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Research Article

Deconstruction of Road Logistics Transportation Cost Management Evaluation Based on Optimal Solution of Linear Programming

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Due to the rapid development of the logistics industry, the business volume of the road transportation industry is also growing rapidly and its transportation costs are also increasing. Therefore, it is particularly important to control the transportation cost. This paper aims to evaluate and analyze the cost management of road logistics transportation based on the optimal solution of linear programming. This paper introduces the basic concept of highway logistics in general and analyzes its components and characteristics. Road logistics transportation has the characteristics of fast speed, low investment, strong flexibility, and easy to adapt to local conditions and does not require much infrastructure. We then analyzed the general linear programming model, made a brief introduction to its mathematical model, and proposed the construction of the optimization model to explore the transportation model of production and sales balance. Finally, taking W logistics company as a case to analyze and discuss, the influence of the transportation route in transit on the transportation cost is studied. And its structure and the corresponding transportation cost of logistics enterprises are analyzed in detail. The experimental results of this paper show that by comparing the calculation results of the road segment method and the linear programming model, the total freight calculated by the segment method is 5610 yuan, while the total freight calculated by the linear programming method is 5490 yuan. Comparing the piecewise methods, it can be found that the linear programming method is more economical in transportation cost than the piecewise method. Therefore, when logistics companies optimize road transportation costs, it is more feasible and effective to use linear programming methods.

1. Introduction

The role of modern logistics in regional economic development is growing, and many places have included modern logistics in their development plans. As an important part of modern logistics, road logistics is becoming increasingly important. At present, although most road logistics and transportation companies have their own information platforms, the degree of informatization is generally not high, and they are limited to the management of the manifests submitted by customers. There is a certain degree of blindness in the daily logistics business management within the enterprise, which cannot provide decision-making information for logistics managers to formulate logistics transportation plans and cannot timely deal with unexpected accidents that occur during transportation. This situation results in an extremely poor experience for the platform to customers. At the same time, most logistics companies do not realize the reasonable distribution of different transportation routes during the transportation process and control the transportation cost to a minimum. The general logistics company will arrange the company's vehicles for transportation after receiving the order. After the vehicles are allocated, the remaining orders will be outsourced. They never thought about shipping costs or how to choose a better shipping method. How to carry out reasonable distribution on different roads to meet different transportation needs is a problem that logistics companies need to solve urgently.

Use the method of linear programming to model and analyze the logistics and transportation process, and carry out quantitative statistical analysis on it. The bottleneck restricting the transportation cost is found, which provides the basis for the logistics management of the enterprise. The new ideas and methods of transportation cost optimization proposed in this paper can provide useful reference for the management practice of current logistics enterprises and can promote the management and operation of enterprises as a whole. The purpose of this paper is to evaluate and analyze the cost management of road logistics and transportation based on the optimal solution of linear programming, in order to make a certain contribution to the management of road transportation cost.

According to the research progress in foreign countries, different researchers have carried out corresponding cooperative research in road logistics. Wasilewski J proposed the issue of actual hazards to products (edible or not) and animals due to border controls in international road transport. The border control system used in the Polish part of the eastern border of the EU has been selected, and some data have been analyzed. These data concern the number of inspections and consignments refused due to epidemiological risks [1]. Choudhari S conceptualized the consumption of raw materials in a road project as a logistics network allocation problem. A linear programming (LP) formulation was constructed by integrating the three phases of material transportation with appropriate decision variables [2]. The aim of Bucsky P is to show the current state of development of autonomous driving in cargo transportation and to analyze what possible future directions are feasible. The level of autonomous driving is very different in different modes of transport, and most likely, the technology will favor road transport over other less environmentally harmful modes of transport [3]. Lakehal A's Bayesian approach covers all the steps needed to implement a decision support solution for risk management and control, from identifying risks and preparing interventions to operating in a crisis. The ultimate goal of road risk control using the impact map method is to optimize the logistics function [4]. Sathish D aims to explore these changes from road to rail transport and to illustrate the impact on logistics providers who rely only on road [5]. Boiko I V reveals the special logistical characteristics of silk as the initial chain of ancient trade and the distinctive features of the mode of transport and freight [6]. However, these scholars' research on road logistics transportation cost lacks technical justification. After the study, it was found that the research of road logistics transportation cost management based on the optimal solution of linear programming has certain reliability. For this reason, one has reviewed the relevant literature on linear programming.

Linear programming is now intensively studied by scholars. Franco J F proposed a new mixed integer linear programming model for solving the electric vehicle charging coordination (EVCC) problem in an unbalanced distribution system (EDS) [7]. Liu Y proposed a geometric external climbing method based on inclusive normal cones for solving general linear programming problems of typical forms [8]. Tanveer M proposed a new linear programming formulation for dual support vector regression [9]. Pramanik S proposed a new concept of optimization problem under uncertainty and indeterminacy. It is an extension of fuzzy and intuitionistic fuzzy optimization, where the degree of uncertainty and falsity (rejection) of the objective and constraints are considered simultaneously with the degree of truth membership (satisfaction/acceptance) [10]. However, these scholars did not evaluate and analyze the cost management of highway logistics and transportation based on the optimal solution of linear programming, but only discussed its significance unilaterally.

The fixed assets of logistics enterprises are mainly the investment in transportation equipment, which is very huge, and the operating cost during the operation period is also very high. To this end, enterprises should reasonably plan transportation costs, optimize transportation routes, and increase the utilization rate of transportation vehicles without increasing transportation prices and reducing the quality of services provided to customers. Therefore, the transportation cost is minimized and the operating profit of the enterprise is improved. By comparing the cost management of road logistics transportation in W logistics company, this paper finds that the total freight obtained by the road segment division method is 5610 yuan, while the transportation cost obtained by using the linear programming method is 5490 yuan. It can be seen that, in terms of total transportation volume, the linear programming method saves 120 yuan in transportation cost compared with the segmented method. The innovation of this paper is reflected in the following: (1) the basic concept of highway logistics is introduced, and its constituent factors and characteristics are analyzed. (2) The general linear programming model is analyzed, and its mathematical model is introduced. (3) Finally, the W logistics company is taken as an example to analyze and study, and the influence of the transportation route in the in-transit transportation on the transportation cost is discussed.

