Assessment for the growth prospects in freight turnover of the international transport corridor "north-south" in modern conditions

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Abstract. The global labor division, the production planetary division and consumption markets are increasingly actualizing the issues of a reliable and sustainable organization of trade supply on the basis of the developing international transport corridors (ITCs), which are becoming points of growth not only for national economies, but also for large regions. The dynamics of the global market contribute to the increase in the number and potential of the transport corridors. The North-South transport corridor considered in the research is one of the strategic in ensuring the goods supply in the direction of the India-Iran-Azerbaijan-Russia-European Union. A predictive analysis of the development dynamics of the transport corridor freight turnover is carried out, the drivers and barriers to its development in the context of changes in the geopolitical and economic environment of the markets are determined. Attention is paid to the issues of balanced development of the potential transport corridors according to the formation of nodal transport and logistics centers at the intersections of the meridional and latitudinal corridors. It is shown that the railway transport in the ITC "North-South" in its Russian segment is becoming a key factor in the development and transportation competitiveness in comparison with alternative routes. The issues of the container transportations` competitiveness of the ITC "North-South" in the context of the multimodality growth and the containerized cargo growth are considered. Prospects for the development of ITC "North-South" in the future depends on active organizational solutions in ensuring the planning and regulation supply, excluding international barriers to its development as well as the introduction of digital technologies for monitoring and managing flows.

1 Introduction

In the human history, the transport and trade are the main catalysts for cultural and technological exchange between regions. A key element playing a leading role in the consolidation of the world economies today is the network of the international transport corridors (ITCs). The research novelty of the transport corridors` development in the world

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economy is also confirmed by the infrastructural and unifying factors of its development, the main determinant which is the further division of labor and consumption markets, Figure 1.

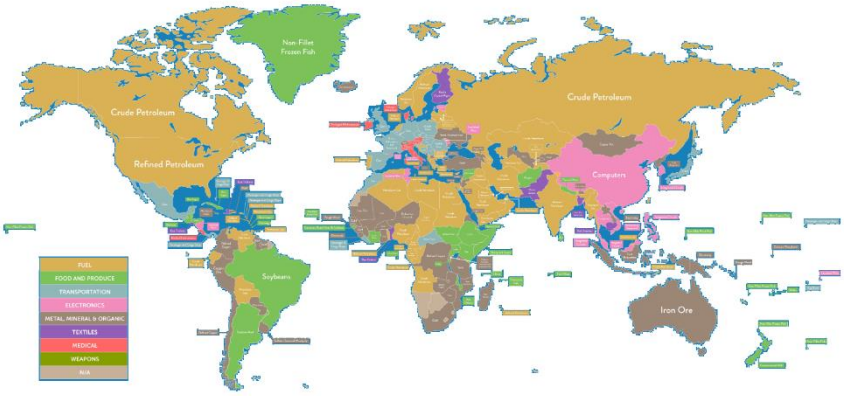

Fig. 1. Markets for goods: specialization of territories and countries: https://www.visualcapitalist.com/wp-content/uploads/2018/02/top-export-every-country-map.html.

According to one of the definitions, “a transport corridor is a set of agreements aimed at changing the speed and direction of the flows` movement in a certain space”, and according to the UN definition, “it is a set of rules governing aspects of transportation and goods transit along a certain route, which are supported by an agreement signed by countries participants ". Among the main functions and tasks of the ITC: ensuring a turnover with low added value of the transport and logistics costs, supporting the globalization of the economy, increasing the competitiveness of the national products economies in the international market.

ITC is the development concentration on the general directions of public transport, the intensification of material, financial and information flows, high quality of service and a variety of services provided, which accelerate firstly the turnover as global capital. Assessing the potential of the ITC for the national economy development of the transit countries, accelerating world trade in the zone of its gravity and eliminating infrastructure and other barriers is an urgent task.

