Research on The Layout of Express Delivery Outlets in Jinan City

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Abstract: The layout of express delivery outlets is the key content of express delivery network organization. The organizational construction of a regional express network should consider multiple aspects, including the number of outlets, the location of outlets and the size of outlets. The construction level of express delivery outlets is directly related to the success of the future development of joint distribution model. This paper analyzes the factors that affect the number and location of express outlets in Jinan. And this paper obtains the distribution of express outlets in Jinan city by establishing mathematical model.

1. Introduction
Jinan actively promotes urban joint distribution work. First of all, Jinan formulated and issued the 2016 urban joint distribution work plan and carried out various works in strict accordance with the plan. Second, we will actively promote the construction of a public service platform for urban joint distribution. At present, the joint delivery public service platform has been put into operation, it has become the first e-commerce service platform in Shandong province to put into market operation in related fields of "the last 100 meters" of logistics and distribution. Third, the government should actively promote the joint distribution platform operators, express delivery companies, enterprises with retail or service outlets, and intelligent express box operators to participate in the construction of the network of public distribution outlets at the end of the city. And we will guide SF express, China Post and other relevant enterprises to further increase the release scale of smart express boxes, and push smart express boxes into communities, schools and office buildings. Based on the current layout of express delivery outlets in Jinan city, the site selection was optimized based on the joint distribution model. It is of great theoretical significance and application value to study whether the network layout of express enterprises is reasonable
t1).

2. Analysis on the Change of the Number of Express Enterprise Network

2.1. Factors affecting the number of express outlets
The number of outlets is the number of express outlets in the region. At the macro level, The number of outlets in an area. First of all, it should be in line with the overall level of regional economic development and reasonable and good market expectations, in line with the country's current actual productivity level and future economic development expectations; From the meso point of view, to match with the city's large logistics network system, so that the network links to form a perfect express network; From the micro point of view, the transportation infrastructure is perfect, there are certain
supporting services, the organization transportation is convenient, the internal operation space is sufficient and efficient, and the division is clear. At the same time, as far as possible do not set in residential areas to affect the lives of residents, do not increase the pressure of traffic roads\(^2\). On the other hand, the number of population, population density and consumption structure are all important factors that affect the number of express delivery outlets. Express delivery services have developed in response to changes in express demand. At this stage, the larger the population, the greater the population density, The younger the consumption structure, the greater the demand for express delivery, the number of outlets will increase accordingly. In general, a region of express business volume and the number of express outlets should be positively correlated, That is, the larger the volume of express business, the more the number of express outlets. Comparing the changes in the number of express delivery outlets in some enterprises nationwide in 2015 and 2017 and making a summary as shown in figure 1, It can be seen that the number of express delivery outlets with the volume of express delivery business is increasing year by year.

\[\text{Figure 1. Changes in the number of domestic outlets of some express delivery enterprises ,2015-2017}\]

2.2. Integration of courier outlets

The number of outlets is related to the service radius of a region carrying out distribution activities, With the same distribution, The larger the number of outlets in an area means the smaller the radius of service, the larger it is. So, in considering the city's common distribution model as the background of the network layout, After eliminating the competitive factors to achieve network integration, the number of outlets reduced, distribution service radius expanded, It can improve the efficiency of express delivery, This is also the greatest advantage and significance of the common distribution model\(^4\). The integration of express delivery outlets is in line with the future industrial development will be more professional and intensive requirements, And the number of current network increases year by year. The network base of each enterprise distribution service in the same area is large and broken, which is the realistic foundation of our joint distribution network integration.

3. Location of Jinan Express outlets

3.1. Analysis on the Factors of Site Selection of Jinan Express outlets

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\(^2\) No page number indicated.

\(^4\) No page number indicated.
The location of the outlets is where the location of express outlets is set. The specific location of the network first involves the corresponding location and index of the logistics land in the overall urban planning, so reserving sufficient and suitable logistics land in the relevant planning documents will reflect the effective action and basic responsibility of the urban planners. Based on the analysis of each express delivery network in Jinan, the latitude and longitude of 30 outlets are intercepted to optimize, and the new express delivery network is designed, as shown in Table 1; the layout selection of express delivery network in Jinan urban area is shown in figure 2.

| branches | Longitude coordinates | Latitude coordinates |
|----------|----------------------|---------------------|
| 1        | 117.002952           | 36.704616           |
| 2        | 116.981793           | 36.686851           |
| 3        | 117.05054            | 36.711457           |
| 4        | 117.040162           | 36.700607           |
| 5        | 116.992689           | 36.671866           |
| 6        | 116.990374           | 36.692433           |
| 7        | 117.006464           | 36.715461           |
| 8        | 117.059664           | 36.691796           |
| 9        | 117.104008           | 36.69461            |
| 10       | 117.071783           | 36.710435           |
| 11       | 117.081427           | 36.68551            |
| 12       | 117.102243           | 36.662292           |
| 13       | 117.085442           | 36.648683           |
| 14       | 117.061578           | 36.674048           |
| 15       | 117.055228           | 36.653133           |
| 16       | 117.042343           | 36.670399           |
| 17       | 117.041449           | 36.664371           |
| 18       | 117.041449           | 36.664371           |
| 19       | 117.122716           | 36.693041           |
| 20       | 117.139946           | 36.70252            |
| 21       | 117.144714           | 36.694274           |
| 22       | 117.140474           | 36.66806            |
| 23       | 117.006478           | 36.673137           |
| 24       | 117.013528           | 36.666916           |
| 25       | 116.986664           | 36.631363           |
| 26       | 117.010006           | 36.624712           |
| 27       | 116.990349           | 36.658489           |
| 28       | 117.015935           | 36.656473           |
| 29       | 116.965833           | 36.611884           |
| 30       | 116.95597            | 36.684808           |
3.2. Establishment of mathematical models

