



Evaluation of the Novosibirsk-Khovd-Urumqi vertical axis by SWOT analysis and determination of transborder urban clusters to develop along the axis

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Abstract. Mongolia is not only a landlocked country located between China and Russia, but also boasts the shortest route between Asia and Europe. The main bridge connecting any country is the axis of transport infrastructure, and the main economic activities such as tourism, foreign trade, exports and imports are intensified through cities, border crossings, and free economic zones along this axis. The Novosibirsk-Khovd-Urumqi axis is one of the road corridors planned under the Russia-Mongolia-China /3 State/ Economic Corridor Program. It has the potential to serve as a sublink of the Trans-Siberian Transport Corridor in the Russian Federation and as a main corridor of China's Belt and Road Initiative. Consequently, research has been conducted along this axis. Within the framework, a SWOT analysis was conducted in the provinces along the axis, considering indicators such as geopolitical conditions, population changes, agglomeration, livestock development, agriculture development, industry development, transport logistics development, and tourism development. While the fundamental infrastructure of the axis is well established and foreign trade is conducted regularly, the timely resolution of the matter regarding future participation in Eurasian cooperation holds significant importance for the axis's continued development. Although the axis is primarily based on the road network, the significant population growth in the major cities along the axis and the connection of large areas with high population density clearly demonstrate the potential for establishing transborder urban clusters along this axis. Within the context of transborder clusters, the Ulgii-Gorno-Altaysk cluster achieved a score of 0.126, while the Khovd-Urumqi cluster received a notably favourable assessment with a score of 0.164 in the analytical hierarchy compared to other clusters. These two transborder urban clusters, it is highly plausible to support population concentration along the Western Vertical Axis and expedite social and economic development.

Keywords: Transportation vertical axis, SWOT analysis, Transfrontier urban cluster, Novosibirsk-Khovd-Urumqi axis, Regional cooperation.

1 Introduction

Mongolia is not only a landlocked country located between China and Russia, but also boasts the shortest route between Asia and Europe. Therefore, we must develop foreign policies and foster cooperation in political, economic, cultural, and other industries with our two neighbouring countries. International cooperation is essential to provide transit access and the development of an efficient transportation system for landlocked countries [1]. "The Vision 2050", Mongolia's long-term policy states that create the principal conditions for participating in trade and economic cooperation by building a main horizontal axis road connecting the East-West countries and a certain vertical axis road connecting neighbours in the north and south [2].

Mongolia, China, and Russia signed a program to build the Mongolia-Russia-China economic corridor in 2016 to promote regional economic integration, infrastructure connectivity, and steady development of trade and investment [3]. As part of this program, 3 main vertical axes have been offered, and the geostrategic position of the Western region is one of the important regions of transit between Russia and China. Mongolia should not limit this road only to transit revenue and use this infrastructure development to enter the market of China, Russia, and further Eurasia [4]. Furthermore, in 2017, Mongolia joined the Central Asian Regional Economic Cooperation (CAREC), which provides access to East Asia and Russia through our country. The CAREC 4a corridor is set to pass through the western region of Mongolia, while the CAREC 4c corridor will pass through the central region of Mongolia [5]. Furthermore, China intends to exploit the resources and geographical advantages of its central and western provinces, unlocking the potential associated with its cooperation with neighbouring countries and the EU [6]. However, on the Russian side, it is believed that the increase in the load of the Trans-Siberian railway would improve the efficiency of transit transportation on the Russian side, in the case of transporting cargo from China to Europe through Mongolia [7].

According to this, the western vertical axis of the Novosibirsk-Khovd-Urumqi region holds a significant position in the political and economic relations between the three countries and other nations. Therefore, there is a need for detailed research on the western axis and the cities along it to thoroughly examine this aspect.

Researchers have conducted various studies along the vertical axis, including the evaluation of the economic impact of Corridor 4a using the IDE-GSM model [8], as well as assessing the tourism potential of the western economic corridor based on its available resources [9]. Our study is innovative in that it evaluates the situation of the axis through SWOT analysis and links it to urban clusters. The SWOT examination, mainly SWOT, analysed the uses of the present work to achieve the organisation's outdoor opportunities and threat with inner strength and weakness [10]. The SWOT technique is used for current work to investigate the western axis and to take a decision strategy regarding the future of the Novosibirsk-Khovd-Urumqi vertical axis.