2 Literature review

Studies of the development potential of transport corridors are both a task for the strategic development of the transport systems, individual elements and technologies for organizing transportation, based on forecast estimates, analysis of drivers and development barriers, but also research on the demand and quality of the transport and logistics services based on the infrastructure of the transport corridor. The complexity and multicriteria assessments of the transport corridors` potential, including the North-South transport corridor, are mentioned in the publications.

The works [1-3] are devoted to the issues of a qualitative assessment of the transport corridor state and its elements. An important place in the development of transport corridors is occupied by the technologies` improvement for organizing the transportation process [4-8]. The interaction of enterprises and the national interests of countries in the gravitational zone of the transport corridor is becoming a dominant factor in its development [9-12]. From

the standpoint of the recipients of transport and logistics services, the indicators of their quality, the speed of delivery of goods, price and other parameters determine the choice of the delivery goods route [13]. Particularly, the issues of competition for attracting investments for the infrastructure development of the national transport systems determine competition in the global market of transport and logistics services [14-18]. Accordingly, the methodological approaches to assessing the potential of freight traffic of a transport corridor are priority studies.

3 Materials and Methods

The assessment of the globalization factors of the world economy and their impact on the ITC development presented in Table 1 and shows their mutual dependence.

Table 1. The globalization factors of the world economy and the ITC development.

Development factors of the world economy	ITC development factors
Scientific and technological progress: application of new knowledge, innovations for the production of products with high consumer properties.	Innovative technologies in the development of transport infrastructure, reducing the costs of interaction between agents in supply chains.
Transnationalization of the global economy: expansion of the influence sphere of the transnational companies.	Initiation of the ITC development projects to ensure sustainable flows.
Economic aspects of the global human problems: food supply, ecology, health and others.	The need to reduce the transport and logistics component in the price of goods, high-tech and environmentally friendly technologies for delivering goods to the final consumer, ensuring the population mobility.
Internationalization and globalization of the world economy: national economies going beyond national borders, increasing the interdependence of national economies, long-term (strategic) relations between companies from different countries.	Ensuring the availability of goods and services on a planetary scale.

Among the advantages provided by the ITC to the participating countries are the following:

• Increasing the competitiveness of the national transport system in the transit traffic segment.

• Increasing the throughput of general directions on the routes of the transit cargo traffic due to effective strategic planning of the traffic network congestion.

• Rational use of available infrastructure capacity to meet the needs of the country's economy.

• Embedding the national economy into the system of the world trade with minimal costs with an increase in the stability of interethnic relation.

• Obtaining additional income from the goods transit, the implementation of the export-import potential of the national economy and others.

Nevertheless, there are negative factors in the implementation of the ITC projects in national transport systems, including:

• Increasing in the environmental load on the regions where the ITC is located.

• Displacement of certain types of products from the national economy by reducing the costs of the export-import operations.

• Developing imbalances in territorial development with a country with a predominant economic growth in the regions where the ITC is located.

• Increasing in the economic and political interdependence of the countries participating in the ITC.

The research considers the prospects for the development of the ITC "North-South" in the above aspects as well as in the context of the convergence of the transcontinental markets for production and consumption: Asia - the European Union.

The formation of the ITC "North - South" was initiated by the Russian Federation Ministry of Transport in order to implement the strategic partnership of our country with the countries of the Caspian region. An international agreement on its creation was signed between Russia, Iran and India on September 12, 2000. At present, the Agreement also includes Azerbaijan, Armenia, Belarus, Kazakhstan, Oman, and Syria. ITC "North - South" in its southern part assumes several routes for cargo using rail transport, Figure 2:

Trans-Caspian route uses the Caspian Sea basin and the seaports of Astrakhan, Olya, Makhachkala (Russia) and Bandar-Anzali, Noushehr and Bandar-Amirabad (Iran).

The western corridor branch is using a rail link through the border crossings (BCPs) Samur (Russia) - Yalama (Azerbaijan), with access to the Iranian railway network through the BCP Astara (Azerbaijan) - Astara (Iran).

