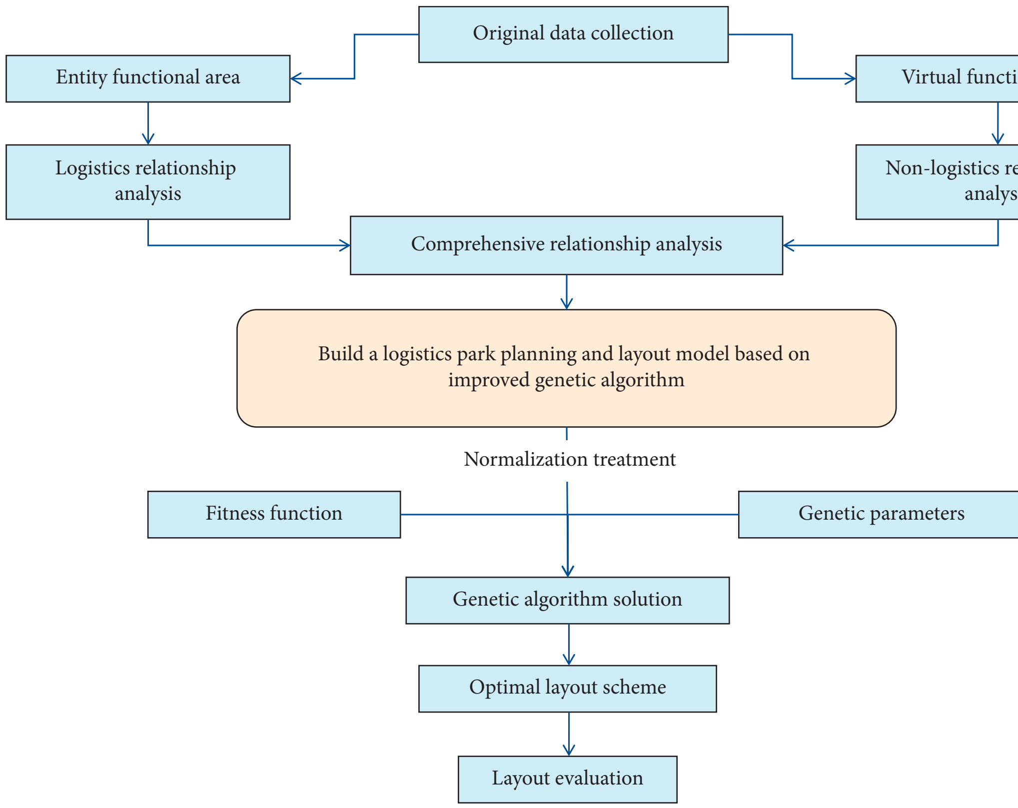

Figure 2: Schematic diagram of logistics park planning and layout based on improved GA.

a local optimum. When the population convergence rate is slow, adaptive GA reduces the likelihood of crossover and mutation, improving the population convergence rate. The logistics park, according to the plan, should include core functions like warehousing, distribution, distribution processing, and multimodal transportation. Furthermore, it should include e-commerce, information processing, commerce, and other office-related functions. A multichannel equidistant layout is used in the logistics park's planning and design, which means that the general plane and each partition block are regular rectangles, and the channels are arranged equidistantly, which is convenient for traffic network [23] formation and transportation convenience. The goal of the selection operation is to select individuals from the population who are highly adaptable and pass them on to the next generation. Individuals with low adaptability are less likely to pass down to the next generation and are gradually phased out. After the selection operation, the crossover operation is carried out. This article uses different crossover methods based on the principle of random pairing to match the chromosome coding mechanisms of symbolic coding and binary coding. For a chromosome k whose fitness value is f_k, its selection probability c_k is calculated as follows:

$$c_k = \frac{f_k}{\sum_{i=1}^{\text{pop\_size}} f_i}. \tag{9}$$

Then, the sum of the fitness values of all chromosomes in the population is as follows:

