

## **The efficient use of international railway transport corridors in Kazakhstan**

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<p>Description</p> <p>The Republic of Kazakhstan has huge benefits related to the presence of international transport corridors lying on its territory. Being the central state of Eurasian continent, it should be actively integrated into the global transport market and become one of the most important transit hub between East and West regions. However, due to the substandard quality of railway infrastructure and logistics, Kazakhstan is not able to efficiently use its transport potential. Therefore, the main objectives were to identify what kind of barriers prevent the efficient use of international transport corridors and what are the possible solutions.</p> <p>To answer these research questions, firstly the analysis of the effectiveness of transport corridors as a component of external transport market was made. Secondly, the current problems existing in transportation field were identified and divided into physical and non-physical barriers. Moreover, the two most crucial physical barriers such as the outdated fleet of rolling stock and the distinction of the railways gauge width were researched. The numerical data were collected from the financial statements and annual reports of transport companies.</p> <p>The results showed, that the use of the international transport corridors for the national economy is highly questionable. Moreover, the most important physical barriers hamper a lot the integration of Kazakhstan into the global transport market. The implementation of solutions were suggested in the theoretical view. In the author's opinion, all these actions will help to approach the fulfillment of the main goal - integration of Kazakhstan into the system of international transport corridors in the effective way.</p>		
Keywords ( <a href="#">subjects</a> ) International transport corridors, railway transportation, East & West interrelations, coefficient of effectiveness, rolling stock, freight wagons		
Miscellaneous		

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## **Abbreviations**

AD – Anno Domini

BC – Before Christ

CIS – Commonwealth of Independent States

ECMT – European Conference of Ministers of Transport

EEA – European Economic Area

EU – European Union

GPS – Global Positioning System

ITC – International Transport Corridor

JSC – Joint Stock Company

KTZ – Kazakhstan Temir Zholy

LLP - Limited Liability Partnership

NSR – New Silk Road

OSJD – Organization for Cooperation of Railways

ROC – Return on Capital

TARM – Trans-Asian Railway Main

TRACECA – Transport Corridor Europe-Caucasus-Asia

UNESCAP – Economic and Social Commission for Asia and the Pacific

# **1 Introduction**

## **1.1 Background**

Being the central state of the Eurasian continent at the junction of large economic regions, as well as various civilizations and cultures, Kazakhstan should be actively integrated into the modern system of global political and economic interrelations. Only with the development of advanced ways of communication, transport, and infrastructure Kazakhstan can become one of the most significant connecting bridges between the West and the East. Economic and geographical features of Kazakhstan (large territory, lack of access to the sea, uneven distribution of settlements and natural resources) make its economy one of the most cargo-intensive in the world, causing high dependence on the transport system. Relatively flat terrain and the presence of vast reserves of natural stone material allow unhindered development of rail transport communications.

Currently, the Republic of Kazakhstan is one of the developing transportation links between Europe and China. Based on this fact, Kazakhstan has huge benefits related to the existence of international railway transport corridors, lying on its territory. However, due to the substandard quality of railway infrastructure and logistics, Kazakhstan is not able to efficiently use the opportunities of these corridors and thereby improve the transit potential of the country, which is one of the main advantages of the Republic in this matter.

Therefore, the current state of Kazakhstan's railway infrastructure is researched and analysed, and the barriers that prevent the use of international passages efficiently are derived. Moreover, based on the analysis the solutions which contribute to the elimination of these obstacles are determined, and implementation processes are described.

## **1.2 Motivation**

Since the beginning of the thesis topic exploration, the boundaries corresponding to the personal preferences of the author in the railway transport and logistics in the

Republic of Kazakhstan were indicated. The decision in favour of writing the thesis on the “Effective use of international transport corridors” was taken after a long search of reliable sources and valuable information, capable of giving comprehensive answers to the task.

Currently, there are serious discussions of this subject within the framework of various strategic programs. Therefore, the desire to write this work is based on contribution to the development of the Republic of Kazakhstan and the author's interest in the field of railway logistics. The author aspires to examine this issue fully and obtains crucial solutions.

### **1.3 Research questions and objectives**

Based on the available information, two main research questions are identified, which determine the whole point of this study:

- What kind of barriers prevent the efficient use of international transport corridors?
- What are the possible solutions to the existing issues?