The eastern corridor branch is a railway connection through Kazakhstan, Uzbekistan and Turkmenistan with access to the Iranian railway network through the Serakhs (Turkmenistan) – Serakhs (Iran) and Akyayla (Turkmenistan) – Inche Burun (Iran) BCPs.

New eastern route (2014) is a railway connection with Aktau (Kazakhstan) – Bereket (Turkmenistan) – Etrek (Turkmenistan) – Inche Burun (Iran) through Kazakhstan and Turkmenistan.

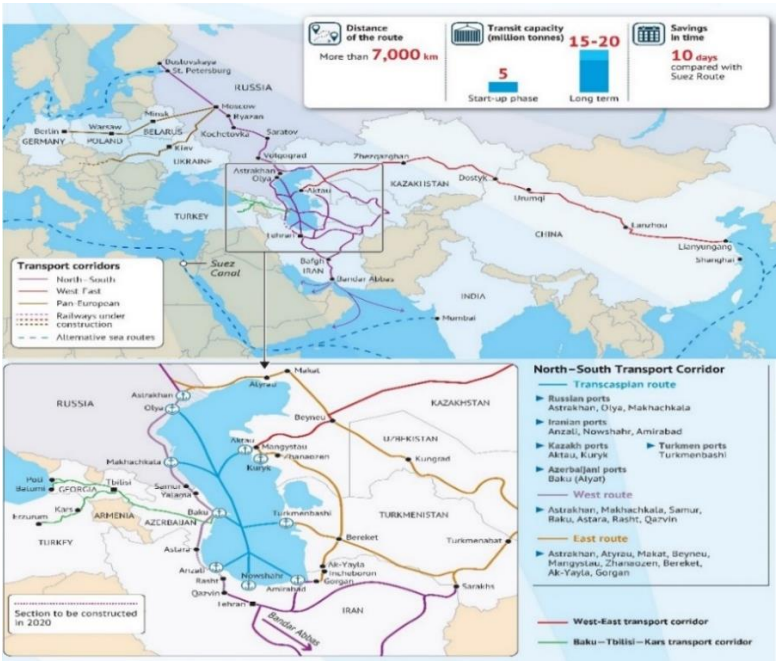

Fig. 2. ITC "North - South": https://valdaiclub.com/multimedia/infographics/international-transport-corridor/

The characteristics of the North-South ITC branches (routes) are quite different, an example with the beginning (end) of the route in central Russia is given in Table 2.

Table 2. Length, delivery time and cost of the cargo transportation by route options Mumbai (India) – Vorsino (Russia) [1].

Route	The length, km	The length of the sections between the st. Astrakhan I and Art. Bender Abbas, km	Delivery time, days	The transportation cost, US$/FEU
№ 1. ITC Trans-Caspian route	6801	2983	25	4750
№ 2. ITC Western branch through Azerbaijan	6752	2934	23	4500
№ 3. ITC Eastern branch through Kazakhstan – Uzbekistan – Turkmenistan	7878	4060	30	6400
№ 4. ITC Eastern branch through Kazakhstan – Turkmenistan	7899	4081	29	5900
№ 5. Sea route to St. Petersburg + auto	14397	–	37	3340
№ 6. Sea route to Novorossiysk + auto	9257	–	29	3170

The main advantage of the North-South ITC western branch over other routes is the shorter transportation distance, which can significantly reduce the delivery time of goods. The new direction will be in demand, because of the interstate container traffic organization. Currently, under international interaction between Russia, Azerbaijan and Iran, the work is underway to form a multimodal route India – Iran - Azerbaijan - Russia, along which it is planned to organize the transportation of goods in containers regularly.