$$F = \sum_{i=1}^{\text{pop\_size}} f_i. \tag{10}$$

For each chromosome, the selection probability c_k is calculated as

$$c_k = \frac{f_k}{F}. \tag{11}$$

For each chromosome, the cumulative probability t_k is calculated as

$$t_k = \sum_{i=1}^{\text{pop\_size}} c_i. \tag{12}$$

Given that each logistics distribution center's demand is a triangular fuzzy number, the logistics volume flowing into each logistics park must also be a triangular fuzzy number, as can be seen by adding and multiplying fuzzy numbers. The extended transportation problem is solved for each chromosome separately. The fitness value of each chromosome is determined using the normalization calibration method based on the obtained objective function value. The order of information functional blocks on a chromosome must be expressed in three ways: the row in which the blocks are located, the distance between adjacent blocks, and the size of the blocks themselves. The above information must be expressed by multi-segment coding in the gene fragments, so that the whole chromosome not only meets the requirements of the logistics park layout, but also facilitates the search operation of the following genetic operators. This article models the logistics park layout problem as a multi-objective function with the least material handling cost and the highest adjacency correlation degree in the functional interval, based on an analysis of the application scope, advantages, and disadvantages of existing layout models. The nonlinear mathematical model with constraints can reduce total construction, operation, and distribution costs while also providing personnel with a convenient, comfortable, safe, and sanitary working environment.

4. Result Analysis and Discussion

In the last chapter, on the basis of expounding the objectives and principles of logistics park planning and layout, an intelligent logistics park planning and layout model based on improved GA is put forward. In order to verify the effectiveness of the model calculation method in this article, simulation experiments are carried out in this chapter. Assuming that there are 20 logistics distribution centers in a certain area, and the demand of each logistics center is known, in order to make full use of the scale effect and agglomeration effect in logistics parks to reduce the distribution cost of the entire regional distribution network, five logistics parks are planned among 10 candidate logistics parks to meet the demand of 20 distribution centers in this area. GA parameters are shown in Table 1.

According to the weight and value of the competitiveness evaluation index of the main logistics nodes, the freight volume share of each main logistics node is calculated. According to the correlation degree of each operation unit module in the comprehensive correlation table, the distance between them is determined, and the specific position of each operation module is arranged accordingly. Through experiments, the recall rate of the algorithm is shown in Figure 3.

According to the data in Figure 3, the recall rate of this algorithm is high, and its recall rate has been at a high level. Through MATLAB running calculation, the best smoothing parameter is 0.89, and the iterative process of the objective function is obtained by operation. The running iteration results of different algorithms are shown in Figure 4.

In the process of algorithm calculation, relevant factors such as the number of workers, facilities and equipment, logistics channels, and auxiliary devices corresponding to each operation unit should be considered, and the theoretical area finally calculated should conform to the planned useable area. In this article, considering the impact of logistics park layout on the surrounding external environment, the concept of environmental distance is introduced, and a logistics park layout model considering environmental distance is constructed. The optimal layout scheme is obtained by designing and improving GA to solve the model. The change trend in the error curve of the algorithm is shown in Figure 5.

From the analysis of the trend in Figure 5, the error of this algorithm is small, which is lower than the other two algorithms. This result shows that the algorithm in this article has certain accuracy. According to the function

Table 1: GA related parameters.

Number	Parameter	Parameter settings
1	Total group number	200
2	Crossover probability	0.5
3	Mutation probability	0.01
4	Maximum number of generations	110
5	Fitness function	300
6	Logistics relationship weight	0.5
7	Process relationship weight	0.2
8	Environmental relationship weight	0.3
9	Penalty coefficient	1

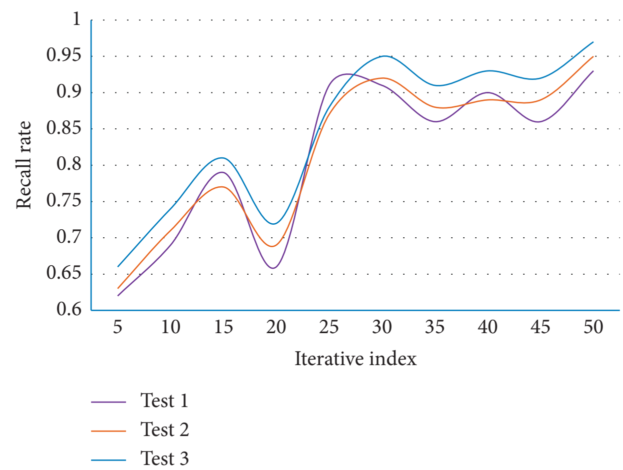

Figure 3: Algorithm recall result.