Because key strategic cities of regional and local importance serve as starting and ending points of the axis, the axis and cities are inherently interrelated concepts [11]. The main bridge connecting any country is the axis of transport infrastructure, and the main economic activities such as tourism, foreign trade, exports and imports are

intensified through cities, border crossings, and free economic zones along this axis [12].

Nowadays, countries widely use the model of economic corridors and transnational urban clusters to promote foreign cooperation and promote trade economies [13]. Almaty in Kazakhstan and Bishkek in Kyrgyzstan are large examples of transborder urban clusters [14]. The smooth economic functioning of enterprises and commercial establishments in a city cluster depends on the availability of facilities for the movement of goods and services. The greater the number of border crossings, harbours, airports and other transportation or logistics facilities, the greater the viability of CCD [15].

Within the framework of this research, our aim is to analyse the current conditions of the western vertical axis of Novosibirsk-Khovd-Urumqi, evaluating its outdoor opportunities and threats along with its internal strengths and weaknesses through SWOT analysis. Furthermore, the study has examined the potential development of transborder urban clusters along this axis.

2 Methods

2.1 Study area

The research area covers a group of six provinces in three countries. The study incorporates data from 2021 provided by various sources, including the Mongolian Ministry of Road and Transport Development, the Mongolian Customs General Administration, the National Statistics Office, the Federal State Statistics Service and the National Bureau of Statistics of China, which were used in the study (Table 1).

Table 1. Study area.

No	Country	Province
1	Mongolia	Bayan-Ulgii, Khovd
2	Russia	Republic of Altay, Altay Krai, Novosibirsk oblast
3	China	Xinjiang

2.2 SWOT analysis

The application of SWOT analysis, an acronym for Strengths, Weaknesses, Opportunities and Threats (Table 2), is a common approach used to analyse the axes of the transportation infrastructure. We processed statistical data, including population, livestock, transportation, agriculture, and industry, along various administrative units of Russia, Mongolia, and China, for SWOT analysis.

To perform a SWOT analysis, the current state of the western vertical axis in the Novosibirsk-Khovd-Urumchi direction was determined by spatial analysis. Spatial analysis provided an understanding of the negative effects of the axis' weaknesses and threats, as well as the positive effects of strengths and opportunities. On the basis of

these understandings, the conditions for further development of the axis have been identified by comparing strengths and risks, and weaknesses and opportunities, on the other hand.

Table 2. SWOT analysis.

	Positive	Negative
Internal	Strengths	Weaknesses
External	Opportunities	Threats

2.3 Analytic Hierarchy Process

The above criteria and alternatives were evaluated using the AHP approach to select the most appropriate cluster city for the Mongolian context. The method of pairwise comparison of criteria suggested by Saaty (1980) and widely known as the AHP is well suited. This approach allows researchers to determine the weights of the criteria of the same hierarchical level with respect to higher-level criteria or to determine hierarchically unstructured criteria weights. The most appropriate alternative was evaluated in the following steps.

1. Structuring the problem and building the AHP model
2. Collecting data
3. Pairwise comparison of each factor
4. Calculation of the consistency index to rank
optimisation requirement for each risk. The measure of consistency (i.e. consistency index) is determined as a deviation or degree of consistency using the following formula [16].

$$CI = (\lambda_{max} - n) / (n - 1) \quad (1)$$

Where: λ_{max} -maximum eigenvalue

N-number of matrix.

Then, consistency ratio, which is a comparison between consistency index and random consistency index, can be derived as shown below.

$$CR = CI / RI \quad (2)$$

CI-consistency index

RI-random consistency index.

