Localization of Transport and Logistics Centers in the Region

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Abstract. The Far East of Russia is the largest Federal district in Russia. Through its territory pass sections of the state border with the countries of the Asia-Pacific region. Transportation from Siberia and central regions of Russia to Asian countries is carried out through the territory of the Far East. The main partner countries in Asia are the PRC, the Republic of Korea and Japan. The regional transport complex is involved in servicing transportation within the Far East, transportation between regions within Russia, transit, export and import cargo traffic. Creating a system of transport and logistics centers in the region will allow to more effectively organizing the transportation process.

On the basis of data on dynamics of freight traffics in the region and also additional socio-economic indexes (the output, population, a gross regional product, volume of transportations on means of transport, etc.) it is offered to organize the system of the transport and logistics centers in the Far East. The calculations made it possible to identify nine points of efficient placement of logistics centers.

It is proposed to create a three-level system of logistics centers: federal, regional and local. Levels are divided depending on the importance in the overall transport system.

1. Introduction and literature review

There is no single generally accepted definition of a logistics and logistics center at present. Moreover, it is recognized that logistics itself develops and changes its content over time.

There are four main stages of logistics development [1]:

- The first stage - until the 1950s. Logistics operations are fragmentary, logistics sections are not integrated. Logistics included purchase and supply, storage and distribution.
- The second stage - 1950-1970. Comprehensive logistics systems included physical distribution and materials management.
- The third stage - 1980-1990. In this period, modern IT solutions are used like automatic identification, JiT (Just in Time) system, Material Resource Planning system and so on
- The fourth stage - from 1990 to the present. Logistics goes beyond individual companies. The logistics develops basing on information systems, local area networks (LAN), wide area networks (WAN), Internet and Intranet.

In our work, we will understand logistics as the process of planning, implementing, and controlling the efficient, effective flow and storage of goods, services, and related information from the point of departure to the point of consumption in order to meet customer requirements [2].
Under the transport and logistics center will be understood nodal points of modal logistics network. Depending on the time of formation, classification, purpose and strategy “nodal points” would be called: storage center; logistic services center; distribution center; logistics park; logistics hub and so on [3-4].

The specialization of the transport and logistics centers is determined by their main functions. There are logistic centers of various specializations, such as: universal, transport, storage, distribution, transport and distribution, with customs clearance and complex [5].

In the scientific literature, many papers are devoted to the problems of logistics and the development of logistics networks. There are studies of the evolution of theoretical ideas about logistics, highlighting the stages of its development, classifications of functions performed [6-8]. In scientific publications topical issues of logistics at the present stage are considered. The "green logistics" based on ecologically safe technologies of transportation and storage, for example [9].

There are works dedicated to the organization of specific goods logistics like storage and transportation of hazardous materials. It also discusses logistics issues for specific purposes like logistics in the provision of humanitarian assistance [10-11]. A lot of research examines the dynamics of the logistics systems of individual regions, countries and large cities [12-13].

A number of works aimed at finding the best locations for logistics centers in the territory. At the same time, the authors use various methods and models for finding the effective point of the location of the center. Some authors use an approach based on an integrated assessment of territories (rating system) [14]. Others use a two-stage procedure resulting in the most desirable location of the logistics center [15] and a hybrid method of preference order based on similarity with the ideal solution and so on [16-18].

2. Method and data

The formation of transport and logistics centers in the Far East was considered in the works of Russian scientists [19-23]. We will apply multilevel selection to the choice of points of placement of the logistic centers, combining tools of statistical estimates (indexes of concentration) and econometric calculations (selection of factors for placement) in this research.

Description of the main stages of the technique used:

1. The data array about volumes of freight traffics on the settlements of the Far Eastern Federal District is formed. Data of all modes of transport functioning now are used (automobile, railway, water).

2. The total number of transport and logistics centers for the Far East is determined. The calculation is based on the concentration index (Herfindahl-Hirschman).

\[
HHI = \sum_{i} S_i^2
\]

where:

- \(HHI\) – the share of the freight traffic at the municipality \(i\) in the total freight traffic of the Far East (%).

The total number of transport and logistics centers created is assumed to be \(1 / HHI\).

3. Specific areas of logistics centers are determined. For this purpose, ranking of the selected municipalities is carried out according to the specific weight of the cargo traffic. The concentration of freight flows in each municipality is determined and municipalities are selected, whose share is at least 2% of the total. Then, among the selected municipalities, the demand for logistics services is determined. To do this, using the regression analysis are selected factors affecting the volume of traffic.

The selected factors are used to calculate the integral indicator of the attractiveness of the municipality to accommodate the transport and logistics center. The integral index is defined as the weighted average of individual factors. The individual factors are calculated as follows.

\[
tij = \frac{x_{ij}}{x_{max}}
\]

where:

- \(tij\) – the individual assessment of the \(j\)-th municipality by the \(i\)-th factor;
- \(x_{ij}\) – the actual value of the \(i\)-th factor for the \(j\)-th municipality;
- \(x_{max}\) – the largest value of the \(i\)-th factor.