The main important development of the new Rasht - Astara (Iran) - Astara (Azerbaijan) railway line, which is the last missing link of the direct railway route along the western branch of the ITC North - South, will be of great importance for the development of the ITC North-South in the mid-term". Additional advantages of the railway connections of the ITC "North - South" western branch (through Azerbaijan) include:

- a length, the shortest route to the capital of Iran (Tehran) and to the nearest port of the Persian Gulf, Bandar Abbas,
- a number of BCPs, only one country on the transit route – Azerbaijan,
- a double-track electrified section through Makhachkala, Derbent and Baku,
- the developed economy of the regions of the branch,
- almost uninterrupted railway infrastructure, with the exception of the Astara (Azerbaijan) - Resht (Iran) highway under construction.

The prospects for the freight traffic development within the limit of the corridor under consideration will be associated both with the development of the trade and economic relations between the countries participating in the International Agreement on the International North-South Transport Corridor between themselves, and with the attraction of the trade flows in the communication of the European countries with the countries of the Persian Gulf and South Asia, Table 3. The obtained data are not available for some countries for 2020.

With a relative decline in international trade in 2020, relative to 2020, there is an absolute increase in trade with all countries, with the exception of Kuwait and Afghanistan. At the same time, the average annual increase in trade with transit countries is more than 5% per year. The positive increase in the turnover with the countries participating in the agreement is also a positive fact in the forecast of the cargo turnover of the ITC "North-South". Accurate

estimates of the prospective cargo turnover are associated not only with the potential assessment of the gravitational countries of the ITC North-South, but also the transit possibilities of the freight flows corridor from India and the Asia-Pacific countries to Eastern and Western Europe.

Table 3. The foreign trade of the Russian Federation with countries along the routes of the ITC "North-South", million US dollars.

Country	2017 y.		2018 y.		2019 y.		2020 y.	
	Export	Import	Export	Import	Export	Import	Export	Import
Transited countries								
Azerbaijan	1934.8	692.5	1713.5	773.3	2312.5	857.4	2075.4	813.7
Iran	1314.9	392.2	1207.8	533.1	1518.2	584.4	1425.2	795.7
Kazakhstan	12465.4	5016.4	13041.2	5348.9	14327.0	5725.0	14031.0	5034.1
Uzbekistan	2 625.1	1026.6	3 320.8	1 063.0	3908.0	1179.3	4660.1	1222.6
Turkmenistan	343.8	84.5	288.8	155.2	543.3	151.5	649.5	320.6
Countries participating in the ITC North-South Agreement								
Armenia	1247.0	528.8	1341.4	627.0	1692.5	857.2	1657.7	646.8
Belarus	18613.8	12043.4	22015.7	12409.6	20780.7	13086.7	15956.2	12585.1
Oman	112.1	3.3	153.5	2.7	235.9	3.9	-	-
Syria	279.8	3.2	396.8	4.2	300.4	5.2	-	-
The countries of the attraction zone								
Afghanistan	205.3	2.9	118.7	3.9	120.9	5.1	-	-
Kuwait	707.9	0.1	644.5	0.5	552.6	1.4	-	-
UAE	1458.9	171.3	1483.3	205.8	1599.3	235.2	-	-
Qatar	49.8	23.5	42.3	36.4	45.9	36.5	-	-
Saudi Arabia	770.7	144.5	762.7	292.1	1402.9	264.2	-	-
Pakistan	261.0	280.0	418.7	313.6	168.9	372.6	-	-
China	38 918.6	48 055.9	56019.4	52225.4	57322.0	54140.5	49061.0	54908.2

The existing geopolitical and infrastructural constraints in terms of the transcontinental railway communication functioning between the ports of the Baltic and the Persian Gulf do not allow accurate estimates of the cargo turnover. Assessing the self-sufficiency of the ITC "North-South" cargo base, you can give different figures from different sources. The most pessimistic forecasts determine the volumes of over 12-15 million tons per year, Table 4.

Table 4. The forecasted volumes of cargo turnover of the ITC "North-South".