3 Results

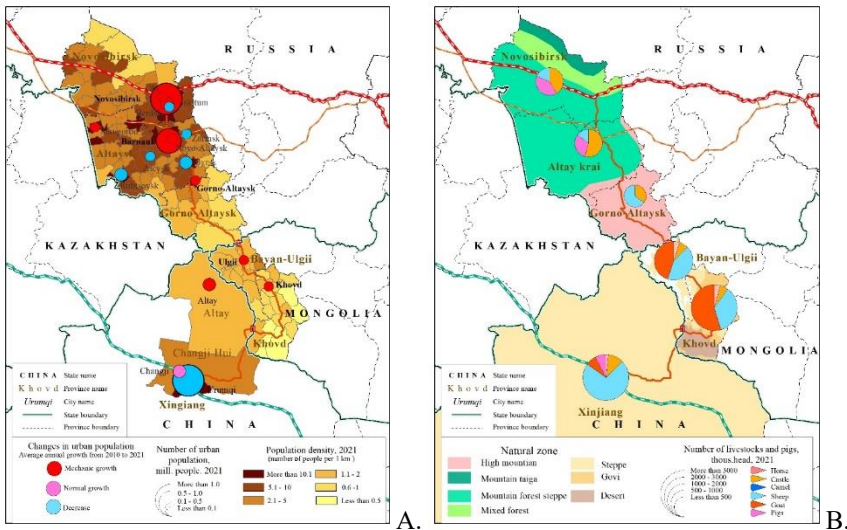
3.1 Spatial analysis of the vertical axes Novosibirsk-Khovd-Urumqi

Mongolia joined the Shanghai Cooperation Organisation in 2004 as an observer country. In addition, in 2017, it became a member of the Central Asia Regional Economic Cooperation. Mongolia is also a member country of the Northeast Asian

Regional Cooperation and the Belt and Road Initiative. Regarding the study area, the western vertical axis is only connected to the Central Asian Regional Economic Cooperation (CAREC) through the CAREC 4a corridor. However, the economic cooperation in the Central Asian region remains one-sided as Russia has not joined in any way. Therefore, for the development of the Novosibirsk-Khovd-Urumqi transport vertical axis, Mongolia needs to become a member of the Shanghai Cooperation Organization and join the Eurasian Economic Union.

In the last decade, the populations of major cities along the axis, such as Novosibirsk, Barnaul and Gorno-Altai (the oblast capitals of Russia), Khovd and Ulgii (the provincial capitals of Mongolia), as well as the Altai cities of the Xinjiang Uygur, experienced growth mechanically or due to the effects of migration. However, the populations of other small cities on the axis experienced a regular decline. Also, the population density is high along the axis, and the highest density is around the beginning and end cities of the axis, which indicates the formation of population concentration and the intensification of urbanisation (Fig. 1a).

Russia's Novosibirsk, Altai Krai, and Altai Republic, which are part of the research area, have relatively few livestock, while the number of livestock is relatively large in China's Xinjiang Uygur Autonomous Region and Khovd and Bayan-Ulgii provinces of Mongolia. However, in terms of the number of pigs, China's Xinjiang Uygur region, as well as Russia's Novosibirsk and Altai Krai regions, have the highest numbers (Fig. 1b). Along this axis, it is possible to export raw materials such as meat, leather, wool, and cashmere from the Khovd and Bayan-Ulgii livestock husbandry provinces in Mongolia and China's Xinjiang Uygur region to the regions of the Russian Federation. On the contrary, Mongolia has the opportunity to import pork from China's Xinjiang Uygur region, as well as Russia's Novosibirsk and Altai Krai regions.