2. Method of Road Logistics Transportation Based on Linear Programming

Although various factors have a certain impact on shipping costs, each factor must be taken into account when formulating freight rates. Generally speaking, transportation cost is mainly affected by transportation volume, transportation distance, cargo density, space utilization, transportation difficulty, vulnerability, and market-related factors. The purpose of this paper is to evaluate and analyze the cost management of road logistics transportation based on the optimal solution of linear programming.

2.1. Road Logistics. Road logistics transportation has the characteristics of fast speed, low investment, strong flexibility, and easy to adapt to local conditions, and does not require much infrastructure. Therefore, transportation can be linked to other modes of transportation [11]. Figure 1 shows a planning diagram of logistics operation information

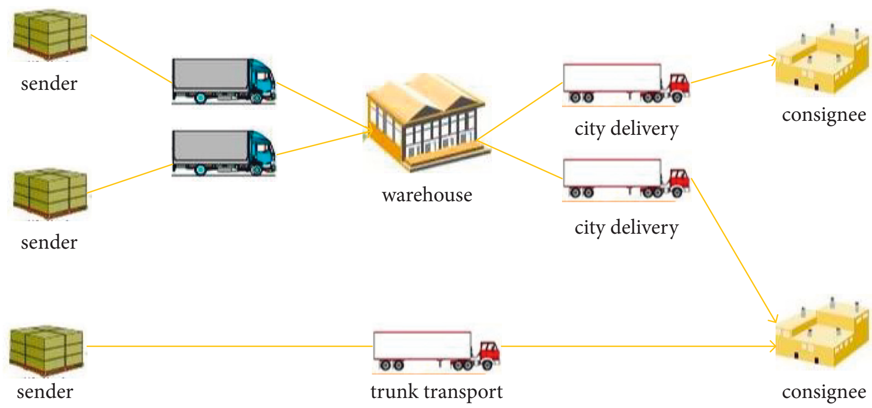

Figure 1: Logistics operation information management planning.

management. Among them, logistics transportation technology mainly includes transportation facilities and transportation operations. The former belongs to the hard technology of transportation, and the latter belongs to the soft technology of transportation.

In general, road logistics has the following advantages: strong mobility and easy to carry. The density of the road network is high, and the distribution range is large. The counties, districts, townships, and villages and towns have basically built roads. The density of the road network in the urban area is relatively large, so the accessibility of road traffic is the strongest. Road logistics has strong mobility and can be started, loaded, unloaded, and dispatched at any time, and there are few links between various transportation links. In addition, road transportation is suitable for the transportation of emergency and small quantities of goods, and plays a pivotal role in rescue and military transportation [12].

Realize "door-to-door" direct delivery. These vehicles are small and can be used in fields, on city streets, in residential houses, in factories, and in front of government offices. In this way, the goods can be transported directly from the sender's warehouse gate to the consignee's warehouse. This is something that other means of transportation such as trains, ships, and planes cannot do.

Short- and medium-distance transportation is fast and low cost. Because land logistics can achieve "door-to-door" direct access, and the travel time is short, there is no need to reverse the car mid-way, so the characteristic of short- and medium-distance transportation is that the transportation speed is faster. Fast delivery can not only increase time value, but also speed up capital turnover, increase the time value of goods, and ensure the quality of goods. This is especially important for fresh goods, valuables, high-end goods, and especially those that need to be shipped urgently [13].

The capital turnover of road logistics is fast, and the initial investment is low. Compared with railway logistics, road logistics does not need to purchase other expensive equipment, install signal equipment, and lay tracks. Due to the low purchase cost of automobiles, the initial capital recovery period is short, and it is easy to expand reproduction in a short period of time to ensure that production and living needs can be met in a timely manner.

Road logistics has strong adaptability and is easy to connect with other logistics and transportation methods. Due to its mobility and flexibility, it can be transported in various situations, combined with rail, water, air, and other transportation methods. This makes land logistics a key link in an integrated transportation system and an efficient means of distribution [14]. Figure 2 shows the integrated transportation system.

Although road logistics has many advantages, compared with other modes of transportation, there are still certain shortcomings, which are mainly reflected in the following aspects: not suitable for long-distance and large-scale transportation. Land logistics is generally only suitable for short-distance transportation, and the unit freight for long-distance transportation is relatively high. The economic radius of road logistics usually does not exceed 200 kilometers.

Driven by the economic interests of the region, local management has become the embodiment of local interests, contributing to local protectionism. The current market barriers between a considerable number of provinces and cities make the growth of networked logistics service companies quite difficult.

Accident rates are high. According to relevant statistics, the incidence of road traffic accidents is about 15 times that of railways and 178 times that of water traffic.

Due to the low vehicle carrying capacity, the road logistics capacity is reduced. In the process of transportation, the vibration of the car will be very large, and it is easy to damage the goods. Vehicle energy consumption is high, transportation cost is high, and railway transportation cost is high [15]. The importance of the transportation industry has increased rapidly with the continuous development of our economy. The development and changes of both passenger transportation and cargo transportation have become an important part of the development of the national economy. Among them, road transportation has become the top priority of the transportation industry.

