Research on the Optimization Method of Regional Logistics Distribution Integration Based on Intelligent Information Processing

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Abstract. At present, the integration method of logistics distribution does not exchange regional logistics distribution information, the related logistics distribution information is not timely understood, and the integration effect of regional logistics distribution is poor, resulting in long distribution time, high distribution cost and small distribution scope. Therefore, the intelligent information processing technology is introduced to optimize the regional logistics distribution integration method. This paper established a regional logistics distribution integration mechanism which is able to process logistics distribution integration information through hierarchical authorization, transform the business data between the upstream and downstream enterprises in the supply chain of the regional logistics center and integrate vehicle resources and human resources to optimize regional logistics distribution based on intelligent information processing. Taking the distribution time, distribution cost and distribution distance as experimental indicators, the experiment is carried out. The results show that the logistics distribution time, cost and distance of the proposed integrated optimization method are better than those of the traditional methods.

1. Introduction
The logistics supply enterprises are small in scale, and their transportation and storage capabilities are relatively weak, and they cannot meet market demands. Therefore, from the perspective of utilization of regional logistics and distribution resources, it is of great practical significance for the development of the transportation industry to integrate logistics distribution in China, optimize resource allocation, reduce duplication of construction, and save expenses. The basic concept of "logistics and distribution integration" refers to the integration of logistics and distribution resources from decentralized to organic and unified item distribution. In terms of customers, it mainly includes the effective integration of logistics operations such as the flow of goods, transportation and warehousing, sales, supply and supply chain. In terms of logistics companies, it includes a high concentration of transportation, warehousing, and comprehensive services, as well as the integration of logistics information among many logistics companies. At present, more applications are based on the unified logistics distribution integration method of object identification. This method is mainly aimed at identifying business applications in the Internet of Things. The information contained in the object identification can be obtained from the classification, which can directly make the objective physical object situation response. Although the integration speed is relatively fast, the content of integration is not comprehensive enough. The logistics distribution time after integration is longer and the cost is higher, which can no longer meet the needs of logistics distribution integration.
Therefore, a regional logistics distribution optimization method based on intelligent information processing is proposed. Intelligent information processing is a processing method that simulates the information processing behaviour of other organisms in nature, and can deal with uncertain systems and uncertain phenomena. It has been widely used in complex system modelling, system analysis, system control, etc. Now it is applied to the integrated optimization of regional logistics and distribution. Experimental results show that the integrated optimization method of regional logistics distribution based on intelligent information processing designed in this paper is superior to the traditional integrated optimization method of regional logistics distribution based on unified object identification, which can effectively reduce logistics distribution costs, reduce manpower and material resources Cost, improve the logistics efficiency of logistics.

2. Establishment of regional logistics and distribution integration mechanism
Before integrating regional logistics and distribution, establish a regional logistics and distribution integration mechanism [1]. The logistics distribution integration mechanism established this time includes two methods. One is that each logistics nodal area A and nodal area B have their own logistics distribution resource pool [2]. After integration, both Area A and B disappear, forming a new region C. If you want to obtain logistics and distribution resources, you can obtain it directly from area C.

As shown in Figure 1, the second way is that nodal area A and region B are mergers, and the two areas conduct logistics and distribution integration on an equal and voluntary basis. After integration, Area A disappears and Area B still exists. The logistics distribution resources of Area A belong to Area B. Following the changes in the distribution market, the logistics distribution resource pool is in a dynamic change, and other regional resources can be continuously merged to meet market demand.

![Figure 1. Schematic diagram of regional logistics distribution integration mechanism No.2](image)

In this way, the logistics distribution information can be combined into a dynamic logistics network structure. If the market changes and consumer demand changes, the structure will also change accordingly.