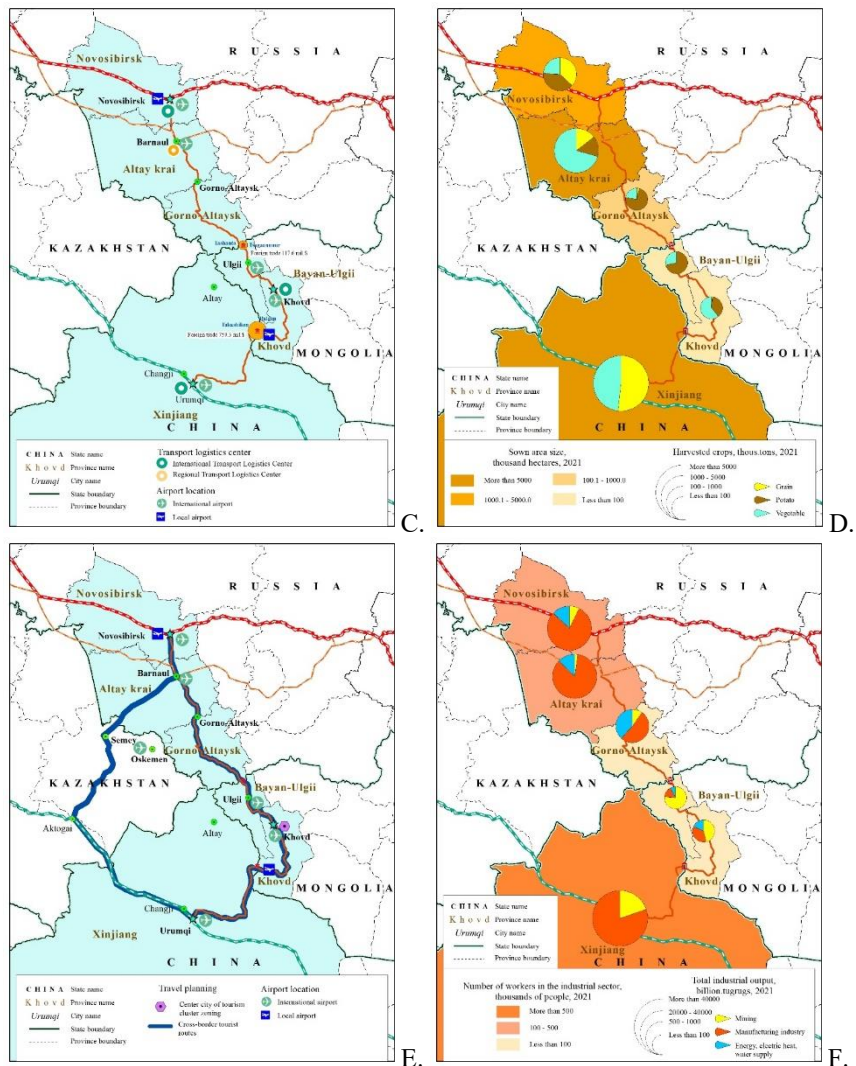


Fig. 1. Socio-economic condition of the western vertical axis along Russia, Mongolia, and China. a. Population change, b. Livestock distribution, c. Transportation logistic centres, d. Crop production, e. Tourism condition, f. Industry.

The Novosibirsk - Khovd - Urumqi axis is based on a road network that was fully paved in 2021. Novosibirsk and Urumqi, as international transport and logistics centres along this axis, will play an important role in the Trans-Siberian Corridor and the Belt and Road Initiative Corridor, as well as in the regional transport network. The Mongolian government plans to develop Khovd as an international transport and logistics centre. Regular transportation and trade activities occur along this axis, and as

of 2022, \$759.3 million was traded at the Bulgan/Takashiken border crossing and \$117.6 million at the Tsagaannuur/Tashanta border crossing (Fig. 1c).

In the study area, agriculture is relatively well developed in China's Xinjiang Uygur Autonomous Region and Russia's Altay Krai, with more than 2 million tons of crops harvested by 2021. However, in Mongolia's Khovd and Bayan-Ulgii provinces, as well as Russia's Altai Republic, agriculture is poorly developed, resulting in a harvest of less than 50,000 tons of crops (Fig. 1d). Given these conditions, it is possible to import grains and vegetables from the Xinjiang Uygur Autonomous Region and Altay Krai, where agriculture is relatively well developed, to the underdeveloped regions of Khovd, Bayan-Ulgii, and the Altai Republic.

There are five international airports and two local airports operating in cities along the axis. The Urumqi and Novosibirsk airports have the highest capacity and rating (4D). The parliament and Mongolian government are planning to develop the airports in Khovd city to a 4C level (Fig. 1e). With the development of this international airport, the city of Khovd will become a tourist centre and hub, providing an opportunity to develop tourist destinations around the border. For example, the tourist route that passes through the three countries surrounding the Great Altai has the full potential to be developed in coordination with the Novosibirsk-Khovd-Urumqi axis.