2.2. General Model of Linear Programming. Linear programming is a quantitative method often used by logistics companies to develop transportation plans. Under the

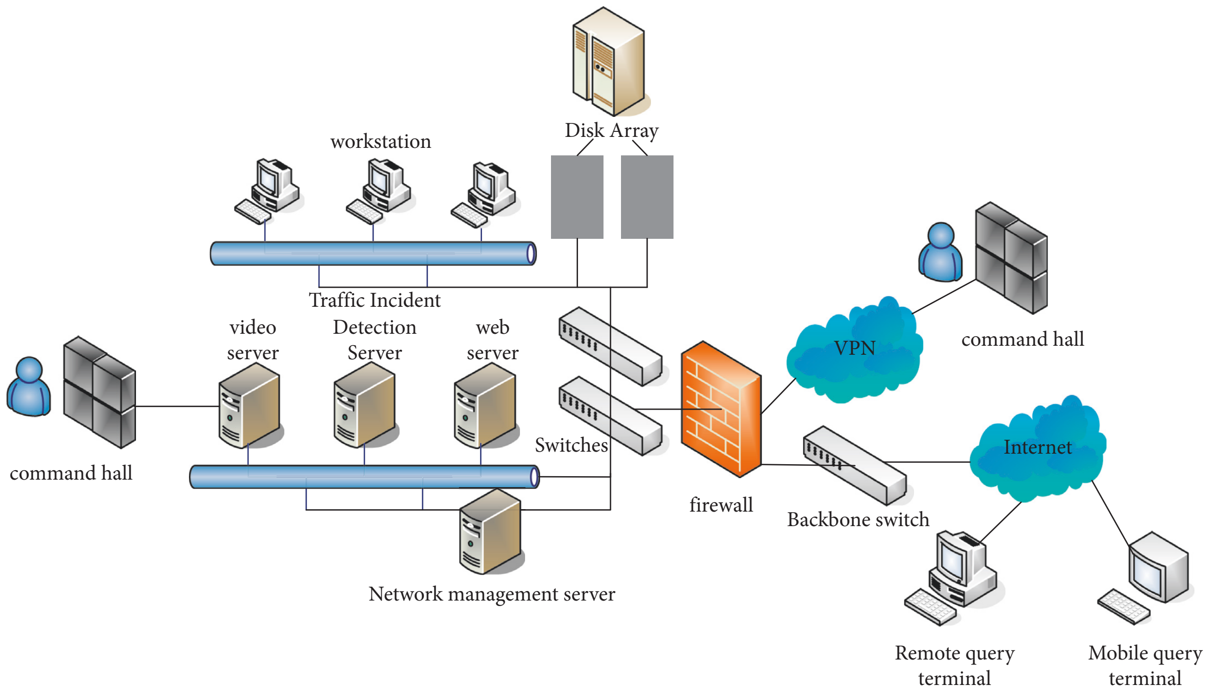

Figure 2: Integrated transportation system.

condition of satisfying certain constraints and objectives, how to make the whole system to be optimal, so as to achieve the least investment, is an important subject in linear programming. In general programming, using linear programming to solve problems is to seek the optimal or optimal solution under the constraints of resources and market demands. The biggest advantage of linear programming is that it can solve many types of problems. In the overall planning, the linear programming method can be used to realize the optimization of the actual production capacity, so as to achieve the expected demand. In addition, there are various algorithms such as nonlinear programming method and comprehensive hybrid method, all of which are designed for the constraints in road transportation planning. At present, the design unit generally adopts the road section division method. Although this method is simple and intuitive, there are often some difficult problems to solve, which lead to some problems in actual operation. In the application of road transportation planning, in order to better promote this method, we will conduct an in-depth discussion on the linear programming method.

2.2.1. Mathematical Model of the General Linear Programming Problem. Linear programming is also known as linear programming. In mathematics, linear programming refers to the optimization problem in which both the objective function and the constraints are linear. The mathematical model of a general linear programming problem can be expressed in the following form:

$$\max(\text{or}\min)c = s_1a_1 + s_2a_2 + \cdots + s_pa_p,$$
$$s.t.\begin{cases} i_{11}a_1 + i_{12}a_2 + \cdots i_{1p}a_p \le (\text{or} =, \ge) j_1 \\ i_{21}a_1 + i_{22}a_2 + \cdots i_{2p}a_p \le (\text{or} =, \ge) j_2 \\ \cdots\cdots \\ i_{q1}a_1 + i_{q2}a_2 + \cdots i_{\text{qp}}a_p \le (\text{or} =, \ge) j_q \\ a_1, a_2, \ldots, a_p \ge 0 \end{cases} \tag{1}$$

Here, s_p, i_{qp} represents the coefficient variable and a_p represents the decision variable.

The short form of the above model is

$$\max(\text{or}\min)c = \sum_{m=1}^{p} i_m a_m.$$
$$s.t.\begin{cases} \sum_{m=1}^{p} i_{\text{nm}}a_m \le (\text{or} =, \ge) j_n (n = 1, 2, \ldots, q) \\ a_m \ge 0 (m = 1, 2, \ldots, p) \end{cases} \tag{2}$$

2.2.2. Characteristics of the Linear Programming Mathematical Model. The objective function of a linear programming problem is a linear function; in linear programming, all constraints can be expressed as linear formulas.

Linear programming is an important branch of operations research and is widely used in military operations, economic analysis, business management, and engineering technology. It can rationally use limited human, material, financial, and other resources to make optimal decisions, thereby providing a scientific basis.

2.2.3. Standard Form of Linear Programming. Because there are different contents and forms between the objective function and the constraints, the linear programming problem has different expressions. For ease of discussion, the standard format for a linear programming problem is written as

$$\max c = \sum_{m=1}^{p} i_m a_m$$
$$s.t. \begin{cases} \sum_{m=1}^{p} i_{\mathrm{nm}} a_m = j_n \, (n = 1, 2, \ldots, q) \\ a_m \geq 0 \, (m = 1, 2, \ldots, p) \end{cases} \tag{3}$$

In the standard form of linear programming model, the objective function is to find a maximum value (or a minimum value), and all constraints are formulas of equality, while the right-hand end constant j_n of the constraint condition is all negative, and the value of the variable a_m is non-negative.

For linear programming problems that do not satisfy the standard form, they can be transformed into the standard form by the following methods.

The objective function is to find the minimum value, that is,

$$\min c = \sum_{m=1}^{p} s_m a_m. \tag{4}$$

Because solving $\min c$ is equivalent to solving $\max(-c)$, let $c^{‘} = -c$, that is,

$$\max c^{‘} = -\sum_{m=1}^{p} s_m a_m = \sum_{m=1}^{p} (-s_m) a_m. \tag{5}$$

Calculations are performed on unrestricted variables. If the variable a represents the difference between the planned quantity in one year and the planned quantity in the previous year, it is clear that the value of a can be positive or negative. At this time, it can be made $a = a^{‘} - a^{‘‘}$, of which $a^{‘} \geq 0$, $a^{‘‘} \geq 0$, and bring it into the linear programming model.