3. Regional logistics information exchange
According to the regional logistics distribution integration mechanism established above, the regional logistics distribution information exchange [3]. In the process of regional logistics and distribution information exchange, due to the existence of certain competitive relationships between some companies with the same or similar business between regions, or the existence of confidential information in some integrated information [4]. Therefore, in order to ensure the scientific integration of logistics and distribution, and to ensure the safety of information, information of regional logistics and distribution is exchanged in the form of hierarchical authorization. The logistics distribution integration information is divided into first-level information, second-level information and third-level information. When exchanging information, according to different levels of information [5], different permissions are granted to regional logistics. The main forms are shown in the following table 1:
Table 1. Logistics distribution information classification and authority

| Information level | Use permission                                    | Authorization |
|-------------------|--------------------------------------------------|---------------|
| Level 1           | Integration information can be obtained at all areas. | No need       |
| Level 2           | Only allow common areas to get integration information | Need          |
| Level 3           | Only allow key areas to get integration information | Need          |

At the same time, business data conversion and exchange between upstream and downstream enterprises in the supply chain of the regional logistics center also need to be carried out [6]. The main means of exchange include warehousing, transportation, agency and transaction of information in the logistics distribution center. The data conversion and communication of each regional logistics distribution center can be realized according to the above-mentioned exchange means. The relevant data exchange mechanism for regional logistics distribution [7] is shown below:

Figure 2. Data exchange mechanism

As shown in the Figure 2, the data information of each regional system will be shared in the switch center. In the information exchange, the main information exchanged is mainly the cargo information, which mainly includes the cargo name, the brand name of the cargo, the owner, the cargo coding information, the cargo category, the cargo specifications, the functional description and other information. In the process of data exchange, this part of content is taken as the key exchange content and stored, and intelligent information technology [8] is used to provide dynamic cargo information [9], which mainly includes real-time location of the cargo, cargo description connection [10], cargo transportation Routes, cargo transportation means, quality information, exception handling costs, storage and entry [11], etc.

4. Regional logistics and distribution integration

The purpose of regional logistics and distribution integration is to reconfigure logistics talents, logistics equipment, logistics funds, logistics information and logistics technology among regions. The integration of regional logistics distribution can be carried out on the basis of the establishment of the above regional logistics distribution integration mechanism and regional logistics distribution information exchange [12]. In order to make the regional logistics distribution integration process more coherent, increase the regional logistics application capacity and market competitiveness, intelligent information processing technology is used to organically combine logistics distribution information with distribution center information. Clarify the functions and advantages of each logistics resource in the regional logistics resources, and form a unified and coordinated logistics resource library [13]. Integrate and classify distribution tasks in real time, find distribution resources that meet distribution needs through logistics distribution tasks, and select distribution solutions. Improve the relationship between upstream and downstream supply chains in regional logistics [14], integrate and optimize the information flow, logistics, and capital flow in the supply chain to ensure the number of
goods delivered, and ensure the correct delivery time and correct delivery location. The table 2 shows
the integrated content:

| Resource management process | Distribution service process | Distribution operation process |
|-----------------------------|------------------------------|------------------------------|
| Planning                    | Demand Analysis              | Take Order                   |
| Resource Organization       | Design                       | Stock                        |
| Resource coordination       | Operation                    | Transportation               |
| Resource control            | Management                   | Consulting                   |

In addition to the above integration of logistics and distribution information, this design will focus
on the integration of vehicle resources and human resources. The specific integration content is shown
below.

4.1 Vehicle resource integration
In logistics and distribution integration, vehicle resources are one of the important integration contents,
which are directly related to the distribution cost and delivery time, so as to focus on integration of
vehicle resources. Vehicle resource integration needs to make the following variable assumptions,
assuming that there are distribution vehicles in the regional distribution centre, and the number of
vehicles required for transportation is less than the number of available vehicles, which is determined
by the number of regional customers, the number of distributions and the vehicle loading capacity.[15]
In the process of vehicle integration, it is necessary to ensure that the ratio of the number of logistics
resources supplied to the number of demands is proportional to this, so as to ensure the normal
operation of the distribution, so it is necessary to determine the demand of the distribution centre for
vehicles [16], the relation formula is:

\[ M = A(k - o) \]  \hspace{1cm} (1)

In formula (1), \( M \) is the demand for logistics distribution vehicles, \( k \) is the number of vehicles
that jointly perform distribution operations, \( A \) is the number of vehicles available for use, and \( o \) is
the remaining vehicles.

Through the above formula calculation, the number of distribution vehicles for this logistics
distribution demand can be estimated. On this basis, the integration of regional logistics distribution
vehicle resources, the calculation formula is:

\[ Q = (P - e) * k_y \]  \hspace{1cm} (2)

In formula (2), \( Q \) is the maximum number of distribution vehicles required in the region, \( P \)
represents the regional logistics distribution fixed vehicle, \( e \) represents the regional logistics
distribution variable vehicle, and \( k_y \) represents the vehicle required for the logistics distribution cargo

According to the above calculations, the integration of vehicles is completed, thereby reducing
vehicle dispatch batches and avoiding the surplus or shortage of resources caused by the disconnection
of vehicle resource supply and demand.

