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Retraction

Retracted: Optimization Algorithm of Logistics Transportation Cost of Prefabricated Building Components for Project Management

Journal of Mathematics

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Manipulated or compromised peer review

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

References

[1] X. Yang, "Optimization Algorithm of Logistics Transportation Cost of Prefabricated Building Components for Project Management," *Journal of Mathematics*, vol. 2022, Article ID 1460335, 9 pages, 2022.

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Research Article

Optimization Algorithm of Logistics Transportation Cost of Prefabricated Building Components for Project Management

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Because the traditional logistics transportation cost optimization algorithm of prefabricated building components has the problems of long transportation time and high transportation cost, a logistics transportation cost optimization algorithm of prefabricated building components for project management is proposed. A project management oriented prefabricated building component management system is built, the logistics and transportation process of prefabricated building components are analyzed, and the logistics vehicles of prefabricated building components under the time window are scheduled. According to the scheduling results, through the waiting unloading time cost, transportation cost, and penalty cost, the total cost objective function is built to obtain the optimal cost. The simulation results show that the proposed algorithm has the shortest logistics transportation time and the lowest transportation cost.

1. Introduction

With the progress of the times and the development of economy, the development of construction industry has ushered in new opportunities and has become an important driving force for China's economic improvement. The traditional cast-in-place construction mode can no longer meet the needs of diversification, high safety, and low energy consumption of current building production, while the energy-saving, labor-saving, safe, and efficient prefabricated buildings gradually replace the traditional production mode [1]. Since 2015, the state has successively issued a series of policies to promote the development of prefabricated buildings. In the same year, the government decided to comprehensively promote prefabricated buildings throughout the country next year and implement unified evaluation standards. It also formulated a series of development plans for prefabricated buildings. It plans to implement prefabricated production in half of the country's construction projects by 2025. In 2016, the government work report further described how to develop prefabricated buildings and proposed that we should not develop blindly. We should fully consider the actual situation, pursue the development of efficient prefabricated buildings, and pay more attention to improving the construction quality of construction projects. The prefabricated construction industry has gradually occupied a certain market share in the construction industry. According to the statistical report in 2019, the proportion of prefabricated buildings in new buildings in China is about 13.4%, with a year-on-year increase of 45% [2].

Prefabricated building refers to the building formed by the unified production and transportation of concrete prefabricated components from the processing plant to the construction site. For construction enterprises, the conditions for selecting suppliers of prefabricated PC components are nothing more than the price, on-time delivery rate, and product qualification rate of PC components. The component price and product qualification rate can be determined according to the industrial and national regulations and the qualification test certificate provided by the component processing factory before selecting suppliers, but the delivery time may depend on weather conditions. The traffic situation changes, which leads to the increase of high logistics cost and becomes an important bottleneck restricting the development of prefabricated buildings in China [3]. The weight of fabricated PC components can reach up to 3 tons, which is a typical bulk cargo, and its transportation cost can account for 50%–60% of the logistics cost of the whole supply chain. Moreover, the time when the vehicles for prefabricated building components arrive at the construction site directly affects the overall project progress. At present, the transportation of prefabricated building components depends on the experience of the dispatchers in the component processing plant, so it is very likely that the vehicles cannot arrive at the construction site on time due to unreasonable scheduling. This will not only increase the cost of rescheduling the construction at the construction site, but also cause the punishment cost of the component processing plant, so that the cost of the whole prefabricated building component transportation supply chain will increase. Therefore, how to reduce the total cost of logistics transportation has become the research object of many scholars.