The answers to these two major questions are given in the Research section.

### **1.4 Research methods**

The study is based on the combined use of two methods of analysis, since this issue requires both the exploration of various documentation, and the use of numerical data.

**Quantitative research** generates data that can be converted to numbers. It collects and analyses only that information that can be measured. Quantitative research focuses more on calculating and classifying features, as well as on constructing statistical models and numbers to explain what is observed. It gives the researcher a clearer picture of what to expect during the study. In quantitative research the investigator performs the function of collecting primary data. Here, the researcher

uses various information gathering strategies such as questionnaires, routine surveys, measurements and other techniques for accumulating numeric or measurable data. The obtained data are often presented in tables containing numbers and statistics. In this type of research, scientists tend to objectively move away from the topic. That is why quantitative research is objective in approach, meaning that it seeks only precise measurements and analysis of target concepts for answering the question. (McLeod, 2017.)

**Qualitative research** produces non-numerical data. It focuses on gathering mainly verbal data, rather than measurements. The collected information is analysed in an interpretive, subjective, impressionistic or even diagnostic manner. The primary goal of this method is to provide a complete, detailed description of the research topic. By nature, it is usually more refined. Qualitative research is ideal for earlier phases of study, and for the last part the quantitative exploration is recommended. Examples of data collection strategies used in this method are individual comprehensive interviews, structured and unstructured interviews, analysis of stories, content or documents, participating surveillance and archival research. The presentation of data in the qualitative study is in the form of words (interviews) and images (video). In it, the numbers are more likely to appear in the form of graphs. This study is primarily subjective in approach, as it seeks to understand human behaviour and the reasons that underlie this behaviour. Scientists tend to subjectively submerge in content in this type of study. (McLeod, 2017.)

Nowadays, there are disputes about which method is better. The reason why there is still no exact answer lies in the fact that any method has pros and cons that vary depending on the topic of the discussion. If the research seeks to answer the question by means of numerical evidence, then the quantitative study must be used. However, if it is required to explain why this is exactly what happened, or why a specific phenomenon takes place, it is necessary to use the qualitative research. Some studies combine both types, allowing them to complement each other. (DeFranzo, 2011.)



## **1.5 Importance of the Study**

As it was mentioned earlier, Kazakhstan, because of its geopolitical position and economic potential, is an active supporter of integration into the international relations system and the participant in global economic processes. Every year this issue becomes more and more urgent and requires the adoption of significant measures to implement it. Despite significant progress in this area and Kazakhstan's accession to various world organizations and spaces, the implementation of all the tasks set also requires priority solutions to problems that impede the further development of Kazakhstan's economy.

The importance of this study is its relevance. Moreover, the existence of such projects is minimal today. Therefore, the sooner the problems of the state are solved, the earlier Kazakhstan will be able to take the leading positions in providing transportation between Asia and Europe. Moreover, every year in the country there are competitions on grant financing of scientific projects, which makes it possible to raise this issue as a priority question.

## **2 Theoretical basis**

### **2.1 Transportation**

Nowadays, the transportation system is considered as an aggregate of all types of communication pathways, vehicles, technical devices and structures on the communication routes that provide the process of moving people and goods of various purposes from one place to another. (Boyce 2003.)

There are many different options to create a characterization of transportation systems. Therefore, the best way is chosen and introduced by the author (see Figure 1). When you think about transportation, it is important to understand the difference between two systems: the movement of travelers and freight movement. Obviously, that these schemes have similarities in the operation methods. However, some crucial differences appear between traveler and freight systems. On the other side, the geographical areas such as urban, intercity and international are considered as

another dimension of transportation systems feature. The third dimension is the difference between ownership of transportation schemes. They can be owned and operated by private, profit-making organizations and public-sector organizations. (Sussman 2000, 7-8.)