2.2.4. Solutions to Linear Programming Problems. For linear programming problems,

$$\max c = \sum_{m=1}^{p} s_m a_m,$$
$$s.t. \begin{cases} \sum_{m=1}^{p} i_{\mathrm{nm}} a_m = j_n \, (n = 1, 2, \ldots, q) \\ a_m \geq 0 \, (m = 1, 2, \ldots, p) \end{cases} \tag{6}$$

Solving a class of linear programming problems is to find a solution from a set of formulas satisfying constraints to maximize it.

A solution $A = (a_1, a_2, \ldots, a_p)^D$ that satisfies the above constraints is called a feasible solution to the linear programming problem. The set of all feasible solutions is called the feasible region as shown in Figure 3.

The feasible solution that maximizes the objective function is called the optimal solution.

Suppose I is the $p * q$ order coefficient matrix $(p > q)$ of the constraint formula system, and its rank is q. J is a full-rank submatrix of $q * q$ in matrix I, and J is a basis for linear programming problems. Assuming no loss of generality, then

$$J = \begin{pmatrix} i_{11} & \cdots & i_{1q} \\ \vdots & \cdots & \vdots \\ i_{q1} & \cdots & i_{qq} \end{pmatrix} = (R_1, \ldots, R_q). \tag{7}$$

Each column vector $R_m \, (m = 1, 2, \ldots, q)$ in J is called a basis vector and is a variable corresponding to basis vector R_m, and a_m is called a basis vector. Variables other than basis vectors in linear programming are called nonbasic variables.

2.3. Construction of the Optimization Model. Selection of variables: the decision variable of the transportation problem has self-evident economic significance, that is, the quantity of goods from one dispatcher to another dispatcher, and the quantity from n dispatchers to mth dispatcher is a_{nm}. Secondly, the determination of the objective function of the problem can minimize the shipping cost and find the minimum value.

Constraints: after the variables are determined and the objective function is constructed, the corresponding constraints are given. The constraints of the transportation problem include three constraints: the constraints of the number of shipments, the limit of the price, and the no-load condition.

Construction of the model: the transportation problem is a very common linear programming problem; because of its special structure, it is much easier to solve than the simplex method. There are generally three steps to establishing a mathematical model from a practical problem: find decision variables in terms of factors that affect what you are trying to achieve. The objective function is determined by the functional relationship between the decision variables and the purpose achieved. The constraints to be satisfied by the decision variables are determined by the constraints imposed by the decision variables.

Model building of supply and demand balance: there are q delivery points $I_1, I_2, \ldots, I_q$ to send a certain material, and the delivery volume is $i_1, i_2, \ldots, i_q$; in addition, there are p receiving points $J_1, J_2, \ldots, J_p$, and the receiving amount is $j_1, j_2, \ldots, j_p$, respectively. It is known that the freight rate for transporting a unit of material from I_n to J_m is s_{nm}, and the total delivery volume $\sum_{n=1}^{q} i_n$ of q shipping points is equal

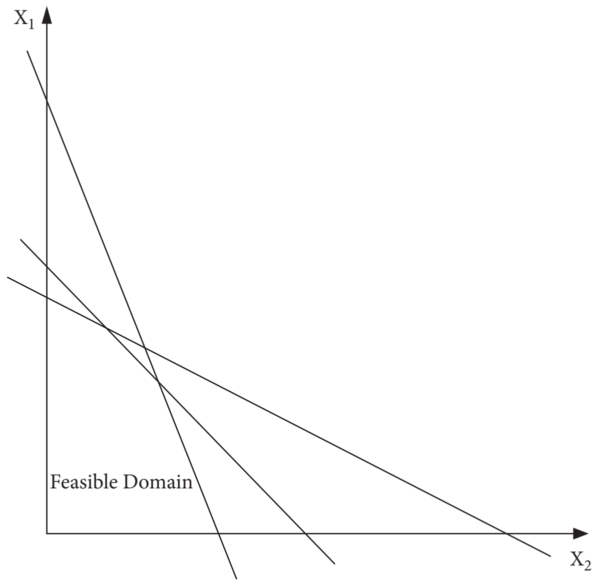

Figure 3: Feasible domain.

to the total receiving volume $\sum_{n=1}^{q} j_m$ of p receiving points. Try to find the transportation plan that minimizes the total freight cost under the condition of balance between supply and demand.

A mathematical model of this problem can be constructed. Assuming that the volume of goods shipped from I_n to J_m is a_{nm}, the total freight is

$$C = \sum_{n=1}^{q}\sum_{m=1}^{p} s_{\mathrm{nm}}a_{\mathrm{nm}}. \quad (8)$$

Furthermore, since the total supply transmitted by the nth transmitting station to the p receiving stations is equal to the supply of I_n, and the number of receivers received by the mth receiver, there are the following constraints:

$$\begin{aligned} &\sum_{m=1}^{p} a_{\mathrm{nm}} = i_n \quad (n = 1, 2, \ldots, q). \\ &\sum_{n=1}^{p} a_{\mathrm{nm}} = j_m \quad (j = 1, 2, \ldots, p) \end{aligned} \quad (9)$$

Thus, the mathematical model for this problem is

$$\min = \sum_{n=1}^{q}\sum_{m=1}^{p} s_{\mathrm{nm}}a_{\mathrm{nm}},$$
$$s.t.\begin{cases} \sum_{m=1}^{p} a_{\mathrm{nm}} = i_n\,(n = 1, 2, \ldots, q) \\ \sum_{n=1}^{q} a_{\mathrm{nm}} = j_m\,(j = 1, 2, \ldots, p) \\ a_{\mathrm{nm}} \geq 0\,(n = 1, 2, \ldots, q;\ j = 1, 2, \ldots, p) \end{cases} \quad (10)$$

The model is a linear programming model with $q * p$q variables and $q + p - 1$ independent constraint formulas.