The research on logistics transportation cost optimization of prefabricated building components is a process from shallow to deep. Scholars have made relevant exploration in the direction of cost optimization of prefabricated building. Literature [4] proposes the transportation cost optimization algorithm of B2C e-commerce return reverse logistics and divides its cost composition into three categories: transportation cost, inventory cost, and other costs. This paper mainly focuses on the transportation cost of return reverse logistics and constructs the location model of return reverse logistics center of B2C e-commerce enterprises according to its cost composition and influencing factors. Genetic algorithm combined with MATLAB programming is used to solve the model and conduct numerical experiments, select a reasonable return logistics center address, reduce the relevant transportation cost, and then achieve the purpose of optimizing the transportation cost of return reverse logistics under the B2C e-commerce environment. Literature [5] proposed the optimization algorithm of litchi cold chain logistics distribution cost model based on ant colony algorithm. Taking four main factors, i.e., distribution vehicle transportation, cold chain energy consumption, litchi loss, and time window punishment, as the research object, the cost model of each factor is constructed, and the objective optimization function of cost optimization in the process of litchi cold chain logistics distribution is determined. The ant colony algorithm is used to solve the example of cost optimal objective function in the process of litchi cold chain logistics distribution, and the optimization roadmap of litchi cold chain logistics distribution path network is obtained. However, the cost of the above two algorithms for the logistics transportation of prefabricated building components is high. Literature [6] proposed the optimization algorithm of logistics distribution path of fresh food cold chain, established a new cost and constraint model, and gave the optimization method using simulated annealing algorithm. The model considered the influence of vehicle speed and load capacity on transportation energy consumption, distinguished the refrigeration energy consumption of vehicle in transit and loading and unloading stage, and described the deterioration rate of food with exponential function rather than constant. The simulated annealing algorithm is used to solve the example. Paper [7] proposed the container liner transportation stowage optimization algorithm. In the research on the container liner multiport stowage optimization problem, a 0-1 integer optimization mathematical model with the constraint of ship stability and the goal of minimizing the total number of containers in the whole route was established, and the improved adaptive genetic algorithm based on P-1 genome chromosome coding design was used to solve it. The feasibility and effectiveness of the stowage mode are verified by example simulation. However, the above two algorithms consume a long time for the logistics transportation of prefabricated building components, resulting in low transportation efficiency.

Since the above algorithms have certain limitations and issues, these problems led us to introduce the proposed method. Hence, in view of the problems in the above algorithms, this paper proposes a project management oriented logistics transportation cost optimization algorithm for prefabricated building components, and the simulation experiments verify that the algorithm has low cost and high operation efficiency, which lays a foundation for the development of logistics transportation. Following the Introduction, the assembly building component management system for project management is given in Section 2. In Section 3, the logistics and transportation process of prefabricated building components are described. In Section 4, an optimization algorithm which covers the logistics transportation cost of prefabricated building components is explained. In Section 5, the experimental analysis is carried out where the authentication of the proposed algorithm is proved. In the end, the paper is finished with a conclusion in Section 6.

2. Assembly Building Component Management System for Project Management

With the proposal and development of prefabricated building mode, we gradually see the application value of prefabricated building process integration. However, at present, it is still difficult to implement the actual project application. Technology has not been a problem, and the biggest bottleneck is the construction organization and management mode. The ultimate goal of the development of prefabricated buildings is to establish the integrated technology of factory manufacturing, mechanized assembly, and standardized management. What needs to be changed on the surface is the construction process, but what needs to be changed in essence is the management system. As the biggest obstacle to the implementation of cost management, if we follow the traditional cost management mode of taking all the responsibility and cutting in blocks, we cannot realize the real value of the integrated process without taking the overall interests of the project as the goal. To solve this problem, the state has been promoting the general contracting mode to achieve the maximum benefits of construction industrialization [8].

2.1. Prefabricated Building Component Factory in Supply Chain. As a transition, the prefabricated building component factory has stepped onto the historical stage as a separate party. The positioning of component factories is mainly divided into component factories, single components, and so on including self-supporting mode, self-supporting and joint venture mode, component processing, and integrated nomadic mode of supporting products. Component + type is only responsible for component production and component deepening. Component ++ type plays a role in the scheme design and decision-making stage, and its main functions include R&D, design, production, installation, technical consultation, and management consultation [9].

The component factory under the integrated positioning takes the service general contracting, cost reduction, and efficiency increase as the core, and the key points of management mainly include component demobilization, transportation and stacking, matching of hoisting sequence, optimization of storage yard and stacking scheme, combination of components and finalized formwork, and combination of components and installation.