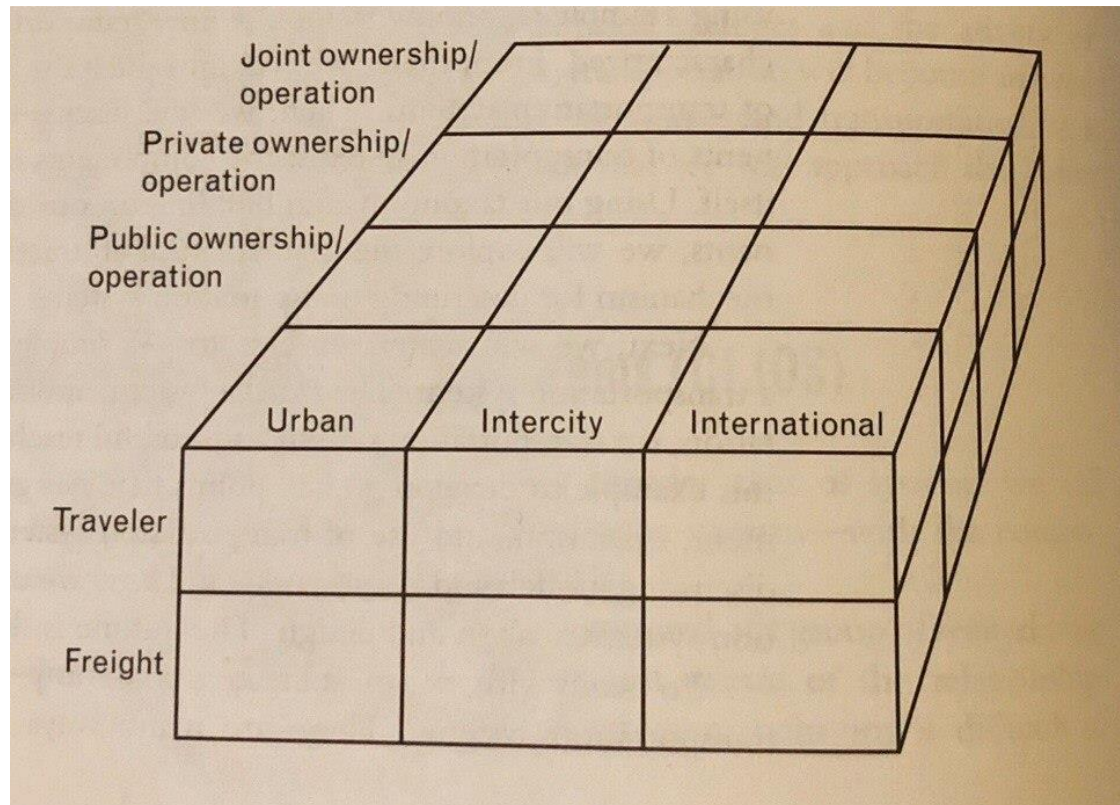


Figure 1. Transportation systems characterization (adapted from Sussman 2000, 8)

### 2.1.1 Basic components of transportation system

In addition to providing a general concept of the transportation system, it is essential to explain the main elements of it.

The first one is **infrastructure**, which is the constant part of transportation scheme. It consists of three categories: guideways, terminals, and stations. Guideways can be divided into two subgroups: highways (general purpose-guideways) and railroads

(special-purpose guideways). Besides, it is possible to consider that air corridors and underground pipelines are also guideways. (Sussman 2000, 11.)

The next section of infrastructure is terminals. A terminal can be determined as a place of gathering or dissipation of passengers and cargo. Firstly, passengers go to bus terminals and airports to be "collected" in busloads or planeloads. After that, they are "scattered" when reaching their destination. Before shipment, cargo must be funded at a port or a rail yard. Also, terminals can perform storage functions. Moreover, terminals are used as intermodal interchange points, which means a variety of different transport modes. (Rodrigue, Comtois, & Slack 2006, 425.)

Another part of the infrastructure is stations. These are the places (for example subway system) where people can enter or exit. (Sussman 2000, 12.)

The second component of the transportation system is **vehicles**. Depending on the environment, there are different categories of transport, in which it performs its functions:

- air (airplanes, helicopters, balloons, airships);
- ground, including underground (metro);
- rail (railway, tram, locomotive);
- trackless (cars, motorcycles, buses, trolleybuses);
- water (ships, boats, boats, yachts), including underwater (submarines);
- space (rockets, satellites).