Different industries have developed in the provinces along the axis. In the Xinjiang Uygur, Novosibirsk, and Altay Krai regions of the study area, the industry, including the processing industry, is relatively well developed. However, in the Khovd and Bayan-Ulgii provinces, industrial development is weak, mainly focussing on the extractive industry sector (Fig. 1f). It can be observed that in the Xinjiang-Uygar, Novosibirsk, and Altai Kray regions, where industries have developed along the axis, there is a potential for exporting raw materials, particularly livestock products, from the Khovd and Bayan-Ulgii provinces. On the contrary, importing processed products from these provinces is also feasible. Furthermore, it is highly possible to foster cooperative and diversified production, coordinated with the industries of Altai, Khovd, and Bayan-Ulgii provinces along the transport infrastructure axis.

Based on the social and economic conditions of the regions along the axis, a SWOT analysis was conducted, and it is shown in detail in the table below.

Table 3. SWOT analysis along the Novosibirsk-Khovd-Urumqi vertical axis.

Strengths	Weaknesses
<ul style="list-style-type: none"> • Connect to a large market with a high population concentration. • Export and import livestock products and raw materials of pet origin. • Export and import agricultural products. • Provide raw materials to regions with developed manufacturing. • Connect with an International Centre for Transport and Logistics. • Fully connected by a road network. 	<ul style="list-style-type: none"> • Only connected by road network • There is no road network that meets international requirements • Weak development of border crossings • Due to the weak industrial development of Mongolia, trade between countries is one-way • Mongolia has not joined the EEU. • Mongolia holds observer status in the SCO. • Due to the distance from Ulaanbaatar and the high cost of transportation, the prices of goods are high.

- Have an international road border crossing.
- Currently engage in regular trading.

Opportunities

- It can be developed based on CAREC.
- The population is growing rapidly in cities along the axis.
- In the case of Russia and China, there will be relatively shorter transportation routes through third countries, leading to a reduction in transportation costs.
- There will be coordination with the Altai Ring Tourism Route.
- Roads in the western region will see significant improvements.
- There will be an intensification of agricultural circulation in border areas.
- There will be smooth economic development at the national level and independent development.
- China is interested in exploiting the resources of the western region in collaboration with Russia.

Threats

- Road construction faces many natural obstacles and costs are high.
- Russia shows less interest.
- Along the axis, the economic development on the Mongolian side is weak and industrialisation low.

3.2 Strengths + Threats:

The axis is currently fully connected to the road network, but the further development of the road poses high construction costs depending on the natural conditions. On the other hand, the fact that Russia is delaying Mongolia's interest in joining the Eurasia Economic Union shows their low interest. However, the fact that the axis has a road network and border crossings of international rank and connects major transport and logistics centres in the region indicates that the axis is beginning to take shape. For Mongolia, it will be possible to export livestock products to regions with developed processing industries. Additionally, it will have the opportunity to import raw materials and industrial products from neighbouring countries (Table 3).

3.3 Weaknesses + Opportunities:

The axial network is solely based on the road network, and non-compliance with international road transport standards creates a weakness. However, with Mongolia joining the Eurasian Economic Union, regional cooperation will become comprehensive, allowing the development of trade and transportation with the CAREC countries, the Russian Federation and European countries. Another important opportunity is the Altai Ring Tourism Corridor, which crosses 3 countries, providing an opportunity for full development. The advancement of this axis will enable the supply of abundant resources from China's western region to Russia. This serves as a fundamental condition to accelerate infrastructure development not only in cities along

the axis but also in Mongolia's western region, thereby supporting the growth of economic sectors (Table 3).

3.4 Transnational Urban Cluster

For the analysis, we opt for 8 Mongolian cities (provincial centres) that are connected to China and Russia. These eight alternatives were assessed using the Analytic Hierarchy Process (AHP), taking into account six key criteria: Population, Urbanisation, Development potential, Energy capacity, Type of border crossing and distance. For the western vertical axis, we identified Khovd and Ulgii, Mongolian cities that satisfy the mentioned criteria. They were then clustered with their closest neighbouring cities, Urumqi, from China and Gorno-Altaysk, from Russia (Fig. 2).