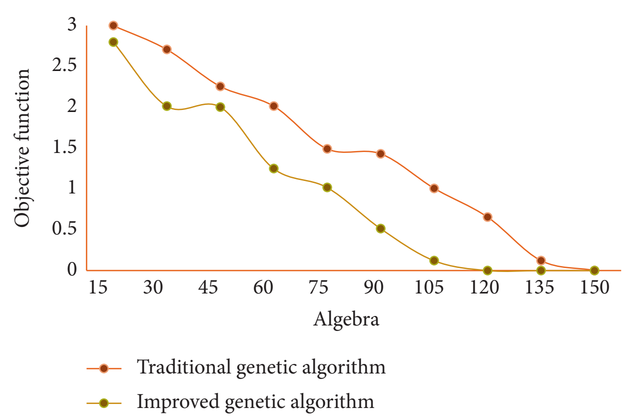

Figure 4: Running iteration diagrams of different algorithms.

setting and positioning, each functional area is divided into storage and distribution functional area, cold chain logistics functional area, long and heavy goods functional area, e-commerce logistics functional area, comprehensive office area, and other areas. Specific areas and freight volume distribution are shown in Table 2.

In this article, different codes are designed according to the characteristics of different layout forms, which reduces redundant codes and improves the computational efficiency. Then, in the design of fitness function, the decrease of population diversity caused by excessive chromosome

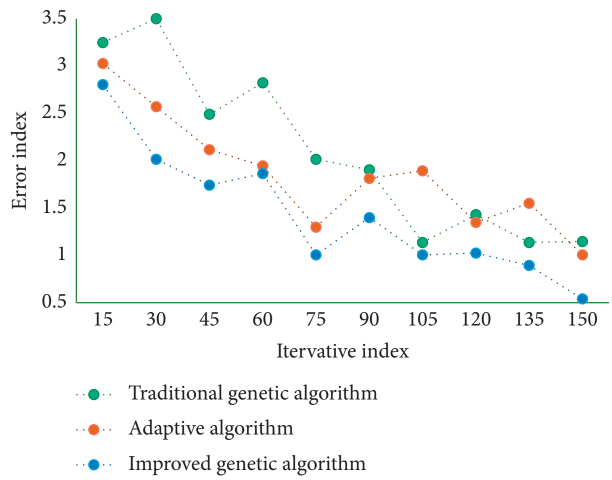

Figure 5: Change trend in the error curve of algorithm.

Table 2: Distribution of freight volume in each functional area of logistics park.

Number	Domain	Freight volume distribution rate (%)	Freight volume distribution (ton)
1	Transportation acceptance area	0	0
2	Distribution area	14	124
3	Intercity logistics area	20	231
4	Cold chain logistics area	23	269
5	Container yard area	6	42
6	E-commerce logistics area	5	40
7	Bonded logistics zone	12	137
8	International intermodal area	20	259
9	Trade and exhibition area	0	0
10	Supporting service area	0	0
11	Business district	0	0
—	Total	100	1102

differences is avoided. Figure 6 shows the running time comparison of the model.

The experiment shows that the functional area layout method with improved GA has great advantages in reducing the total cost of material handling, increasing the correlation between functional areas, saving operation time and land utilization rate, and its weighted total score is better than that obtained by using the relational graph method, which has certain superiority and feasibility. Combining with the actual situation, this article analyzes the factors such as implementation technology and operation cost, makes a comparative evaluation of each candidate scheme, selects the best design scheme, and then obtains the final layout

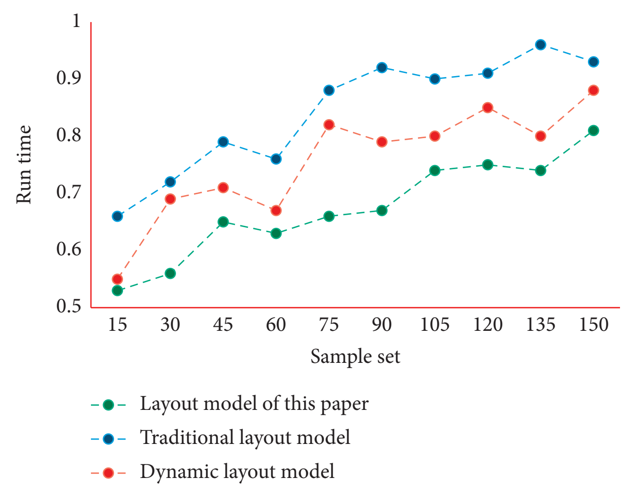

Figure 6: Comparison of running time of models.