2.2. Management Process of Prefabricated Building Components. By analyzing the research text of component factories of well-known enterprises in the industry, this paper summarizes the specific management process for prefabricated building components. As can be seen from Figure 1, regarding the subordination of logistics management of prefabricated building components and the relationship with other systems, components are warehoused after passing the finished product inspection standard, and checked and delivered after receiving the transportation instruction, and the marketing management team is responsible for after-sales operation [10]. The problem components shall be handled by the technical management team, repaired and returned to the factory according to the problem size of fabricated building components, and then handed over to the logistics management team for retransportation. It can be seen from Figure 1 that the general transportation service is completed by cooperation between multiple departments. From the signing of the contract through bidding to the completion of transportation delivery, each department is responsible for tracking the components, which are divided into marketing, technology, quality, procurement, production, inventory, and logistics management. Although logistics is rarely mentioned in the structure, it is a main line that runs through the capital flow with the product itself. In order to better manage, many enterprises will establish project management departments independent of the enterprise to coordinate and manage the project.

3. Logistics and Transportation Process of Prefabricated Building Components

Transportation refers to the logistics activities of processing and packaging the goods according to the needs of users within a certain area, and finally transporting them to the location designated by users on time. Transportation is the organic combination of "transportation" and "transportation." Transportation refers to the transportation of users, vehicles, transportation routes, and so on, while "transportation" refers

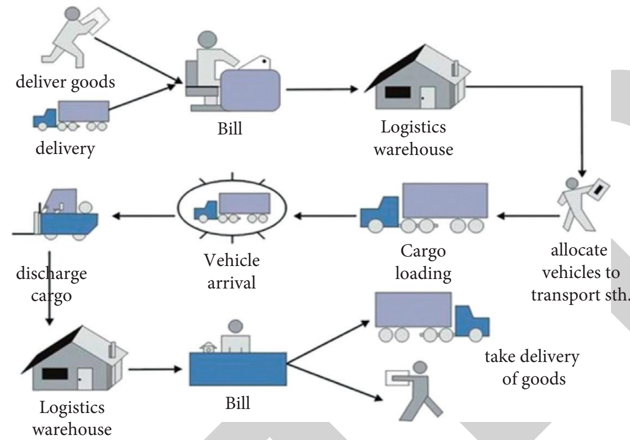

Figure 1: Component management process.

to the transportation of goods. Transportation is the transportation link in the logistics system, and it is the end and last link of the entire logistics system. The biggest difference between transportation and delivery is the extension of transportation and delivery, which is derived from social high-level production for a long time. Transportation is the scientific and reasonable arrangement of transportation tools and routes through the transportation department, which can not only meet the needs of customers, but also reduce the logistics cost. At the same time, scientific transportation can not only enable enterprises to achieve zero inventory, but also alleviate traffic pressure and reduce environmental pollution [11].

According to the prefabricated building component management system for project management, the logistics transportation process of prefabricated building components is analyzed. When transporting according to customer needs, the transportation center will arrange vehicles according to the actual situation. The basic transportation process is shown in Figure 2.

(i) Divide transportation area: in order to make the vehicle transportation route more reasonable and the transportation cost lower, the management personnel of the transportation center need to divide the transportation area according to the customer's area, traffic conditions, and other information before transportation [12].

(ii) Determine user transport sequence: after the area is divided, the delivery sequence is preliminarily arranged according to the time window required by customers in this area, so that customers can enjoy better service [13].

(iii) Arrange vehicles: first, determine the characteristics of the goods to be transported, the number of vehicles, and the vehicle load. Secondly, load the goods according to the user's transportation sequence. Finally, the goods that can be transported by the same vehicle are determined according to the demand of each user and the transportation cost.

(iv) Select transportation route: after determining the goods to be transported by each vehicle, select a

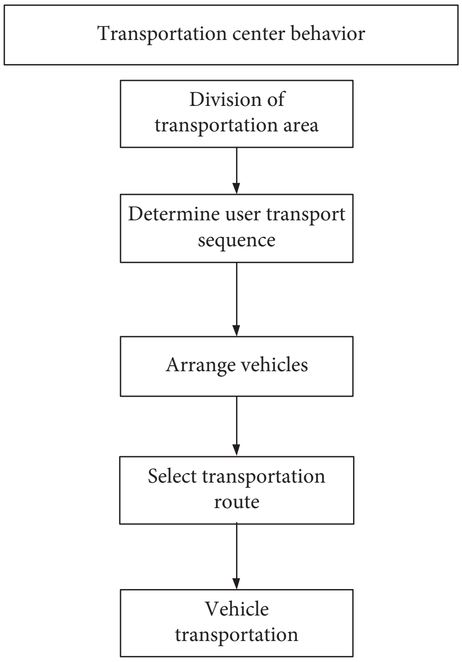

Figure 2: Basic flow chart of transportation.

scientific and reasonable transportation route with short distance and low cost according to the customer's time window, specific location, and other conditions, aiming at obtaining the lowest transportation cost.