Model building of supply and demand imbalances: when the output is greater than the sales, there are $\sum_{n=1}^{p} i_n > \sum_{m=1}^{p} j_m$, and the mathematical model of the transportation problem is

$$\min \sum_{n=1}^{q}\sum_{m=1}^{p} s_{\mathrm{nm}}a_{\mathrm{nm}}$$
$$s.t.\begin{cases} \sum_{m=1}^{p} a_{\mathrm{nm}} \leq i_n \quad (n = 1, 2, \ldots, q) \\ \sum_{n=1}^{q} a_{\mathrm{nm}} = j_m \quad (j = 1, 2, \ldots, p) \\ a_{\mathrm{nm}} \geq 0\,(n = 1, 2, \ldots, q;\ j = 1, 2, \ldots, p) \end{cases} \quad (11)$$

In order to make full use of the transportation mode in which supply and demand are balanced, the first set of inequalities in the above formula are transformed into formulas, and it is necessary to consider an imaginary sales place J_{p+1} with a demand of $j = \sum_{n=1}^{q} i_n - \sum_{m=1}^{p} j_m$, which is used for saving goods. Suppose the transport volume from I_n to $J_{n=1}$ is $a_{n,p+1}$, then there is

$$\sum_{m=1}^{p} a_{\mathrm{nm}} + a_{n,p+1} = \sum_{m=1}^{p+1} a_{\mathrm{nm}} \quad (n = 1, 2, \ldots, q). \quad (12)$$

Now consider that J_{p+1} is the assumed pin, and in fact, if the supply from the nth starting point I_n to the first p receiving points J_m is still not finished, the excess amount is stored locally, so in fact $S_{n,p+1} = 0$.

To sum up, in the case of sending more than receiving, its mathematical model can be

$$\min c = \sum_{n=1}^{q}\sum_{m=1}^{p+1} s_{\mathrm{nm}}a_{\mathrm{nm}} = \sum_{n=1}^{q}\sum_{m=1}^{p} s_{\mathrm{nm}}a_{\mathrm{nm}},$$
$$s.t.\begin{cases} \sum_{m=1}^{p+1} a_{\mathrm{nm}} = i_n\,(n = 1, 2, \ldots, q) \\ \sum_{n=1}^{q} a_{\mathrm{nm}} = j_m\,(j = 1, 2, \ldots, p) \\ a_{\mathrm{nm}} \geq 0\,(n = 1, 2, \ldots, q;\ j = 1, 2, \ldots, p) \end{cases} \quad (13)$$

Therefore, in this model, $\sum_{n=1}^{q} i_n = j_{p+1} + \sum_{m=1}^{p} j_m = \sum_{m=1}^{p+1} j_m$, so the above formula is a transportation model with balanced production and sales. Figure 4 shows the research technology roadmap of this paper.

3. Experimental Results of Road Logistics Transportation Research Based on Linear Programming

W Logistics Company (referred to as W Company) is a representative third-party logistics company. The company provides transportation, warehousing, loading and unloading, distribution, and other services for the majority of users across the country. The company is currently responsible for transporting the P and Q products of company H from various warehouses to various sales outlets. At present, we have learned that the total market demand in

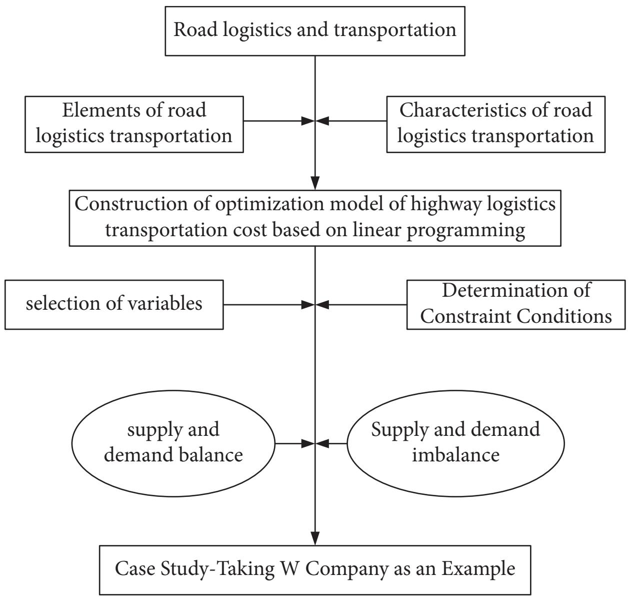

Figure 4: Research technology roadmap.

various places is 102 tons. Company H has 10 warehouses and 5 sales locations, all of which can be transported by road without administrative or engineering obstacles, so planning and design can be carried out according to the full mapping relationship.

The locations of supply and demand are shown in Figure 5. The rectangle is the warehouse, and the small circle is the point of sale.

3.1. Background Information of W Logistics Company. Overview of each warehouse: Company W has a total of 10 warehouses, as shown in Figure 5. In the warehouses A1-A10, two kinds of commodities, P and Q, are stored, respectively. All warehousing and sales locations are connected by roads and extended access roads, which are convenient and fast. The above production site is flat and safe to drive. Figure 6 shows the inventory at various warehouses, and Figure 7 shows the shipping distance.

It is known that the freight rate of a 15-ton car is 3 yuan per kilometer, and the freight rate is proportional to the mileage. Follow this rule. Combine the above information. Calculate the freight for each warehouse, as shown in Figure 8.

Overview of point of sale: on the basis of comprehensive research, W Company conducts overall planning for each sales network. According to the supply and demand profile, nearby pickup, supply balance, and other factors, the demand for each point of sale transferred from neighboring warehouses is counted, as shown in Figure 9.

Conventional method of material dispatching-road section zoning method: according to factors such as supply and demand, terrain, and traffic conditions, the working area of the vehicle can be roughly divided, which is usually called "section division." It can be roughly divided into three parts: A, B, and C. The corresponding demand of each branch and the corresponding warehouse supply are shown in Table 1.