Each mode of transport has its weight, durability, crashworthiness, efficiency and method for propulsion (for example, railway freight wagons, that cannot move by themselves). These factors should be contemplated for selection of the appropriate transport vehicle in different working fields. (Boyce 2003.)

The third element is **power systems**, meaning different types of engines and motors that actuate vehicles. There are many examples of power methods such as internal combustion, diesel engines, regenerative braking (accumulated energy from braking process), human, animal, and wind power (Sussman 2000, 13).

The next piece of the transportation system is **fuel**. Fuel is the energy source, which is used to run different modes of transport. It could be gasoline, diesel fuel, natural gas, electricity. Moreover, solar energy is considered as the main source of power in the future due to the innocuous impact on the environment (Zholudeva 2016).

The last components are **control and location systems**. These elements provide the possibilities for monitoring vehicles, infrastructure and transportation networks. Mainly, they are operated by humans. However, there are masses of automated technologies which allow maintaining control without human participation (for example, block control system that prevents collisions of trains). Also, such location technology as the Global Positioning System (GPS) allows monitoring the position of vehicle and driver to avoid losses of freight. (Miller, & Shaw 2001, 3-5.)

### **2.1.2 Role of transportation**

The economy of any state cannot function successfully without transportation system. Transport plays a considerable role in the country's economy and is an integral part of it. The development and regular performance of industrial, agricultural, supply and trade enterprises depend on the transport operation. It has a great importance in foreign economic relations, in defence of the country, and in the development of new industrial regions (Mathew, & Krishna 2007).

The level of transport development in the country determines the level of its civilization to a certain extent. It can significantly affect economic growth, expanding trade, raising the standard of living. It helps to increase productivity by reducing the time of delivery of goods or travel to the workplace. Transport is actively influencing the environment - its share in the total gross emissions into the atmosphere from all production activities is almost 40%. The main share of pollution (about 80%) is provided by road transport. (Mathew, & Krishna 2007.)

The meaning of transportation:

- **Economic.** The development of transport involves new territories, natural resources and labour reserves in the economy.
- **Social.** The development of transport increases the mobility of the population, improves the cultural level and the public mood.
- **Political.** The development of transport systems, including international transport corridors, affects the interests of neighbouring countries and large international transnational corporations.

Thereby, transport is one of the largest basic industries, which has close connections with all elements of the economy and social sphere. With the further development of the country, expansion of its internal and external transport and economic relations, a growth of production volumes and improvement of living standards, the importance of transportation and its role as a system-forming factor will intensively increase. (Goldsby, Iyengar, & Rao, 2014.)

### 2.1.3 New trends in transportation

Commercial transport companies carefully and sharply react to the introduction of new technologies. This is facilitated by several reasons such as the lack of digital culture, the problems of confidentiality, cost. However, the main issue is the profitability and productivity of a separate technology that can make the company competing in the transport market. Here are some potentially high-impact technologies existing nowadays:

- **Self-driving trucks.** Several companies are currently testing self-managed lorries. While many technical problems remain unresolved, proponents of this technology argue that self-managing vehicles will be safer and less expensive. At first look, the possibilities and difficulties created by unmanned trucks may seem just a repetition of those related to the development of self-managed vehicles. But trucks are not only long cars. Autonomous lorries can coordinate

their movements on longer highway distances, reducing air resistance and saving on fuel. Also, the management system of these trucks allows entering the desired time of the route, which will help drivers complete their trips on time or even earlier. However, the technological difficulties faced by autonomous vehicles will become higher than for self-managed cars. Companies will need to prove that sensors and codes used will cope with situational problems on the road no worse than a professional driver whose skills have been honed for years: for example, in conditions of poor quality of road surface or unpredictable behaviour of other drivers. Besides, technology has the reverse side of the coin - the social one. In conditions of ubiquitous automation of workplaces, the introduction of self-controlled cars into production can strongly affect the labour force. (Houghton 2017.)