(v) Transport goods by vehicle: determine the final vehicle transportation route according to the above determined goods and vehicle arrangement, transportation sequence, and transportation route required by the customer [14].

4. Optimization Algorithm of Logistics Transportation Cost of Prefabricated Building Components

Prefabricated building refers to the building assembled on site by prefabricated components produced by the factory. In terms of structural form, it can be divided into fabricated concrete structure, wood structure, and steel structure. From the perspective of component application specialty, it can be divided into building components, highway components, municipal components, water conservancy components, etc. The components studied in this paper are mainly fabricated reinforced concrete components, such as prefabricated walls, slabs, columns, beams, balcony slabs, and stairs. The logistics transportation cost optimization problem of prefabricated components studied in this paper is a vehicle scheduling problem aiming at logistics transportation cost optimization in logistics transportation management [15].

4.1. Determination of Starting and Ending Vehicle Dispatching Lines. In this section, we determine the starting and ending vehicle dispatching lines. In the process, we first described the starting point of transportation. Then, the final stop position is explained. We give the mathematical description of both positions and provide the best dispatching and terminating positions with respect to time and maximum authority.

4.1.1. Start Scheduling Location. The starting dispatching position refers to the starting point of logistics transportation goods, which can change with the change of multimodal transport network structure. Generally, it is directly affected by the two physical coefficients of multimodal transport network node coverage intensity and vehicle transportation dispatching frequency [16]. The node coverage strength of intermodal network can be expressed as z. In a complete prefabricated building component logistics transportation network, this physical quantity is composed of upper limit value z_l and lower limit value z_0, where l represents the value of transportation vehicle scheduling coefficient per unit time. The vehicle transportation scheduling frequency can be expressed as q. Due to the variability of the logistics transportation network of prefabricated building components, the actual value result of this physical quantity is not completely fixed [17]. The starting dispatching position of logistics transportation vehicles for prefabricated building components can be defined as

$$A_0 = \sqrt{\sum_{z_0}^{z_l} \frac{(\max W - q_1 q_2)^2}{l^2}}, \quad (1)$$

where q_1 and q_2, respectively, represent the value results of two different vehicle transportation scheduling frequencies, and $\max W$ represents the maximum logistics vehicle scheduling authority value per unit time.

4.1.2. Stop Scheduling Location. The termination scheduling position refers to the end point of logistics transportation goods. It can also change with the change of the structure of multimodal transport network. It is usually directly affected by two physical quantities: vehicle travel distance and logistics network scheduling cycle of prefabricated building components. The vehicle travel distance can be expressed as d. Due to the existence of the initial scheduling position, this physical coefficient always belongs to a dependent variable, and its numerical level cannot be directly affected by the subjective scheduling factors of prefabricated building component logistics transportation vehicles [18]. The logistics network scheduling cycle of prefabricated building components can be expressed as D. Generally, the greater the value of this physical index, the farther the transportation distance that logistics vehicles can reach. According to the joint formula (1), the termination scheduling position of prefabricated building component logistics transportation vehicles can be defined as

$$A_n = \frac{dD \times \sqrt{c_0^2 + c_n^2}}{\eta \cdot A_0}, \quad (2)$$

where c_0 represents the logistics transportation optimization parameters related to the starting dispatching location, c_n represents the logistics transportation optimization parameters related to the ending dispatching location, and η represents the logistics dispatching authority value matching the transportation vehicle [19].