Forecast, mil. tons	The document, title, link
20	Analysis of existing ITCs, existing international transport corridors passing through the territories of the EuroAsEC member states, 2019. URL: https://index1520.com/analytics/analiz-sushchestvuyushchikh-mezhdunarodnykh-transportnykh-koridorov-prokhodyashchikh-cherez-territor/
25	V. V. Putin: The launch of the ITC North-South will allow 2.5 times faster delivery of goods from Europe, 2018. URL: https://1prime.ru/News/20180812/829118358.html
10 (+ 4 mil.pas.)	Iranian President calls for railway completion to port Anzali, 2021; The Iranian Ambassador to Russia met with a representative of the Russian Railways leadership, 2021. URL: http://casp-geo.ru/sostoyalas-vstrecha-posla-irana-v-rossii-s-predstavitelem-rukovodstva-rzhd-rossii/
15-20	A.Karavaev: Transport corridor "North-South": transit realities and prospects for transregional integration, 2019. URL: http://politanalyse.com/2019/06/19/transportnyj-koridor-sever-yug-realii-tranzita-i-perspektivy-transregionalnoj-integracii/

According to the self-sufficiency of the railway line is achieved at the level of more than 10 million tons, it can be concluded that the operation of the ITC North-South is strategically economic and financial.

The development of transcontinental directions for organizing the goods and passengers` flow has both supporters and competitors-opponents. Often, the solution of such large-scale tasks is more in the geopolitical plane than in the geoeconomic or national one. Considering the geopolitical aspects of the ITC development, it follows from the competition with the existing transport corridors in the zone of its gravitation and their influence on its cargo base. ITC "North - South" is quite independent and relatively independent from other corridors. Moreover, its development can contribute to the development of alternative corridors, Table 5.

Table 5. Challenge and "cooperation" of the ITC "North-South" with other transport corridors.

Transport corridor	Advantages	Disadvantages
ITC and "TRACECA" Trans-Caspian	Active position on its development by the EU countries, Central Asia and even China; Ready transport infrastructure; Development of port infrastructure by Azerbaijan and Georgia	Crossing the sea areas of the Caspian and Black seas; A large number of border crossings; Competitiveness of the cargo base in certain directions
Transport corridor "Transsib"	Non-competitive nature of the cargo base with the ITC "North - South"; Possibility of "cooperation" of the meridional and latitudinal corridors at the points of their intersection	Lack of coordination transport and logistics centers at points of intersection with others; Weak development policy coherence
Euro-Asian transport corridor	Steady cargo traffic and checkpoints; Developed checkpoints; Common customs space	Competition with freight traffic passing through Central Asia (from India and Pakistan)
Transport corridor Baku-Tbilisi-Kars	Possibility of changing flow at the point of intersection; Possibility of Turkey's integration into the ITC North-South	Competition with the cargo base of the Central Asian countries with an orientation towards the countries of Eastern Europe

The current state of the ITC North-South can be characterized by the following provisions: the established development axes, active development of the international corridor support programs, investment support from the World Bank, the presence of problems in the infrastructure development for land-based clusters of transport corridors, aggravation of the struggle for attracting investments and geopolitical influence through the implementation of the ITC projects. At the same time, the main logistic factors of organizing streaming processes in the interests of the market and the end user are the guaranteed delivery time, the integral cost of the service, delivery time, safety (reliability, safety). In modern transport and logistics chains, the land transport links are not inferior to sea ones, which makes it possible to give optimistic forecasts for the development of the ITC North-South, which has survived decades of oblivion for geopolitical reasons. The multivariance development and the possibility of connecting the southern and northern seas by a land route with a length of about 2.5 thousand km is one of the main advantages of the development of the ITC North-South.

Other advantages of the transport corridor such as the intersection of two national borders (in the shortest version), strong economies in the corridor gravitational zone, high population density of territories in the corridor of the ITC routes, favorable geographic and climatic conditions, the absence of geopolitical risks of transit countries and a growing number of countries, " Joining the project are catalysts for the development of this project. At the same time, it should be noted that there is a certain lag in the transport and logistics market of the main partner countries of ITC "North-South" (Russian Federation, Azerbaijan, Islamic

Republic of Iran) with a positive trend in their assessments in recent years. The data of the logistics efficiency rating from the World Bank are presented in Figure 3 (Azerbaijan has no rating data in recent years).