- **Real-time logistics.** Currently, transport companies attempt to integrate vehicles into supply chain across all its data. It will be possible to monitor transport location, the health and fatigue of the driver, temperature and pressure of the freight through cloud-based analytics. Moreover, based on sensors data it will be possible to generate the most efficient and profitable ways for moving loads. (Tipping, & Kletzel 2017.)
- **Robotics.** The world companies UPS, DHL and FedEx, are testing robots for loading and unloading purpose. Advanced technologies, based on gyroscopes and mapping tools will be able to identify and move different shipments with consideration of their sizes, descriptions and picking locations. Labor costs will be dramatically reduced due to the new robotics. At the same time delivery process will speed up. (Tipping, & Kletzel 2017.)

## 2.2 Railway transportation

Railway transportation was both a product and a motor of the industrial revolution. Originated in the beginning of the XIX century (the first steam locomotive was built in 1804), by the middle of the same period it became the most critical transportation of industrial countries of that time. By the end of the XIX century, the total length of

railways exceeded one million kilometres. Railroads linked the inner industrial areas with seaports. New industrial cities were established along the rails. However, after the Second World War, the railway transportation commences losing its significance. It could not withstand the competition with road transport in freight transportations, airplanes (at long distances) and personal cars (at short distances) in passenger transportation. However, the collapse of the railways, which was predicted in the fifties and sixties, did not happen. In 1970, about half of the national freight turnover of states was accounted for railway transportation. Railways have many advantages - high load capacity, reliability, relatively high speed. Nowadays, the railroads carry a variety of goods, mostly - massive such as raw materials, agricultural products. The introduction of containers facilitating reloading also increased the competitiveness of railway transportation. Currently, the most extended length of railways is owned by the United States, and Germany has the thickest network (km of railroad per square km of territory). (Armstrong 2008.)

The role of suburban railways and subways is still high. Electrified routes are much more environmentally friendly than road transport. The most electrified rails in Switzerland (up to 95%), the least electrified railways in the US (about 5%), in Russia this figure reaches 47% (Thomas, & Sydenham 2017).

### **2.2.1 Material and technical base of the railway transport**

Material and technical base of railway transport can be divided into two parts:

- Stationary fixed devices;
- rolling stock.

Stationary devices include paths, bridges, traffic lights, passenger stations, platforms, locomotive and wagon depots, cargo stations, driveways, devices for water, heat and electricity. (Begagoin, Frolov, & Fetisova 2012, 10.)

The rolling stock includes:

- wagons (freight and passenger);

- locomotives (electric locomotives, diesel locomotives, electric trains, diesel trains);
- motor vehicles.

**Rolling stock** is a technical means that move along the track with passengers and goods during transportation (ibid., 10-11).

### 2.2.2 Structural diagram of the rolling stock

The rolling stock can be represented in three large-block groups:

- locomotives or traction rolling stock;
- rail cars and special purpose railway vehicles, collectively referred to as self-propelled, non-taut rolling stock;
- wagons, or non-self-propelled rolling stock.

Each of the groups is classified according to different characteristics on smaller blocks (see Figure 2).

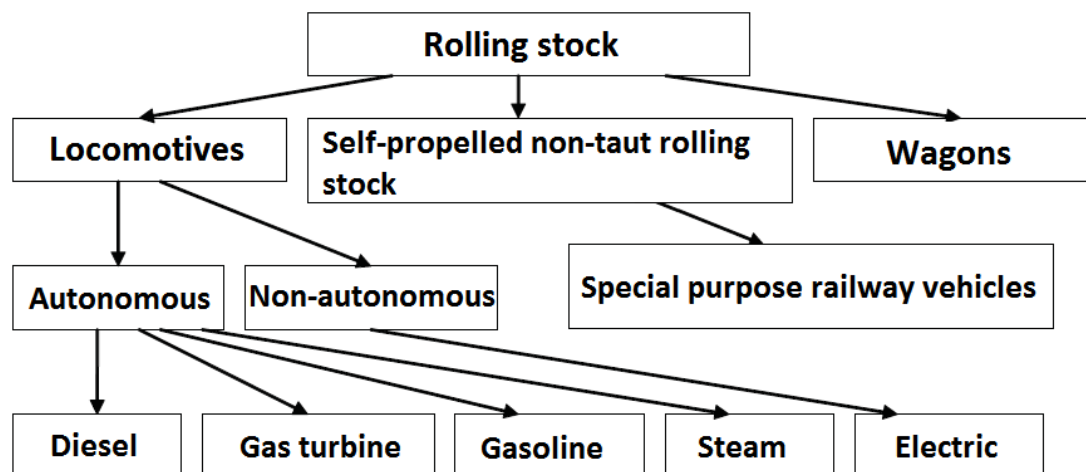


Figure 2. Structural classification scheme of rolling stock (adapted from Begagoin, Frolov, & Fetisova 2012)