4.2. Transportation Path Grid Model. Based on the learning algorithm of artificial intelligence, the linear programming model of logistics transportation path of prefabricated building components is constructed, and the mathematical problem of transportation path optimization planning of prefabricated building component logistics is expressed as follows:

$$\begin{cases} \min C = \sum_{k=1}^{K}\sum_{i=1}^{V} x_{i,k}C_{i,i+1}^{k} + A_n \sum_{k=1}^{K}\sum_{l=1}^{K}\sum_{i=1}^{V} y_{i,k}C_{i}^{k,l}, \\ \min T = \sum_{k=1}^{K}\sum_{i=1}^{V} x_{i,k}T_{i,i+1}^{k} + A_n \sum_{k=1}^{K}\sum_{l=1}^{K}\sum_{i=1}^{V} y_{i,k}T_{i}^{k,l}, \end{cases} \tag{3}$$

where T is the total time spent on transportation; C is the total cost spent; $x_{i,k}$, $y_{i,k}$ are the decision variables; $x_{i,k} = 1$ is the selection of k transportation mode between nodes i and $i+1$; $y_{i,k} = 1$ is the change of transportation mode k at node i into another transportation mode l; V is the set of transportation nodes, the set of alternative routes; and K is the set of transportation modes. Considering the spatial characteristics, it is found that the number of logistics transportation paths of prefabricated building components is n. The traffic logistics parameter characteristics are linearly fused, and the spatiotemporal parameters of traffic flow data are $L_1, \ldots, L_n$ and $P_1{}^{\min}, \ldots, P_n{}^{\min}$. By establishing the adaptive optimization grid distribution model of the logistics transportation path of prefabricated building components, the weight parameter distribution model of the memory unit is obtained, and the weight factor W^T is obtained. According to the traffic flow distribution of the target road section, combined with block matching, the path parameter distribution set of the logistics transportation of prefabricated building components is obtained, and the transportation path grid model is constructed:

$$F = \frac{\sum_{j=0}^{N} c_{ij}x_{ijk}u_{ij}}{\sum_{i=1}^{N} G y_{ik}}, \tag{4}$$

where i, j are the logistics vehicle transportation stop node and adjacent node, the number of adjacent nodes j of node i is n, c_{ij} is the distance from node i to adjacent node j, u_{ij} is the transportation cost per unit distance, k is the number of transportation vehicles owned by the logistics company, G is the fixed departure cost, $x_{ijk} = 1$ when vehicle k is from node i to adjacent node j, $y_{ik} = 1$ when node k is transported by vehicle i, and x_{ijk}, $y_{ik} = 0$ [20] in other cases.

4.3. Vehicle Scheduling with Time Window. The vehicle scheduling problem is to organically organize and combine several loading points and unloading points to form a series of vehicle routes through the arrangement of vehicle departure sequence when the vehicles of prefabricated building components are limited. The premise of solving this problem is to meet certain constraints, and the ultimate goal is to make the general route of vehicle transportation the shortest, the transportation time the least, and the total cost the lowest [21]. Vehicle scheduling optimization problem is actually to solve the most efficient transportation scheme. The vehicle scheduling problem with time window for prefabricated building components can be described as follows: let $R = (V, A)$ be a complete undirected graph, where V is the node set and A is the edge set. In a fabricated building component processing plant, k vehicles transport the required components to n construction sites. After one transportation trip, the vehicles need to return to the component processing plant for reloading for transportation. If the prefabricated building component transport vehicle does not arrive within the time window required by the construction site, the corresponding penalty cost will be incurred. Considering the distance of the road, the vehicle will exceed the maximum transit time of the vehicle due to long-distance transportation, resulting in the penalty cost. Each construction site can be served by multiple vehicles at the same time, but one vehicle can only serve one construction site at a time, and the needs of customers are random. The goal of vehicle scheduling problem for prefabricated building components is to arrange scientific and reasonable vehicle scheduling time and route, so as to minimize the total cost of vehicle transportation under the condition of meeting the time window and needs of customers [22].

(i) The difference between the driving time of vehicle k and the maximum driving time is

$$TO_i = F\max\left(T_{io} - T_{oi}\right), \tag{5}$$

here o is the component processing plant.