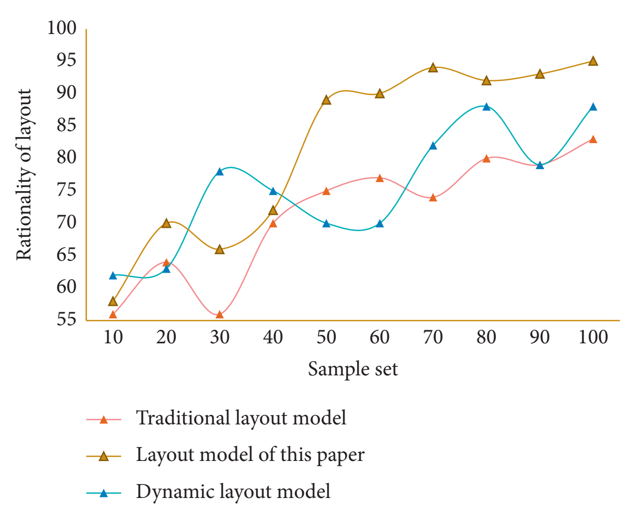

Figure 7: Comparison of rationality of planning and layout of different models.

scheme. The rationality comparison of planning layout of different models is shown in Figure 7.

It can be seen from Figure 7 that the rationality of the planning and layout of this model is higher than that of the other two models, so it is reasonable to apply this model to the planning and layout of intelligent logistics park. In order to verify the effectiveness of the model and algorithm in this article, numerical simulation experiments are carried out in Visual C++ environment. The results show that the error of this algorithm is only 0.54, which is 0.6 lower than the traditional planning method. This method has certain efficiency and accuracy and can get a satisfactory layout scheme in a short time. Therefore, this algorithm is an effective algorithm to solve the optimal layout model of logistics park considering scale effect and uncertain demand. This model can effectively use space, equipment, personnel, and energy. The model has sound functions, strong storage, and throughput capacity and can provide logistics support for multimodal transport.

5. Conclusions

The effective realization of logistics park functions and the full play of scale benefits are heavily influenced by the layout planning of intelligent logistics parks. Traditional logistics park planning and design methods have many limitations, so to carry out the layout planning of intelligent logistics parks, a set of methods guided by strategic development goals and based on scientific planning and design is required. The general framework of logistics park layout planning is presented in this article, which employs qualitative and quantitative methods and draws on the beneficial experience of logistics park development planning at home and abroad. An intelligent logistics park layout model considering environmental distance, logistics distribution cost, and operation cost is constructed on the basis of analyzing the correlation of each functional area of the logistics park using the improved systematic layout planning method. The loss of population diversity caused by excessive chromosome differences is avoided in the fitness function design. The optimal layout scheme of an intelligent logistics park is obtained using GA to solve the model. Experiments show that this algorithm has an error of only 0.54, which is 0.6 less than traditional planning methods. This method has certain efficiency and accuracy and can get a satisfactory layout scheme in a short time. According to the analysis and research of this article, it can play a certain role in the optimal allocation of regional logistics resources, the supply capacity of modern logistics system, and the improvement in operation efficiency. It provides an exploratory direction for the research of logistics park planning. However, due to the limited time and my academic knowledge, the model constructed in this article still needs further improvement. For example, a more detailed system dynamics model of logistics park operation and management can be established, and the expansion of park business can be fully considered—when the layout changes, how to change the position of the entry and exit points of each work unit to adapt to the new layout, etc. These problems will be further studied.

Data Availability

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

Conflicts of Interest

The author does not have any possible conflicts of interest.

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