4.2 Human resources integration
In the logistics and distribution process, assembly operations, coordinated scheduling operations, and
transportation operations at all links require the support of staff, so the integration of human resources
is necessary.[17] In the integration, it is necessary to determine the number of people performing the
assembly operation and thus the number of people required in the area. The formula is:

\[ B = D / S (U - a) \]  \hspace{1cm} (3)
In formula (3), \( B \) is the number of people required for the assembly operation, \( D \) represents the efficiency of the assembly operator, \( U \) represents the number of assembled products, and \( S \) represents the maximum amount of work that the assembly personnel can complete when the dispatching vehicle \( a \) is executed.

It can be seen from the above formula that the integration of manpower is determined by the number of dispatch vehicles required by each batch and the work efficiency of manpower \([18]\), in order to estimate the amount of manpower resources required in the region \([19]\). On this basis, the expression of human resources integration is:

\[
K = X(C) + h(x)
\]  

(4)

In formula (4), \( K \) represents the number of people in the region after integration, \( X \) represents the number of people in the regional logistics distribution, \( C \) represents the number of people required for joint assembly operations, and \( h \) represents the number of people required for collaborative scheduling operation \( x \).

Through the above calculations, the integration of human resources is completed to avoid the waste of human resources \([20]\), and the integration of regional logistics distribution based on intelligent information processing methods is completed.

5. Experimental comparison

Taking the regional logistics distribution centre of a city as an experimental object, the traditional regional logistics distribution integration optimization method is compared with the designed regional logistics distribution integration optimization method based on intelligent information processing, and the integration effects of the two methods are compared.

5.1 Experiment data source

There are 15 delivery stations in a certain area of the city. Each delivery station has about 15 people, and each delivery station has about 50 vehicles. There are currently three problems in the logistics distribution of this place, as shown in the following table 3:

| No. | Content                | Detailed information                                                                 |
|-----|------------------------|---------------------------------------------------------------------------------------|
| 1   | Limited delivery range | At a growing stage, limited by the number of distribution stations, the service radius is small |
| 2   | High distribution cost | The route and vehicle load are not clear                                              |
| 3   | Long delivery time     | There are many delivery links and long waiting time                                    |

Table 3. Problems in logistics distribution in the experimental area

Aiming at the problems of logistics distribution in the experimental area, the traditional method and the method designed this time were used to integrate the logistics distribution in the area, and the distribution time, distribution cost and distribution situation were used as comparison content.

In order to save experimental time, a total of 10 delivery items were designed, of which the first item to be distributed was the closest to the distribution point, 600 m, the distribution distance was gradually increasing, and the distance to the 10th item to be distributed was 9 km. Compare the logistics distribution situation after integration respectively.

Data collection is realized through the Shenjianshou cloud platform, which is fully automated and does not require manual participation. Data collection, data analysis and processing can be performed directly, and the output results are reflected in a tabular form.
5.2. Comparison of delivery status
The object identification unified logistics distribution integration method, block chain logistics distribution integration method and the distribution after the proposed integration method are shown in the following table 4:

| Distribution point | Object identification distribution integration method | Block chain logistics distribution integration method | Proposed method |
|--------------------|-------------------------------------------------------|-----------------------------------------------------|-----------------|
| 1                  | Deliverable                                           | Deliverable                                         | Deliverable     |
| 2                  | Deliverable                                           | Deliverable                                         | Deliverable     |
| 3                  | Deliverable                                           | Deliverable                                         | Deliverable     |
| 4                  | Deliverable                                           | Deliverable                                         | Deliverable     |
| 5                  | Deliverable                                           | Deliverable                                         | Deliverable     |
| 6                  | Non-deliverable                                       | Deliverable                                         | Deliverable     |
| 7                  | Non-deliverable                                       | Non-deliverable                                     | Deliverable     |
| 8                  | Non-deliverable                                       | Non-deliverable                                     | Deliverable     |
| 9                  | Non-deliverable                                       | Non-deliverable                                     | Deliverable     |
| 10                 | Non-deliverable                                       | Non-deliverable                                     | Deliverable     |

It can be seen from the above table that the object identification unified logistics distribution integration method and the block chain logistics distribution integration method can deliver goods when the distance is close, but as the distance increases, the two traditional methods cannot deliver goods. And the proposed distribution integration method can deliver goods at short distances and long distances, indicating that the integration method fully integrates logistics information, and adds service distribution stations, thereby increasing the distribution distance.