(ii) The penalty cost for vehicle k's failure to arrive within the time window required by construction site n for the i-th transportation is

$$G_{kn} = TO_i\gamma\left(T_{kn} - L_n\right). \tag{6}$$

(iii) The service times of construction site n are

$$CW_{nr} = \frac{N_n}{Q_r}. \tag{7}$$

(iv) The calculation parameters of the i-th transportation of vehicle k serving construction site n are

$$z_{ikn} = \begin{cases} 1, & \text{The } i-\text{th delivery of vehicles } K \text{ serves the construction site } n, \\ 0, & \text{otherwise.} \end{cases} \tag{8}$$

(v) The calculation parameters of vehicle k for transportation are

$$y_k = \begin{cases} 1, & \text{Vehicle } k \text{ is enabled,} \\ 0, & \text{otherwise.} \end{cases} \tag{9}$$

4.4. Cost Objective Function. According to the above vehicle scheduling results with time window, the cost objective function is constructed. According to the characteristics of the transportation form of prefabricated building components, considering the waiting unloading time cost in the transportation process and the penalty cost for failing to meet the soft time constraint, the objective function of the total transportation cost includes not only the transportation cost, but also the waiting unloading time cost and the penalty cost caused by failing to meet the time window requirements of the construction unit. The purpose is to obtain the transportation vehicle arrangement plan when the total transportation cost is the lowest under the constraints of hard time window of each construction unit.

4.4.1. Waiting Time Cost. If the transport vehicles planned by the prefabrication plant need to queue up to unload the fabricated building components after arriving at the construction site, on the one hand, the waiting time will cause the personnel and vehicles to be idle; on the other hand, it may lead to failure to meet the time requirements of other construction sites, thus losing credibility and being subject to the agreed economic punishment. In the waiting time, from the perspective of the supplier, personnel and vehicles will not be used effectively, resulting in a waste of resources and an indirect loss of reputation. A unit waiting time cost coefficient s is proposed by the prefabricated component factory according to the expert's speculation. It is assumed that the tangible and intangible costs of the prefabricated plant caused by waiting increase linearly with the increase of waiting time. The total waiting time cost is

$$U_1 = \sum_{i=1}^{n} s y_i. \tag{10}$$

4.4.2. Transportation Cost. The transportation cost of prefabricated building component vehicles refers to the fuel cost and temporary maintenance cost consumed by vehicles starting from the component processing plant, passing through various construction sites, and finally returning to the component processing plant, which is directly proportional to the total distance traveled by vehicles. The longer the distance, the higher the cost. Therefore, the main factor affecting the transportation cost is the total distance of vehicles, which puts forward requirements for the vehicle dispatcher of the component processing plant to make scientific and reasonable vehicle time and route arrangement before vehicle transportation. Then, the transportation cost generated during vehicle scheduling of prefabricated building components can be expressed as

$$U_2 = \sum_{i=1}^{n} D_{ok} z_{ikn}. \tag{11}$$

4.4.3. Penalty Cost. The normal working time of vehicle drivers is 8 hours; that is, the longest driving time of vehicles is 8 hours. If the working time exceeds 8 hours, it is the driver's overtime, which will produce corresponding overtime expenses, and the driver is prone to fatigue due to driving for a long time, resulting in incalculable consequences, so it will produce corresponding punishment costs. Then, the penalty cost for exceeding the maximum driving time of the vehicle during vehicle scheduling of prefabricated building components can be expressed as

$$U_3 = \sum_{i=1}^{n} G_{kn} T O_i. \tag{12}$$

4.4.4. Total Cost Objective Function. The transportation cost optimization problem of prefabricated building components studied in this paper considers the transportation in the supply process, the waiting time cost caused by unreasonable logistics transportation, and the penalty cost for not reaching the construction site in time. The objective is to realize the lowest logistics transportation related cost of prefabricated component enterprises through reasonable transportation vehicle scheduling. Therefore, the total target cost includes vehicle transportation cost, waiting time cost, and penalty cost, which can be obtained as follows:

$$U = U_1 + U_2 + U_3. \tag{13}$$

5. Simulation Experiment Analysis

In order to verify the effectiveness of the logistics transportation cost optimization algorithm of prefabricated building components for project management in practical application, the experiment was carried out using the following configurations: MATLAB 7.0, VS2010 + OpenCV2.4.13, Windows 10, Intel® Xeon® CPU E5-2603 v4 @2.20 GHz, 32 GB memory. The logistics transportation network structure of prefabricated building components was set as shown in Figure 3.