**Locomotives** are self-propelled vehicles, the free movement of which is limited to the track gauge. The main purpose of the locomotive is the creation and realization of the necessary power consumed for the train's traction and the overcoming of the resistance forces to the movement of the train (ibid., 11).

### 2.2.3 Wagons classification

**A wagon** is a unit of railway rolling stock, intended for the carriage of passengers or cargo. The car fleet is characterized by the complexity and variety of types and constructions. This is due to the need to meet various requirements for transportation: protection of cargo from atmospheric influences, maintaining the quality of perishable goods, providing comfort to passengers. Wagons are classified according to four main features: destination, operating location, axle and gauge width. (Pyrgidis 2016.)

The cars are divided into two main groups: **passenger and freight**. Park of passenger cars consists of:

- Non-self-propelled wagons moved by locomotives (long-distance cars, inter-regional and suburban communication, dining cars, luggage, postal, and special cars);
- self-propelled, having their own power plant or receiving energy from the contact network.

The fleet of freight cars consists of universal and special wagons of the following types:

- covered - for goods that require protection from atmospheric influences and mechanical damage;
- open-top cars - for bulk, stacking and piece cargo, which do not require protection from weather effects;

- platforms - for long, stackable, bulky, loose and wheeled-caterpillar cargo that do not require protection from atmospheric effects;
- cisterns - for liquid, gaseous and pulverized cargo. (Pyrgidis 2016.)

#### **2.2.4 Draft of trains**

The main technological process in railway transport is the movement of trains. The traction of trains is carried out by locomotives, which are designed to convert the energy they receive into mechanical energy of train movement. Locomotive is a power traction device intended for the movement of trains or individual wagons along railroad tracks.

There are two types of traction:

- autonomous, when the primary energy carrier and all devices for its transformation are on the locomotive itself;
- non-autonomous, when the primary energy carrier and part of the converter devices are outside the locomotive but are continuously connected to it by channels for the transfer of already partially converted energy.

Diesel and steam locomotives belong to autonomous type, electric locomotive – to non-autonomous. (Babichkov, Gyrsky, & Novikov, 1971.)

### **2.3 Interrelation of East and West regions**

China is the rising star in the world, both for the economy and for military development. The growing economy of China provides a market for European products, and vice versa, China produces many things for the European market. The official relations of the EU member states and China are less divided, in general, China's relations with the EU countries are similar, based primarily on the economy. (Christiansen, & Maher 2017.)

### **2.3.1 The conception of New Silk Road**

The New Silk Road (NSR), which was launched in 2013, is the concept of a new intercontinental transport system promoted by China in cooperation with Kazakhstan, Russia and other countries. The idea of the New Silk Road is based on the historical example of the ancient Great Silk Road, which operated since the second century BC and was one of the most important trade routes in antiquity and in the Middle Ages. The current NSR is an important part of China's development strategy in the modern world. The new Silk Road not only has to build the most convenient and fast transit routes through the centre of Eurasia, but also strengthen the economic development of the internal regions of China and neighbouring countries. (Bruce-Lockhart 2017.)

China is promoting the "New Silk Road" project not just as a revival of the ancient Silk Road, a transport route between East and West, but as a large-scale transformation of the entire trade and economic model of Eurasia, and primarily of Central and Middle Asia (Christiansen, & Maher 2017). According to heads of states: "It is a question of reaching a new level of partnership in the future, which implies a common economic space throughout the Eurasian continent."

The Chinese call this concept - "One belt - one way". It includes a lot of infrastructure projects, which should eventually envelop the entire planet. The project of a global system of transport corridors connects Australia and Indonesia, the whole of Middle and East Asia, the Middle East, Europe, Africa and through Latin America, to the United States (see Figure 2). Among the projects within the framework of the New Silk Road, railways and highways, sea and air routes, pipelines and power lines, and all related infrastructure are planned. According to the most conservative estimates, 4.4 billion people (more than half of the world's population) will participate in the project. (Kuhn, 2015.)