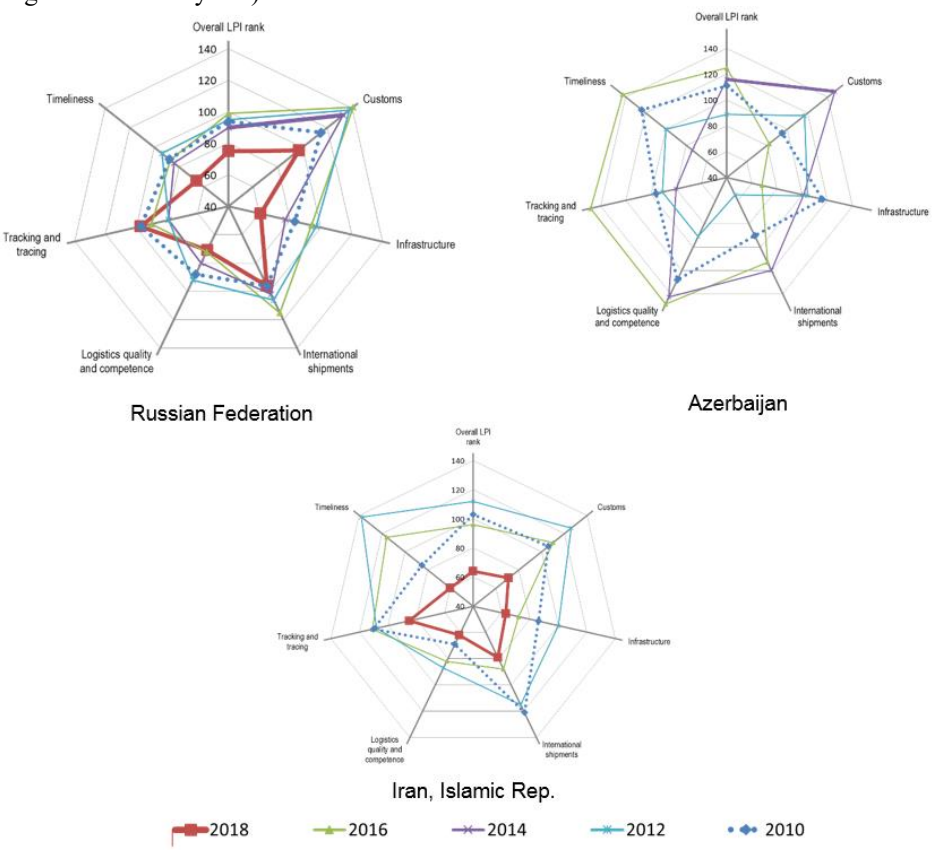

Fig. 3. LPI rating of the ITC "North-South" countries-regions.

The instability, low values, and incompleteness observed in the assessments, in our opinion, are associated with active geopolitical changes in relation to the transit countries of the ITC North-South, economic sanctions and military operations in the corridor gravitational zone.

When determining the attraction zone of the transport corridor, one should proceed from the following theoretical provisions. It is shown on the presented scheme, the point D is the point of the traffic flow origin, which belongs to the competition zone of the transport corridors, and point C is the point of "inclusion" of adjacent traffic flows into the transport corridor AB.