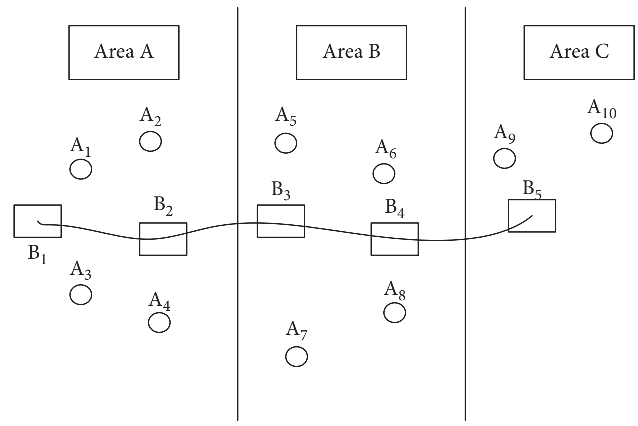

Figure 5: Supply and demand layout diagram.

Combined with the storage capacity of each warehouse, it can be seen that the requirements of Area B can no longer be met. Taking into account the transportation situation, and according to the principle of nearby access, it can be considered to borrow a batch from each of the adjacent areas *A*, *A*4, and *C*, *C*9.

Supply planning for Area *A*:Area *A* has two sales points, *B*1 and *B*2, the four warehouses *A*1, *A*2, *A*3, and *A*4 are based on the principle of picking up goods nearby, and their supply and transportation are shown in Table 2.

Combined with the product freight rate map, the minimum freight rate for section *A* can be calculated to be 2,400 yuan.

Supply planning for Area *B*:Area *B* has two sales points, *B*3 and *B*4, and four warehouses, *A*5, *A*6, *A*7, and *A*8. Since the two sales points *B*3 and *B*4 are in short supply, we have borrowed some products from Area *A* and Area *C*, respectively. According to the principle of nearby procurement, its feeding and dispatching conditions are shown in Table 3.

Combined with the product freight rate map, the minimum freight rate for section *B* can be calculated to be 2460 yuan.

Supply planning for Area *C*:Area *C* has one point of sale at *B*5 and two warehouses at *A*9 and *A*10. According to the principle of picking up goods nearby, the supply and transportation are shown in Table 4.

Combined with the product freight rate map, the minimum freight rate for section C can be calculated to be 750 yuan.

According to the experience plan of each section, the aggregate transportation cost of the whole line is calculated to be 5,610 yuan.

3.2. Construction of the Optimization Model. The supply and demand dispatch table is drawn according to the supply and demand of the supply and demand point and the freight rate. Now, the analysis and modeling are carried out for the P product and the Q product, respectively.

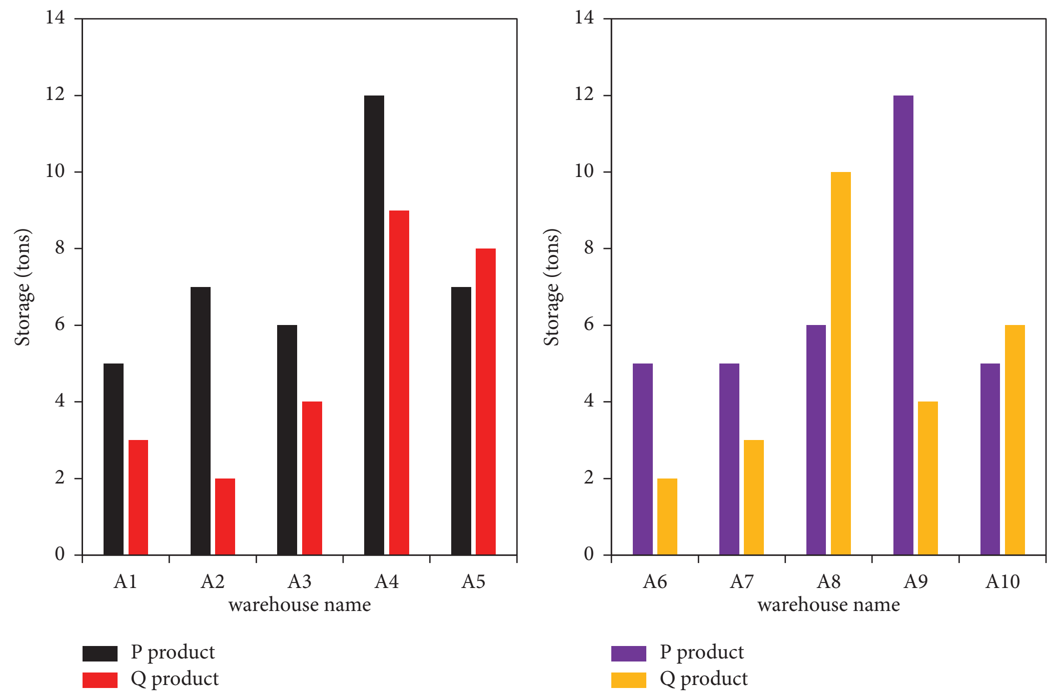

Figure 6: Storage capacity of each warehouse.