5.3 Comparison of delivery time
The traditional method and the regional logistics distribution integration method based on intelligent information processing designed this time are as follows in table 5:

| Distribution point | Traditional method (distribution time / min) | Proposed method (distribution time / min) |
|--------------------|-----------------------------------------------|------------------------------------------|
| 1                  | 5                                             | 2                                        |
| 2                  | 9                                             | 3                                        |
| 3                  | 12                                            | 5                                        |
| 4                  | 15                                            | 7                                        |
| 5                  | 19                                            | 9                                        |
| 6                  | 25                                            | 12                                       |
| 7                  | -                                             | 12                                       |
| 8                  | -                                             | 12                                       |
| 9                  | -                                             | 14                                       |
| 10                 | -                                             | 20                                       |

From the above table, it can be seen intuitively that the logistics delivery time after the integration of the traditional integration method is longer than the delivery time of the method designed this time. When the delivery distance is close, the difference between the delivery time of the two methods is small, but with the increase of the delivery distance, the delivery time of the traditional method is
more and more, which is much different from the delivery time of this design method. When the distance increases, the traditional method can no longer deliver.

5.4 Comparison of distribution cost
Comparing the unified logistics distribution integration method of object identification, the logistics distribution integration method of block chain and the distribution cost after the proposed integration method, the results are shown in the following table 6:

| Distribution point | Object identification distribution integration method (cost/yuan) | Block chain logistics distribution integration method (cost/yuan) | Proposed method (cost/yuan) |
|--------------------|---------------------------------------------------------------|---------------------------------------------------------------|----------------------------|
| 1                  | 5                                                             | 7                                                             | 2                          |
| 2                  | 7                                                             | 9                                                             | 4                          |
| 3                  | 9                                                             | 11                                                            | 4.5                        |
| 4                  | 10                                                            | 13                                                            | 5                          |
| 5                  | 15                                                            | 14                                                            | 5.5                        |
| 6                  | 16                                                            | 18                                                            | 6                          |
| 7                  | -                                                             | 22                                                            | 6.5                        |
| 8                  | -                                                             | -                                                             | 7                          |
| 9                  | -                                                             | -                                                             | 7                          |
| 10                 | -                                                             | -                                                             | 9                          |

As can be seen from the table above, the logistics distribution centre after the integration of the design method, the distribution cost of the object identification unified logistics distribution integration method and the block chain logistics distribution integration method is significantly higher than the designed method. For distribution point 1, the object identification unified logistics distribution integration method delivery cost is 5 yuan, the block chain logistics distribution integration delivery cost is 7 yuan, and the designed method logistics distribution integration delivery cost is only 2 yuan. It can be seen that the distribution cost of the proposed method is the lowest.

In summary, the proposed integrated optimization method of regional logistics distribution based on intelligent information processing is superior to the traditional method in distribution distance, distribution time and distribution cost. This is because the method designed this time can fully integrate the human resources, vehicle resources and related logistics information of logistics distribution, and establish a detailed cargo description table, which can be pre-judged before logistics distribution. Therefore, it is proved that this design method is better than the traditional integration method, which not only increases the distribution scope, but also reduces the distribution time and logistics distribution cost, and can be applied to the actual regional logistics distribution integration.

6. Conclusion
The regional logistics distribution integration optimization method based on intelligent information processing in this study has achieved certain results, but the actual logistics distribution integration is more complicated and there are still certain influencing factors. The optimization method of regional logistics distribution needs to be improved, mainly reflected in the following aspects:

First, the method of this research is also proposed under the logistics distribution needs and related national policies. Some issues such as the distribution of benefits to the integrated members, distribution standardization and standardization still need to be resolved; second, the management expenses of logistics distribution. And the specific situation of the management model needs further study; third, there are many studies on integration issues in this study. Due to the different problems of
different logistics centres, this study did not give corresponding countermeasures. In the follow-up research, corresponding countermeasures will be given according to the actual situation of each area; fourth, in the integration of regional logistics and distribution, some resource supply is greater than the predicted resource demand, and the remaining resources can be leased to other enterprises to obtain additional delivery income and indirectly reduce distribution costs. For this part of funds, it is also the next step research content.