Figure 3. The concept of New Silk Road (adapted from Kuhn 2015)

### 2.3.2 The Great Silk Road in Antiquity

Regular caravan trade between China and Central Asia began not later than the second century BC when China united into a single empire and the endless internal opposition of individual Chinese kingdoms was replaced by a single foreign policy. In the north, the first Great Wall of China was built to repel nomadic Huns, in the southeast, sea trade developed, and in the west, Chinese diplomats and merchants set off on a distant journey, initially in search of allies against the Huns or for the precious jade deposits on the territory of present Xinjiang (Jinchen 2016).

Having reached Central Asia, the Chinese soon realized that in exchange for beautiful Arab horses and other goods scarce for China, it was possible to supply unique products from China, especially silk fabric - silk was highly valued not only for its beauty, but also for its ability to resist insect parasites, that was very important for the anhydrous spaces of central Eurasia. This was the beginning of the trade in silk, which soon assumed a huge scale. (ibid., 2016.)

The Great Silk Road went along several routes-branches:

- The southern branch is from China through the Taklamakan desert, the southern Pamir, Bactria (Afghanistan), Parthia (Iran), India and the Middle East, where Chinese goods across the Mediterranean fell into the provinces of the Roman Empire, and later to Byzantium, Arab and Western European countries;
- The northern branch is from China through the Turfan oasis, between Altai and Tibet, through the Pamir to the Fergana valley, through the Kazakh steppes to Eastern Europe.

China traded not only silk, but also porcelain, tea, rice, jewelry and other products in exchange for gold, silver, leather, wool, carpets, exotic fruits and other goods from Central Asia. The exchange of technologies between the East and the West took place along the Silk Road - this is how, apparently, powder, paper and other technical achievements of China came to Europe (Cartwright 2017).

The organization of caravan trade required both diplomatic efforts and the creation and support of a complex infrastructure network for thousands of kilometers, where it was necessary to dig wells, create recreation and parking places (caravanserais), arrange river crossings. Caravan trade along the Great Silk Road was of immense historical significance. Thus, among the many possible factors and causes of the fall of the Roman Empire is called the deficit of a silver coin for the maintenance of the army, which arose, among other things, because of the exchange of Romans silver for luxury items from the East, including silk from China. (Mark 2014.)