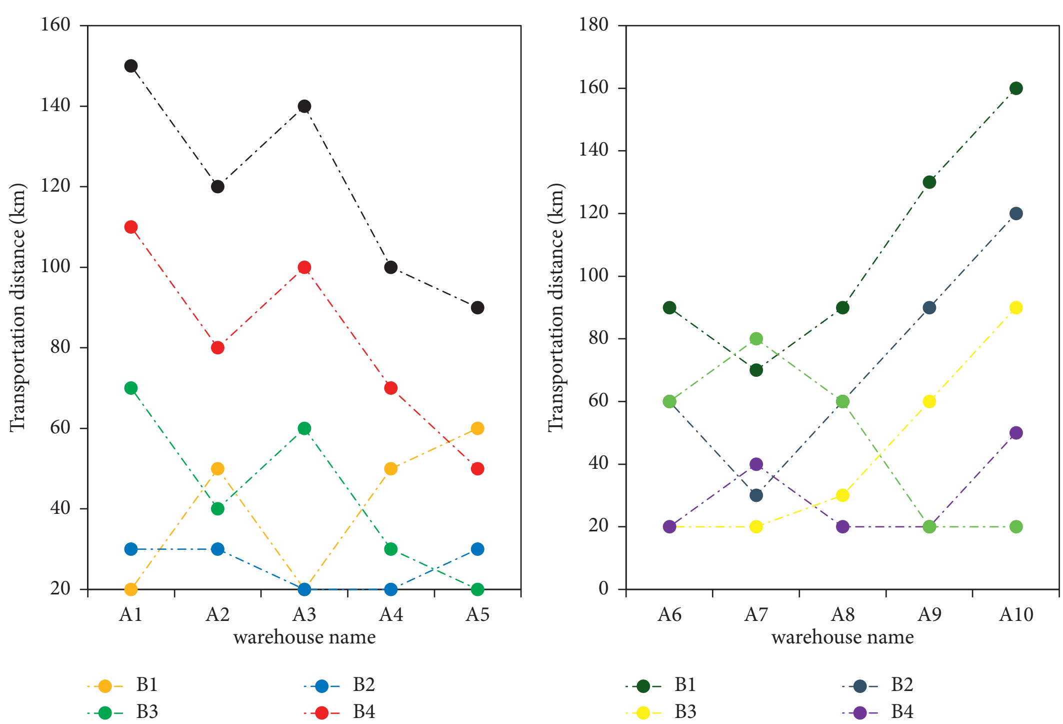

Figure 7: Shipping distance.

First solve the P product, and the transportation problem of the P product can be expressed as follows: it can be known that the shipping cost from each warehouse to each shipping unit is $s_{\mathrm{nm}}\,(n = 1, 2, \ldots, 10; m = 1, 2, \ldots, 5)$. The total delivery volume $\sum_{n=1}^{k} a_n$ of 10 shipping points is 70 tons, and the total receiving volume $\sum_{m=1}^{l} b_m$ of 5 receiving points is 55 tons, which is a problem of supply and demand imbalance. Because supply exceeds demand, we set up another sales office B6 that requires 15 tons, which translates into a supply and demand balance transportation problem. The next step

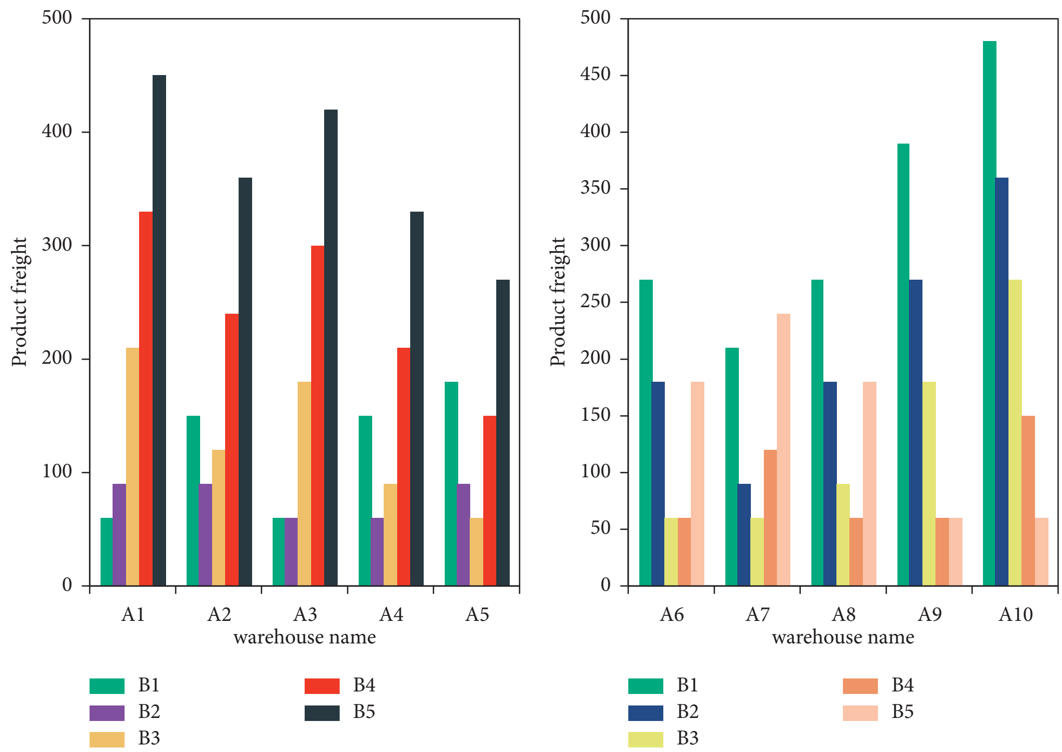

FIGURE 8: Product freight rates.

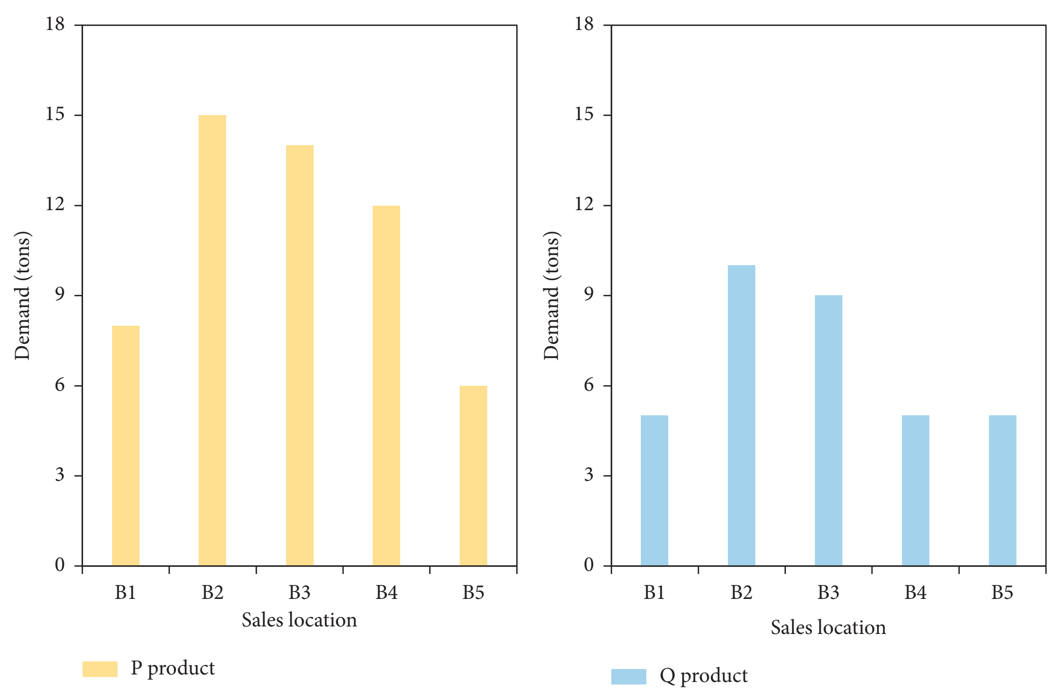

FIGURE 9: Demand statistics figure.