Acknowledgement
This research work is based on the support of “2020 Woosong University Academic Research Funding”

References
[1] Zhanping W, Yangwen F, Chenliang Z. Research on Digital Resources Integration Method in the Big Data Era: Model Design and Experimental Analysis——Taking the Logistics Industry as an Example J. Modern Intelligence, 2019, 39 (9): 92-100.
[2] Mengmeng W, Joint optimization of location-path-inventory of perishable supply chain considering carbon emissions J. Journal of Shanghai Maritime University, 2019, 40 (4): 45-51
[3] Haoran H, Kai F, Jianmin F. Decision Analysis of Logistics Distribution Scheme of Fresh Agricultural Products from the Perspective of Error Avoidance J. Mathematics in Practice and Theory, 2019, 49 (3): 108-117.
[4] Xianlong Z, Zuwei L, Review of Research on Logistics Distribution Optimization Problems Based on Electric Vehicles J. Mathematics in Practice and Understanding, 2018, 48 (13): 33-42.
[5] Hongyan W, Xinyan Z, Research on the distribution route of agricultural logistics vehicles under the "Internet" J. Jiangsu Agricultural Sciences, 2019, 47 (17): 233-237.
[6] Xufeng Z, Ruxing W, Zhongyi Z, Agricultural logistics information system model based on blockchain technology J. Jiangsu Agricultural Sciences, 2019, 47 (15): 263-268.
[7] Ligang C, Jie D. Research on RFID investment decision-making based on improved joint procurement and distribution model J. Chinese Management Science, 2018, 26 (5): 86-97
[8] Xiaoke Z, Qizong W. Research on Rural E-commerce Logistics Service Quality Evaluation Based on AHP-Fuzzy Comprehensive Evaluation J. Mathematics in Practice and Theory, 2019, 49 (5): 121-127.
[9] Quqin L, Jinhua W. Analysis of factors affecting warehouse fire accidents based on system dynamics J. Journal of Safety and Environment, 2018, 18 (5): 1767-1773.
[10] Xiangyue D, Xiaoyan Y. Research on the development path of logistics industry in Shanxi cities under the "One Belt and One Road" initiative J. Mathematics in Practice and Understanding, 2019, 49 (7): 270-275.
[11] Xianchong Z, Changshi L, Kaijun L, et al. Time-dependent green vehicle path model and improved ant colony algorithm J. Journal of Management Sciences, 2019, 22 (5): 57-68.
[12] Liucheng S, Yan S. Model and algorithm of vehicle routing problem with order selection J. Transportation System Engineering and Information, 2018, 18 (2): 194-200.
[13] Mingda D, Rongheng L, Hua Z. Workflow bottleneck mining and optimization based on critical path J. Small Microcomputer System, 2019, 40 (7): 1368-1373.
[14] Lili H, Yangkun X. Location allocation and adaptive immune algorithm of multi-cold chain logistics center J. Mathematics in Practice and Theory, 2018, 48 (16): 31-39.
[15] Bei L, Qiang W, Tong X, et al. Analysis of integrated learning methods for neural machine translation J. Journal of Chinese Information Processing, 2019, 33 (3): 42-51.
[16] Yinghua S, Jingjing N, Wei L, et al. Dynamic LAP model of public-private collaboration in emergency logistics during the early post-earthquake period J. Chinese Journal of Safety Science, 2018, 28 (3): 173-178.
[17] Liucheng S, Yan S. Model and algorithm of vehicle routing problem with order selection J. Transportation System Engineering and Information, 2018, 18 (2): 194-200.
[18] Jupeng W, Guohui Z, Huang Bo, et al. Narrow channel path planning based on two-way rapid exploration of random trees *J. Computer Applications*, 2019, 39 (10): 2865-2869.

[19] Chao H, Shengtao L, Yi Z, et al. Mobile robot path planning based on multi-objective locust optimization algorithm *J. Computer Applications*, 2019, 39 (10): 2859-2864.

[20] Shengfei F, Qi L, Wenlie W, et al. Adaptive ant colony algorithm for mobile robot path planning *J. Computer Engineering and Applications*, 2019, 55 (17): 35-43.