Use the latitude and longitude values collected above as the coordinate value, so that the coordinates of the j points are \((a_j, b_j), j=1,2,3,\ldots,30\). And using the coordinate value to solve the appearance of dot between the color distance, namely:

\[
c_{kj} = \sqrt{(a_k - a_j)^2 + (b_k - b_j)^2}
\]

Among them \(k \neq j, k,j=1,2,3,\ldots,30\).

Pre-design add 5 dot coordinate value is \((x_i, y_i)\), among them \(i=1,2,3,\ldots,30\). Let the \(g_{ij}\) indicate the distance value of the new i dot, then:

\[
g_{ij} = \sqrt{(x_i - a_j)^2 + (y_i - b_j)^2}
\]

Among them \(i=1,2,3,\ldots,30\).

The \(h_{il}\) indicates the distance between the i node and the l node.

\[
h_{il} = \sqrt{(x_i - x_l)^2 + (y_i - y_l)^2}
\]

Among them \(i,l=1,2,3,4,5\).

At this time the original 30 points and the expected increase in the distance between the 5 points can be expressed. Next, through the above representation to find out the distance from each network to the nearest network, set the \(w_j\) as the existing j network to the other network minimum distance, then:

\[
w_j = \min\{c_{kj} + 100 \times (1 - z_k), g_{ij}\}, k \neq j; k,l = 1,2,\ldots,30
\]

Where the \(z_k\) is a 0-1 variable, \(z_k=0\) indicates that the k dot that currently exists will be removed, and 1 indicates that the k dot that already exists remains.

\[
u_l = \min\{g_{ij} + 100 \times (1 - z_l), h_{il}\}, i \neq l; i,l = 1,2,3,4,5
\]

Let the N of the original 30 nodes be the most appropriate (by making the N equal to an integer less than or equal to 30, through multiple optimization operations contrast to determine the value of the N). The target value of the model is the minimum value of \(d_2-d_1\) if the \(d_1\) is the minimum value of these minimum distances and the \(d_2\) is the maximum value of these distances.
Finally, the serial number of the new network and the corresponding latitude coordinates and the layout of the express delivery network in Jinan City are shown in Table 2 and figure3.

| branches | Longitude coordinates | Latitude coordinates |
|----------|-----------------------|----------------------|
| 1        | 117.002952            | 36.704616            |
| 2        | 116.981793            | 36.686851            |
| 3        | 116.982604            | 36.722806            |
| 4        | 117.05054             | 36.711457            |
| 5        | 117.040162            | 36.700607            |
| 6        | 116.992698            | 36.671866            |
| 7        | 116.990374            | 36.692433            |
| 8        | 117.006464            | 36.715461            |
| 9        | 117.059664            | 36.691796            |
| 10       | 117.104008            | 36.69461             |
| 11       | 117.071783            | 36.710435            |
| 12       | 117.081427            | 36.68551             |
| 13       | 117.102243            | 36.662292            |
| 14       | 117.085442            | 36.648683            |
| 15       | 117.061578            | 36.674048            |
| 16       | 117.055228            | 36.653133            |
| 17       | 117.042343            | 36.670399            |
| 18       | 117.041449            | 36.664371            |
| 19       | 117.122716            | 36.693041            |
| 20       | 117.139946            | 36.70252             |
| 21       | 117.144714            | 36.694274            |
| 22       | 117.140474            | 36.66806             |
| 23       | 117.006478            | 36.673137            |
| 24       | 117.013528            | 36.666916            |
| 25       | 116.986664            | 36.631363            |
| 26       | 117.015006            | 36.624712            |
| 27       | 116.990349            | 36.658489            |
| 28       | 117.015935            | 36.656473            |
| 29       | 116.965833            | 36.611884            |
| 30       | 116.95597             | 36.684808            |
| Add1     | 117.0024              | 36.69121             |
| Add2     | 117.0696              | 36.68551             |
| Add3     | 117.1098              | 36.68187             |
| Add4     | 117.0498              | 36.6378              |
| Add5     | 116.9651              | 36.64916             |

4. Conclusion
 Courier service outlets directly face the end user's location. Most of them belong to densely populated areas of the city, such as schools, residential areas, and commercial areas. The location is more close to the market, the density is large, the number is small, and the land area is small. Through the analysis of the location selection of different levels of courier outlets in Jinan, it is concluded that courier, as an emerging industry, not only has the function of transportation, but also the characteristics of the service industry of non-material production. The nature of its land use actually integrates logistics and storage land. The various characteristics of land for service facilities, and its connection and interaction with other types of land in the city cannot be ignored. What must be considered in the
location selection of the express delivery outlet is the coordination with the surrounding land types, and whether the transportation links from the outlets to the terminals during the shipment or collection process have a good or bad impact on road traffic or the entire city.

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