The conditions are necessary for the traffic flows` attraction from point D to the ITC routes AB is as follows.

$$T^{\mathrm{a}}_{DC} + T^{r}_{CB} < T^{\mathrm{a}}_{DB}, M^{a}_{DC} + M^{\mathrm{r}}_{CB} < M^{a}_{DB}, \quad (1)$$

$$T^{a}_{DC} + T^{r}_{CB} > T^{a}_{DB}, M^{a}_{DC} + M^{r}_{CB} < M^{a}_{DB}, \quad (2)$$

$$M^{\mathrm{a}}_{DC} + M^{r}_{CB} > M^{a}_{DB}, T^{a}_{DC} + T^{r}_{CB} < T^{\mathrm{a}}_{DB}. \quad (3)$$

Where T is the goods delivery time, days; M is the cost of the goods transportation, rubles, on the specified route by road («a») or rail («r») transport.

The conditions (2), (3) determine the incomplete dominance of the monomodal transportation over multimodal, at the same time; the freight traffic can be involved in the ITC in terms of other parameters of the transportation organization (regularity, reliability, environmental friendliness, etc.). The problem arises of determining the cargo base with the satisfaction of the main transportation parameters for cargo owners (delivery time, transportation cost), with the involvement of attracting freight flows from adjacent routes, which can be localized in the following subtasks, Figure 4:

- an analysis and calculation of possible schemes for the goods delivery in accordance with the tariff setting for various types of transport,
- a graphic representation and description of the transport corridor's capabilities in a competitive environment,
- a freight traffic distribution of the transport corridor, according to the selected delivery scheme.

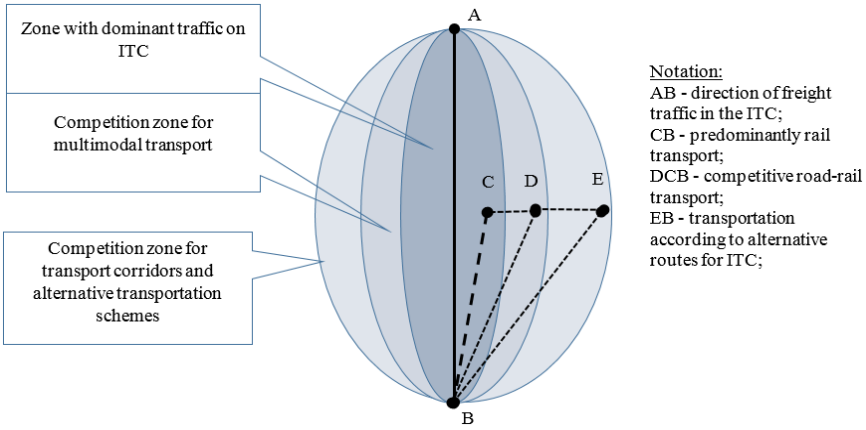

Fig. 4. Scheme of the attraction zones of the transport corridor.

As a result of the calculations, data on the cost of transportation and the goods delivery time by road and rail transport were obtained, Table 6.

The difference in cost between rail and road transport is explained by the ability of the rail transport to transport heavy cargo in bulk at the lowest cost in comparison with road transport, as well as reduced tariffs for container cargo transportation provided by the Russian Railways.

1) The calculations of delivery times for rail transport do not correspond [2], but according to expert estimates, the delivery time will be reduced by at least 2 times, for example, by changing the transportation route: according to the authors' calculations, the shortest distance from Vyborg to Samur is 3,016 km and passes along the axis: Vyborg - St. Petersburg - Bologoye - Moscow - Ryazan - Ryazhsk - Michurinsk - Rtischevo - Saratov - Astrakhan - Kizlyar - Makhachkala - Samur, while, when calculating through AS ETRAN, the route passes along the Vyborg - St. Petersburg - Vologda - Yaroslavl - Orekhovo-Zuevo (Moscow) - Ryazan - Ryazhsk - Michurinsk - Povorino - Verkhniy Baskunchak - Astrakhan - Kizlyar - Makhachkala - Samur and is 3345 km, passby the stressful section of St. Petersburg - Bologoye - Moscow [3].

2) In the absence of the technological and engineering means of increasing the throughput of the St. Petersburg - Bologoye - Moscow railway line for the passage of transit freight trains in order to reduce the delivery time, there is a possibility of using a multimodal cargo delivery

scheme: the containers` centralized delivery to the point of logistics center by road transport and further formation of the constant schedule lines for container trains.

