THE APPLICATION OF GIS FOR ANALYSIS OF PRECONDITIONS FOR THE DEVELOPMENT OF TRANSPORT CORRIDORS OF THE RUSSIAN ALTAI IN THE CONTEXT OF THE GREAT ALTAI

Tikunov V.S.
Lomonosov Moscow state university, Russia
Rotanova I.N.
Altai state university, Russia
Efremov G.A.
Altai state university, Russia

The concept of the Silk Road Economic Belt represents a new opportunity for international cooperation in the fields of transport, trade, investment and humanitarian relations. The promotion of economic cooperation, primarily based on the creation of an international transport corridor, will significantly increase the business activity of adjacent regions in the service industry, infrastructure industries, as well as in tourism [1].

In order to analyze the conditions for the development of transport networks, GIS was built and various proposed options for the development of transport corridors of the Altai region were considered, in particular, the consideration of Altai as one of the cross-border transport and logistics hubs of Internal Asia (Eastern Central Asia). One of the main tasks was to study the possibility and justification of creating an international transport corridor passing through the territory of the Russian Altai [2].

A GIS covering the border areas of the four States located within the boundaries of the Altai mountain system has been created. According to the applied principles of interdisciplinary, convergence of information, as well as a systematic approach to the development of cartographic models of multilevel mapping of phenomena and objects at the international, national, regional, local levels, the cartographic basis is created at different scales corresponding to the territorial coverage:

- local-regional – 1:1 000 000, 1:2 000 000, 1: 2 500 000, 1:3 000 000;
- inter-regional and macro-regional – 1:4 000 000, 1:5 000 000, 1:8 000 000.

ESRI products (ArcGIS 10.1, 10.3) are selected as the main tools for creating a GIS project in the Altai region. GeoServer is chosen as a web mapping server. Its main advantages include the ability to work on any platforms; support for a large number of raster and vector data formats; support for WMS, WFS, WCS and WFS-T standards; the ability to integrate with Oracle, MySQL, PostgreSQL and other DBMS, as well as with the OpenLayers library; creation of high-quality cartographic result (support for scalable signatures, colorings, export to png, tiff, gif, jpeg formats); completely open free compiled Java code.

A logical model of the unified spatial database of the transborder Altai region is being developed, including a number of local object-oriented and domain-oriented databases (DB), built on the same principles and having the appropriate structure. Local databases are created separately for each of the countries of the Altai region. In addition, a common database, basic cartography, is being created, which contains elements of a cartographic framework, in particular the following layers: geodetic framework, hydrography, communications, human settlements, administrative division, vegetation and soils, land relief and socio-economic objects. It, in turn, also has an internal structure and is divided into two thematic blocks: social-geographical and physical-geographical [3].

Elements of the cartographic framework, with some thematic layers included, constitute a set of basemaps that serve as substrates for displaying thematic information as well as those used in the mapping process. The following maps were adopted as basic maps: Physical map, landscape map, population settlement map, road transport infrastructure Map. Preparation of base maps as a model framework and model linkages, facilitates the process of matching cards in the section or block, and provides a comprehensive series of maps.
The created GIS made it possible to analyze the prerequisites for the development of transport corridors of the Russian Altai in the context of the Great Altai.

Altai is a mountain system located in the Central part of Eurasia, where the borders of four States converge: Russia, Kazakhstan, Mongolia and China, called in the geopolitical context of the Altai region, or Great Altai (Fig. 1).

By the beginning of the 21st century, there was a favorable situation for the development of mutually beneficial cooperation between border regions, and, accordingly, the need to develop transport communications.

The Altai region includes two regions of the Russian Federation: the Altai Krai and the Altai Republic. In Altai Krai there are highways connecting Russia with Mongolia and Kazakhstan, the Central Asian States. Through the Republic of Altai highway connecting Russia with Mongolia, built road to the Republic of Kazakhstan. There is no direct road connection with the people's Republic of China, although the Republic of Altai is directly bordered by Xinjiang Uygur national region (XUAR) of China, the length of the border is a little more than 50 km, passes in the mountainous inaccessible region of Altai.

The length of public roads in the Altai Krai is about 17000 km (including Federal – more than 600 km). According to this indicator, Altai Krai ranks third in Russia and first in the Siberian Federal district. Of the total length of roads: 8,500 km have asphalt pavement; 6,500 - crushed stone; 2,000 km-dirt roads. All district centers are connected with the Barnaul roads with a firm covering.

The basis of the road transport infrastructure of the region are Federal highway P256 (formerly M52) "Chuysky tract" with the entrance to the Barnaul and A322 (formerly A349) Barnaul — Rubcovsk — border of Kazakhstan.

Federal highway "Chuysky trakt": Novosibirsk — Novoaltaisk (access road to Barnaul) — Biysk — Mayma (access road to Gorno-Altaiisk) — the state border with Mongolia passes through the territory of the Novosibirsk region, Altai Krai and the Republic of Altai. The track is part of the Asian route AH4 (Novosibirsk — Biysk — Aranta (Mongolia) — Urumqi — Islamabad — Karachi).
The Federal highway A322 (formerly A349) ("Zmeinogorsky tract") comes from Barnaul in South-Western direction to the border with Kazakhstan, 40 km to the South of Rubtsovsk. It is part of the Asian route AH64 Petropavlovsk-Astana-Pavlodar-Semipalatinsk - Rubtsovsk-Barnaul.