According to the road network structure of logistics transportation of prefabricated building components, the logistics transportation cost optimization algorithm of prefabricated building components for project management proposed in this paper, the B2C e-commerce return reverse logistics transportation cost optimization algorithm proposed

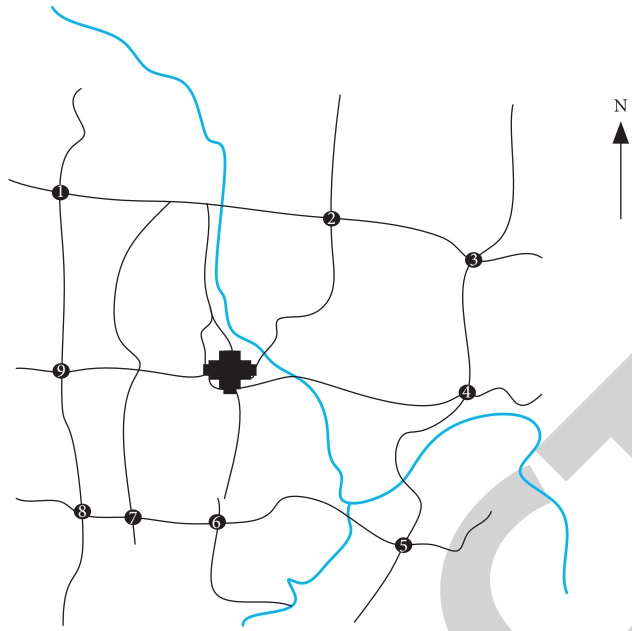

Figure 3: Road network structure diagram of logistics transportation of prefabricated building components.

Table 1: Comparison results of logistics transportation cost error rate of fabricated building components.

Number of experiments/times	Error rate (%)		
	Paper algorithm	Reference [4] algorithm	Reference [5] algorithm
10	4	18	32
20	5	18	34
30	7	18	37
40	8	20	40
50	9	22	42
60	9	24	43
70	10	25	43
80	12	27	44
90	13	32	45
100	15	35	48

in literature [4], and the litchi cold chain logistics distribution cost model optimization algorithm based on ant colony algorithm proposed in literature [5] are adopted; the logistics transportation cost error rate of fabricated building components is compared and analyzed; and the comparison results are shown in Table 1.

According to the data in Table 1, the logistics transportation cost error rate of assembled building components of the logistics transportation cost optimization algorithm of assembled building components for project management proposed in this paper is less than 15%, while the logistics transportation cost error rate of assembled building components of the B2C e-commerce return reverse logistics transportation cost optimization algorithm proposed in [4] is less than 35%. The error rate of logistics transportation cost of prefabricated building components of the optimization algorithm of litchi cold chain logistics distribution cost model based on ant colony algorithm is less than 48%. The logistics transportation cost optimization algorithm of prefabricated building components for project management proposed in this paper has a low cost for logistics transportation of prefabricated building components.

In order to further verify the effectiveness of this algorithm, the logistics transportation cost optimization algorithm of prefabricated building components for project management proposed in this paper, the B2C e-commerce return reverse logistics transportation cost optimization algorithm proposed in literature [4], and the litchi cold chain logistics distribution cost model optimization algorithm based on ant colony algorithm proposed in literature [5] are adopted, The logistics transportation time of fabricated building components is compared and analyzed, and the comparison results are shown in Figure 4.