Table 6. Parameters for assessing the attractiveness of the transport corridor.

Transportation hub name	Automobile transport			Railway transport		
	Buslovskaya	Vyborg	Ust-Luga	Buslovskaya	Vyborg	Ust-Luga
Transit transportation cargo cost in a container, USD)*						
Taganrog	3144.7	3101.9	3148.9	682	680	682
Yeisk	3311.4	3268.6	3315.6	685	685	685
Taman	3747.4	3704.6	3751.6	703	700	700
Novorossiysk	3654.7	3612.0	3659.0	697	695	695
Tuapse	3731.7	3688.9	3735.9	705	703	705
Olya	3998.1	3955.4	4002.4	700	700	700
Makhachkala	4273.1	4230.4	4277.4	718	715	715
Samur	4538.1	4495.4	4542.4	725	723	725
Transit delivery cargo time in a container, days						
Taganrog	3	3	3	7	8	8
Yeisk	3	3	3	7	8	8
Taman	3	3	3	8	9	9
Novorossiysk	3	3	3	8	9	9
Tuapse	3	3	3	8	9	9
Olya	3	3	3	8	9	9
Makhachkala	4	4	4	8	9	9
Samur	4	4	4	8	9	9

*Calculation of delivery times for road transport was carried out in accordance with [11], which indicates the mode of work and rest of truck drivers (9-11 hours a day).

4 Discussion

The main problems in the development of transport and logistics infrastructure and its balance of the ITC "North-South", in our opinion, are:

- the presence of infrastructural gaps in the railway communication through the Iran territory,
- the sanctions pressure on the Islamic Republic of Iran, hindering the implementation of railway and other transport projects, as well as the use of the Iranian territory as a transit country,
- an imbalance in the capacity of the corridor sections both in road and rail links,
- the absence of objects of transport and logistics centers for connecting the corridor with latitudinal and other corridors, contributing to the variability of the transportation organization and an increase in the cargo base.

The development of the transport technologies and logistics services as a driver for the development of ITC "North-South" occurs in the following areas:

• Organizational solutions in the field of creating a consolidating cargo base, transport infrastructure (especially rolling stock, containers), management of the transportation process in the form of single operators,

• Creation of digital management centers for the transport corridor, ensuring the elimination of barriers in the organization of document flow, the development of communications between the transportation participants,

• Creation of the financial responsibility centers for the transport infrastructure development, transportation insurance, ensuring the discipline of payments and other issues,

• Creation of an analytical center for monitoring transport and logistics processes of the ITC "North-South", scientific support for its development, the formation of analytical materials in the interests of the project participants.

Some practical solutions contributing to the development of the North-South ITC include:

• Increasing the multimodality of transportation, including through the development of container transportation,

• Development of schemes for increasing the cargo base potential of the transport corridor due to supply (routes) transportation routes with the development of their transport infrastructure,

• Search and implementation schemes for the consolidated development of the ITC "North-South" with latitudinal and other competitive corridors.

5 Conclusion

Modern trends in the economy and geopolitics and their impact on the technology of the international transportation are expressed in the following provisions that are directly related to the ITC "North-South":

1) Digitalization of global economic relations (digital logistics, digital transport, smart logistics) form a new quality in the ITC organization, which is associated with the new (fourth) industrial revolution,

2) Active transition to common platforms in transport technologies (for example, EU countries, Eurasia projects),

3) Unification of commodity and cargo units (pallet, container, piggyback, etc.) gives a new impetus to the online trading system and the associated increase in commodity flows in the ITC,

4) Intensification of developments in the field of cross-platform vehicles for transportation in international traffic,

5) Projects for the integrated development of freight and (or) passenger traffic, increasing the ITC social significance,

6) Integration of educational programs in the field of training for ITC, in the field of international and integrated logistics.

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