is to build a mathematical model of this problem. Assuming that the delivery volume of goods from A_n to B_m is x_{nm}, the total freight is $R = \sum_{n=1}^{k} \sum_{m=1}^{l} s_{\mathrm{nm}} x_{\mathrm{nm}}$.

Furthermore, note that the total amount sent by the nth warehouse A_n to the 6 receiving locations is equal to the supply of A_n, and the total amount received by the mth receiving location $\mathrm{B_m}$ to the 10 shipping points is equal to the demand of B_m. So, there are the following constraints: $\sum_{m=1}^{6} x_{\mathrm{nm}} = a_n\,(n = 1, 2, \ldots 10)$, $\sum_{n=1}^{10} x_{\mathrm{nm}} = b_m \quad (m = 1, 2, \ldots 10)$.

Table 1: Demand detail table.

Warehouse	Demand (tons)					
	Area *A*		Area *B*		Area *B*	Total
	B1 point of sale	B2 point of sale	B3 point of sale	B4 point of sale	B5 point of sale	
A1	8					8
A2		4				4
A3	5	4				9
A4		17	2			19
A5			13			13
A6				7		7
A7			8			8
A8				9		9
A9				1	10	11
A10					1	11
Total	13	25	23	17	11	99

Table 2: Supply and dispatch table in Area *A*.

	Point of sale			
	*B*1		*B*2	
Warehouse	P product	Q product	P product	Q product
*A*1	5	3	0	0
*A*2	0	0	3	1
*A*3	3	2	3	1
*A*4	0	0	9	8
Total demand	8	5	15	10

Table 3: Supply and dispatch table in Area *B*.

	Point of sale			
	*B*3		*B*4	
Warehouse	P product	Q product	P product	Q product
*A*4	2	0	0	0
*A*5	7	6	0	0
*A*6	0	0	5	2
*A*7	5	3	0	0
*A*8	0	0	6	3
*A*9	0	0	1	0
Total demand	14	9	12	5

Table 4: Supply and dispatch table in Area *C*.

	Point of sale	
	*B*5	
Warehouse	P product	Q product
*A*9	6	4
*A*10	0	1
Total demand	6	5

Thus, the mathematical model for this problem is min = $\sum_{n=1}^{k}\sum_{m=1}^{l} s_{\mathrm{nm}}x_{\mathrm{nm}}$,

$$\text{s.t.}\begin{cases}\sum_{m=1}^{6} x_{\mathrm{nm}} = a_n\,(n = 1, 2, \ldots 10)\\ \sum_{n=1}^{10} x_{\mathrm{nm}} = b_m\,(m = 1, 2, \ldots 10)\\ x_{\mathrm{nm}} \geq 0\,(n = 1, 2, \ldots 10; m = 1, 2, \ldots 10)\end{cases}.$$

Bring it into the computer software to solve: the total freight of P product is $R = 3450$ (yuan).

In the same way, the Q product is solved, a mathematical model is constructed, and the total freight of the Q product is finally obtained as 2040 yuan.

In summary, the minimum shipping cost $R = 3450 + 2040 = 5490$ (yuan) can be obtained.

Combined with the comparative analysis of the results obtained by the linear programming model and the road section division method, the total freight calculated by the road section division method is 5610 yuan, and the total freight calculated by the linear programming method is 5490 yuan. By comparing the segmentation method, it is found that the linear programming method saves the transportation cost compared with the segmentation method in the overall transportation cost. In resource allocation, it is difficult to obtain the best dispatching scheme by the traditional road partitioning method. Using the resume model established by the linear programming method, the optimal operation diagram can be obtained quickly, so as to formulate the optimal operation diagram for the logistics company.

Therefore, it is feasible and effective to use the linear programming method to optimize the road transportation cost of logistics enterprises. Using the linear programming method to establish a mathematical model and establish a traffic route scheme, not only can the transportation cost be calculated quickly and easily, but also the cost is very low. Because the MS software for solving the linear programming problem is free, it is sufficient to meet the calculation requirements of the transportation cost in this paper. This will help logistics operators monitor transportation costs, accurately perform cost accounting and optimization, formulate reasonable transportation plans, and make effective decisions.

4. Conclusions

Due to the rapid development of computer technology, the solution efficiency of linear programming has been greatly improved, and it has been widely used in the fields of economy and life. Through example analysis, the effectiveness and effectiveness of the method are proved. Using the corresponding linear programming software, the transportation cost can be calculated quickly and easily, and the optimized transportation plan can be given to improve the profitability and competitiveness of the enterprise. Therefore, in order to reduce costs, people must strengthen management and establish a rational route to reduce time and cost. In addition, it is worth noting that the quality of transportation should also receive great attention. If the transport is not stored properly, this will affect the quality of the product and increase the shipping cost. All in all, under the premise of reducing transportation costs, it is necessary to ensure that the quality of products meets the needs of customers, and to improve the quality of products under the premise of controlling costs. This paper only studies the cost of transportation in the logistics supply chain. However, the transportation activities of logistics enterprises are multi-link. Due to the influence of the theory of contradictory benefits, the excessive pursuit of transportation costs in a single link is likely to lead to an increase in the total transportation cost. Therefore, in many cases, it is necessary to study the cost from the perspective of global cost optimization.

Data Availability

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

Conflicts of Interest

The author declares no conflicts of interest.

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