It can be seen from Figure 4 that the logistics transportation cost optimization algorithm of prefabricated building components for project management proposed in this paper consumes less time (about 7 s) than the B2C e-commerce return reverse logistics transportation cost optimization algorithm proposed in document [4] and document [5]. The proposed optimization algorithm of litchi

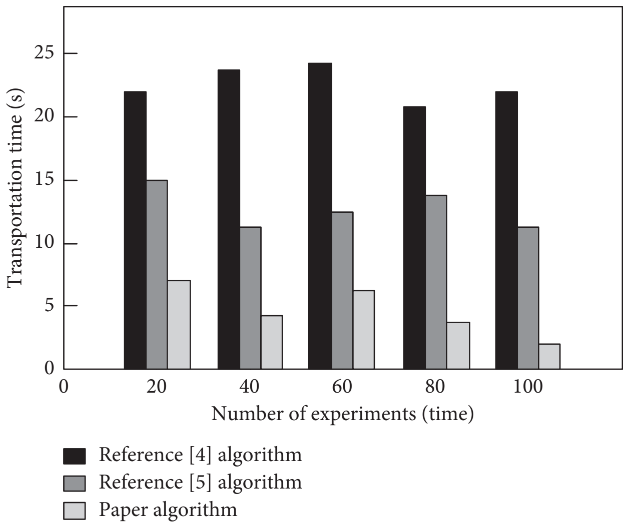

FIGURE 4: Comparison results of logistics transportation time of three different algorithms.

cold chain logistics distribution cost model based on ant colony algorithm consumes less time for logistics transportation of assembled building components.

6. Conclusion

The system, process, and logistics under the prefabricated construction project management mode are different from those under the traditional mode. The construction process is simplified, the on-site operation time is greatly shortened, and the cost optimization space is transferred to production and transportation, while the cost optimization space of raw materials is limited. PC components are the main products of prefabricated construction. Their transportation cost has become the largest space for cost optimization of assembly enterprises. Although the country has been advocating construction industrialization, the extensive model left over from the early stage of reform and development has not been significantly improved. The logistics cost control of the project needs to be optimized both systematically and technically. Based on the principle of logistics cost management, this paper uses the system optimization method in the field of logistics to optimize the transportation cost. The purpose is to reduce the strategic cost, operation cost, and activity cost of transportation; improve the level of industrialization; and remove obstacles for the development of assembly enterprises. At the same time, this study is conducive to the interdisciplinary intersection of logistics management and construction engineering management and clarifies the shortcomings of the construction industry model compared with the industrialization model. The industrial production scheduling optimization theory is combined with the practice of prefabricated construction engineering to verify its theoretical feasibility. It has certain theoretical significance to provide theoretical reference for the development of architecture to industrialization and lay the foundation for establishing a more perfect theoretical system of PC component transportation.

In this paper, we applied the project oriented management to the research on logistics transportation cost optimization of prefabricated building components. Although some research results have been acquired, due to the restricted exploration level and the absence of in-depth comprehension of model development and solution algorithm, there are still a few deficiencies in this research, which should be additionally improved. Firstly, this paper studied the transportation business between the manufacturer (component factory) and the demander (construction site) of the prefabricated building component, where supply chain transportation cost management was not considered. Considering the common interests of all participants in the prefabricated building component supply chain, including raw material suppliers, the supply chain management of prefabricated building components will be a more practical research. Secondly, the transport vehicles under study had the same model and load, and the demand of each construction site was known. In reality, the vehicles equipped by each prefabricated building component factory might be of multiple models, and the load might also be different to meet different demand. The specifications and requirements for PC components might change dynamically on the construction site due to resource constraints such as changes in manpower, machinery, and traffic conditions and the influence of uncertain factors. The breadth and depth of research need to be further expanded and studied. Thirdly, in the aspect of algorithm improvement, because I am still in the primary stage of mastering the artificial fish swarm algorithm, I slightly improve the field of vision and step size, so that the convergence speed and accuracy of the algorithm have been strengthened. At present, the rapid development of intelligent optimization algorithms such as fish swarm algorithm, tabu search algorithm, genetic algorithm, ant colony algorithm, and particle swarm optimization algorithm needs further research and exploration combining these intelligent algorithms. Moreover, the loading optimization was not fine enough. From the perspective of independent transportation, the transportation cost per unit distance was not a strict linear change. The vehicle fuel consumption after component unloading will fluctuate compared with that before unloading, and the loading link of transportation cost can be further refined. Finally, for the transportation optimization of single vehicle type and single transportation center, more complex multiple vehicle type and multiple center problems may appear in practical engineering. The specific optimization feasibility needs to be analyzed, and the upper and lower bound optimization of scheduling problem need to be 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 declares that he has no conflicts of interest.

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