The weights when calculating the integral index are determined according to the coefficient of determination of the corresponding pair regression.
4. The separation of selected locations of transport and logistics centers by levels: federal, regional and local. The division into levels occurs taking into account the indicators of the economic activity of the territory: the volume of processed cargo, population, GRP per capita (Table 1).

Table 1. Criteria for the separation of logistics centers by level.

| The level of transport and logistics center | Population, thousand people | GRP per capita, thousand rubles per person | Volume of freight transportation, million tons |
|--------------------------------------------|----------------------------|--------------------------------------------|----------------------------------------------|
| Federal                                    | > 600                      | > 300                                      | 30                                           |
| Regional                                   | 150-600                    | 200-300                                    | 4-30                                         |
| Local                                      | < 150                      | < 200                                      | < 4                                          |

Source: calculated by the authors.

To carry out calculations using this methodology, an array of data was generated from 170 municipalities of the Far East of Russia (urban districts, municipal districts, etc.). For each municipality, the ROSSTAT’s official information was collected for five years (2013-2017): the volume of cargo turnover by types of transport, the density of roads, the density of railways, the presence of sea and river ports, and the population. For cities, data on industrial production and trade turnover is grouped, for municipal districts - GRP.

3. Results

Based on the generated array of information, a concentration index was calculated. According to calculations, it is proposed to place 9 logistics centers in the Far East.

The municipalities of the Far East were ranked by the volume of traffic and the density of the road network. For the correction, a correction factor was used, estimating the correlation between the traffic volume and the density of the automobile / railway network. The values of the coefficient from 0.9 to 1.1 in increments of 0.02. Of the 170 municipalities of the Far East, 30 were selected with the highest rating.

To determine the locations of the logistics centers, the demand for their services has been estimated. According to the results of the correlation analysis, it was revealed that the greatest relationship is observed between the volume of freight turnover and the volume of shipped own-produced goods, work performed and services on its own (0.75), retail turnover (0.69), wholesale trade (0.62) population size (0.66). Such factors as investments in fixed assets, exports and imports were less significant. These factors were not taken into account in further calculations. Also, trade in a generalized form without division into wholesale and retail was taken further into account.

To assess the impact of each of the selected factors on the volume of freight, paired regression models were built. We have abandoned the use of multiple regression because of the multicollinearity. Regression models obtained are statistically significant (Table 2).

Table 2. Regression models parameters.

| Regression equation | Factor (x_i)         | R   | R^2  | F-criterion | t-statistics |
|---------------------|----------------------|-----|------|-------------|--------------|
| y = 1184 + 9.25x_1  | Population           | 0.66| 0.44 | 16.0        | 4.0          |
| y = 1527 + 57.4x_2  | Trade turnover       | 0.69| 0.48 | 10.0        | 3.17         |
| y = 1334 + 80.68x_3 | Volume of goods manufacturing | 0.75| 0.56 | 14.47       | 3.8          |

Source: calculated by the authors.

The results of the calculation of the integral indicator of the attractiveness of the municipality for the location of the transport and logistics center are as follows: Vladivostok - 0.880; Khabarovsk - 0.825; Komsomol'sk-on-Amur - 0.575; Yakutsk - 0.315; Blagoveschensk - 0.311; Yuzhno-Sakhalinsk - 0.206; Ussuriisk - 0.179; Nakhodka - 0.138; Artem - 0.133.
Next, the resulting locations of transport and logistics centers are distributed by levels in accordance with the previously specified criteria (see Table 1). On the territory of the Far East we offer to form a network of transport and logistics centers in the following structure:

- Federal transport and logistics centers are proposed to be established in the cities of Khabarovsk and Vladivostok.
- Regional transport and logistics centers are proposed to be created in the cities of Yakutsk, Kom-somolsk-on-Amur, Ussuriysk, Nakhodka, Yuzhno-Sakhalinsk.
- Local transport and logistics centers transport and logistics centers are proposed to be created in the cities of Blagoveshchensk and Artem.

4. Conclusion and discussion

The Far East of Russia is a border region. Cargo transportation from Siberia and central regions of Russia to Asian countries: China, the Republic of Korea, and Japan is carried out through its territory. The regional transport complex is involved in the maintenance of export and import cargo flows. Creating a system of logistics centers will allow you to more effectively organize the process of transportation.

According to the study, it is proposed to form a system of transport and logistics centers of three levels. The centers of the federal level will be located in the cities of Khabarovsk and Vladivostok.

The location of transport and logistics centers corresponds with the priorities of the modern state policy for the development of the Far East. An additional positive trend in the development of the logistics system will be given by an increase in cargo traffic in reaching the full capacity of residents of the territories of advanced economic development, a free port and others. This will have a positive effect on the loading of objects of the transport and logistics infrastructure of the region.

5. References

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