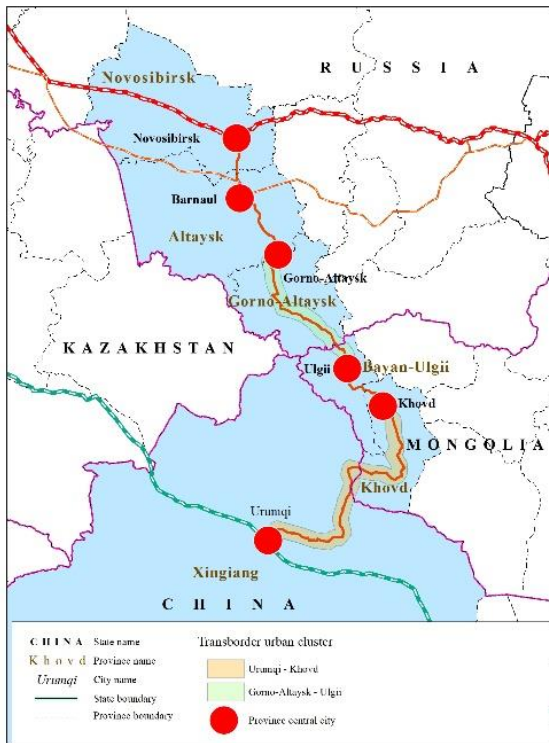


Fig. 2. Transborder urban clusters along the Novosibirsk-Khovd-Urumqi vertical axis

Within the framework of transborder clusters, the Ulgii-Gorno-Altaysk cluster achieved a score of 0.126, while the Khovd-Urumqi cluster obtained a score of 0.164 in the analytical hierarchy. The Khovd-Urumqi transborder urban cluster received a notably favourable assessment compared to other clusters (Table 4). This preference arises from the inherent advantages exhibited by these groups, including shorter distances between their respective cities, the presence of free economic zones, the

availability of international border crossings for transit, and well-maintained road infrastructure. Consequently, the promotion of population concentration along the Western Vertical Axis and the acceleration of social and economic development emerge as highly feasible within the context of transborder urban clusters.

Table 4. Final evaluation using an analytical hierarchical process (AHP).

Criteria	Populat ion	Urbani sation	Development potential	Energy capacity	Border crossing type	Dista nce	GOAL
Choibalsan-Khulunbuir	0.012	0.015	0.004	0.001	0.027	0.023	0.061
Dalanzadgad-Yinchuan	0.003	0.012	0.004	0.018	0.013	0.008	0.057
Sainshand-Hohhot	0.001	0.015	0.026	0.021	0.050	0.032	0.144
Khovd-Urumqi	0.001	0.035	0.026	0.021	0.030	0.032	0.164
Ulgii-Gorno-Altaysk	0.001	0.015	0.026	0.003	0.030	0.032	0.126
Uliastai-Kyzyl	0.006	0.035	0.009	0.027	0.007	0.032	0.117
Choibalsan-Chita	0.003	0.035	0.026	0.038	0.018	0.032	0.151
Sukhbaatar-Ulan-Ude	0.033	0.035	0.026	0.028	0.048	0.032	0.181
Total	0.030	0.095	0.145	0.029	0.202	0.202	1.000

4 Conclusions

A SWOT analysis was carried out in the provinces along the axis, considering indicators such as geopolitical conditions, population changes, agglomeration, livestock development, agriculture development, industry development, transport logistics development and tourism development. The results of the analysis indicate the importance of promptly addressing the issue of joining Eurasia cooperation to facilitate the development of this axis.

In addition, essential infrastructure elements, such as a paved road network and international border crossings, have been established along the axis. This enables regular trade not only with neighbouring countries but also with other nations worldwide, creating a relative advantage for the axis's further development. Furthermore, the provinces located along this axis exhibit diverse industrial and agricultural development, allowing mutually beneficial export and import activities in a complementary manner.

Although the axis is primarily based on the road network, the significant population growth in the major cities along the axis and the connection of large areas with high population density clearly demonstrate the potential for establishing transborder urban clusters along this axis.

In conclusion, the axis has the potential to evolve as a subaxis of the Trans-Siberian transport corridor in Russia and the corridors being developed under China's Belt and Road Initiative. One of the conditions that will expedite the axis's future development is the establishment of a tourism corridor that spans the three countries surrounding Altai.

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