Also in the territory of edge pass highways of regional value Biysk-Novokuznetsk; Biysk-Belokurikha; Aleysk – Rodino – Kulunda — the state border with the Republic of Kazakhstan; Novosibirsk – Kamen-na-Obi — Barnaul, the highway "Altai-Kuzbass" the Main transport corridors of Altai Krai with an exit to the neighboring regions are shown in figure 2.

![Figure 2 - main transport corridors of the Altai territory](image)

According to the program of development of highways of Altai Krai, till 2025 it is planned to increase the capacity of transport due to increase of a share of roads of I and II technical categories at reconstruction, construction of rounds of the cities of Barnaul, Biysk, Rubtsovsk.

In Altai Krai, a system of public-private partnership in the construction of roads is being implemented. On this basis, the construction of the road "Zmeinogorsk - Rubtsovsk - Mikhaylovka - Slavgorod - Karasuk".

Works on construction and reconstruction of the objects having strategic importance and providing an exit to the neighboring States and subjects of the Russian Federation are carried out.

Railway communication in the Russian part of Altai is available only in Altai Krai. Major railway junction is the city of Barnaul. Currently, the railway lines from Barnaul go in five directions: to Novosibirsk, Kemerovo, Biysk and two to Kazakhstan (South and Turkestan-Siberian). More than half of the administrative districts of the region have a railway connection. The air network is developing on the basis of the international airport, operating in Barnaul since 1967, which is the only international airport in the Altai territory and the Altai Republic. Barnaul airport has the ability to take almost all types of aircraft.

Geographic features of the Altai Republic led to the development of two modes of transport: road (90% of all modes of transportation) and aviation. In the Republic of Altai there is no railway and river transport. Road transport and roads play an extremely important role in
the provision of freight and passenger transport and have a huge impact on the socio-economic development of the Altai Republic (Fig. 3).

![Figure 3-Main transport corridors of the Altai Republic.](image)

The network of highways in the Republic of Altai is represented by one Federal and territorial highways. The total length of roads is about 4000 km, of which 600 km are Federal roads R256 (formerly M52) "Chui tract", 3000 km are regional roads, 400 km are local roads.

Of the 3,000 km of roads of regional importance, 80% are paved, the rest are unpaved. Thus roads with improved surface (asphalt) is about 800 km, the length of the transition (gravel) covering 1,500 km In main road I – V of the technical categories.

Federal highway P256 (M-52) "Chuiisky tract" (technical category – II and III) is part of the Asian route AH4 (Novosibirsk – Biysk – Yarantai (Mongolia); Urumqi – Islamabad – Karachi). The total length is 960 km, most of which – 540 km runs through the territory of the Altai Republic. In 2008 we put into operation the highway Gorno-Altaisk – Turochak – Tashtagol with a length of 180 km, the opening of through traffic between the Republic of Altai and Kemerovo region.

The road situation is difficult due to sharply crossed and mountainous terrain, as well as a large number of bridges - 130 pieces per 1000 km of roads.

In 2011, the company completed the reconstruction of the airfield airport Gorno-Altaisk. The airport complex was reconstructed. During the reconstruction, the airport was equipped with one of the most modern complexes of light, radio navigation and meteorological equipment. The airport has introduced the latest system of passenger service and control, baggage handling, improved service infrastructure. It is planned to build a new terminal building for passengers of international airlines.

Under physical and geographical conditions, there is no railway communication in the Republic of Altai. The nearest railway station is in the Altai region, Biysk (100 km from Gorno-Altaisk).
The strategy for the development of railway transport in Russia for the period up to 2030 contains a project for the construction of the railway branch Biysk – Gorno-Altaysk. Construction of the railway is assigned to the main directions of development of transport infrastructure in Altai Krai in the sphere of railway transport till 2020. The aim of the project, which has the status of socially significant, is to provide the region with access to the railway network of the country.

The most promising areas for the formation of transport corridors and key points within the framework of the concept of the "Silk Road Economic Belt" can be:
- development of a network of highways of the international level on the basis of the General directions "Chuysky tract" with an exit to Mongolia and further to China and "Zmeinogorsky tract" with an exit to Kazakhstan and further to China;
- nodal points are seen: Barnaul, Biysk, Rubtsovsk, Zmeinogorsk in Altai Krai; Gorno-Altai, Kosh-Agach, Tashanta, Ust-Kan, Ust-Koksa in Altai Republic;
- development of a network of railway transport from the city of Biysk to Gorno-Altai; key points in Biysk and Gorno-Altai – Mayma.
- development of air transport: granting international status to the airport of Gorno-Altai, reconstruction of the airport of Biysk and a number of airports in administrative regions of Altai Krai and the Republic of Altai.

The greater Altai can become one of the "Integration zones" due to the existing border ties, the passage of traditional trade routes, migration routes and other conditions created under the influence of natural geographical factors. The tourist and recreational potential of the region "Great Altai" creates conditions for the organization of various kinds of rest and improvement, attracts with the remained phenomena of history and culture.

The reported study was funded by RFBR according to the research project № 17-55-53109.

Reference