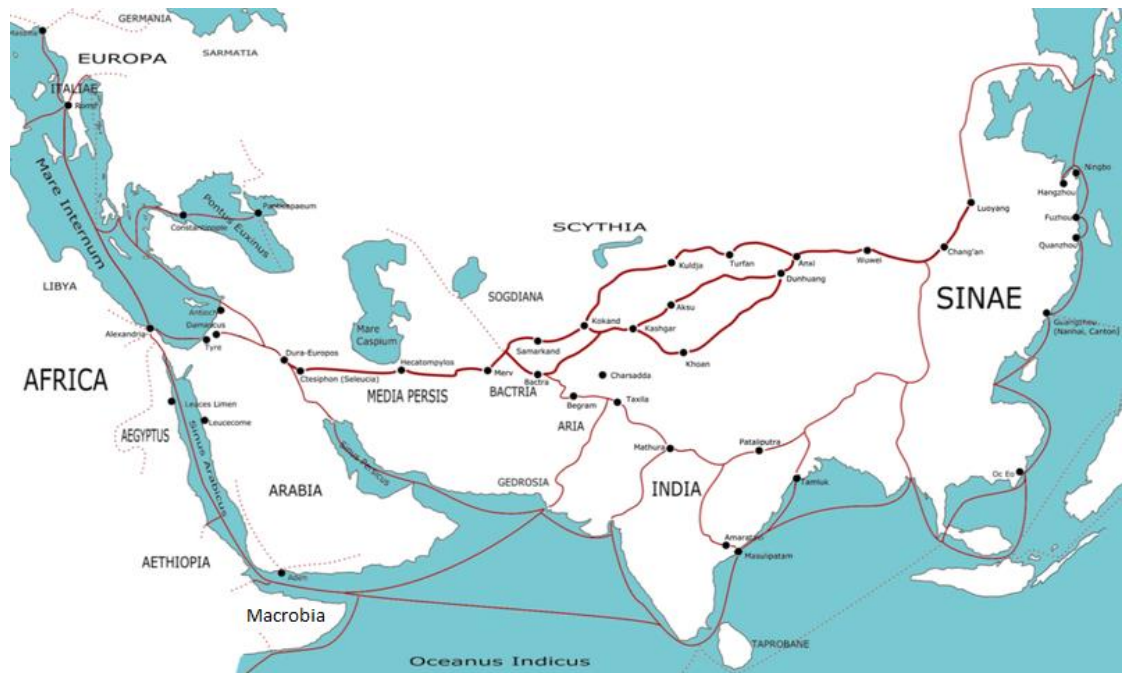


Figure 4. Routes of the Great Silk Road in the first century AD (adapted from Mark 2014)

### 2.3.3 Combining projects from different countries

On April 2, 2015, the Minister of Foreign Affairs of the China proposed to unite the concept of transport mega-projects existing in the countries in the joint economic corridor.

In the overland part of the "New Silk Road" it is planned to build three railway corridors. The northern corridor will pass through the territory of Russia, central and southern - through the territory of Central and Middle Asia, including Kazakhstan, which is, together with Russia, the member of the Eurasian Economic Union. Subsequently, the railway corridors will be complemented by road corridors. (Jinchen, 2016.)

The main direction of the "New Silk Road" through Central Asia is supposed to be about 6,500 kilometres long, of which 4,000 will pass through the Chinese territory from the Pacific coast to the Xinjiang Uyghur Autonomous Region. Then the way goes through Kazakhstan, Uzbekistan, Turkmenistan, Iran, Iraq, Syria and Turkey, and from

there to Europe - through Bulgaria, Romania and the Czech Republic to Germany. Also, branches from the main route are also planned for many other neighbouring countries. (ibid., 2016.)

The sea route will pass along the ancient trade route: from Guangzhou to China along the coasts of Vietnam, Thailand, Malaysia, Singapore and Indonesia, past India to the Red Sea with branches to the Persian Gulf and Africa, and through the Suez Canal in the Mediterranean. As a separate entry point to Europe before the Ukrainian crisis, the Chinese planned to build a deep-water port in the western part of the Crimea. (McBride 2015.)

In addition, Russia and China are also discussing the Arctic route: the possible inclusion of the Northern Sea Route development project in the strategy of the New Silk Road (Suokas 2017).

#### **2.3.4 Kazakhstan in “New Silk Road” concept**

In 2012, President of Kazakhstan Nursultan Nazarbayev proposed the project "Kazakhstan - New Silk Road", which should become a kind of bridge between Europe and Asia. It will be based on the four principles: speed, stability, security and modernity. Within the framework of this project the work on the establishment of the movement of regular container trains between China and Kazakhstan was launched. (Gupta 2017.)

On the 11<sup>th</sup> of November 2014, Nazarbayev announced a new policy of the state "Nurly Zhol", the core of which will be an infrastructure development plan designed for five years. Within its framework, an initiative has been put forward to build and operate a new high-speed railway from China to Europe through the EEA countries with a length of 4.5 thousand kilometers. The project "Nurly Zhol" is quite consistent with the idea of the "Economic belt of the Silk Road", proposed by the Chairman of the China Xi Jinping (it suggests deepening cooperation between China, Central Asia and Russia). (ibid., 2017.)

The implementation of the Nurlı Zhol project means a new stage in the development of the transit position of Kazakhstan, based on modern transport and logistics technologies. It is expected that the volume of international transit traffic of Kazakhstan by 2020 will double, which will relate to the growth of transport not only between China and the EU, but also between China and Russia, Turkey and Iran, between Russia and Central Asian countries, Iran and the Indian Ocean countries, between the Central Asian countries and China. The creation of a container bridge will significantly improve the transport and logistics conditions of foreign trade relations for the neighbours of Kazakhstan and the entire post-Soviet space. At the same time the Republic of Kazakhstan will acquire the functions of the Eurasian transit hub. (Shepard 2017.)

## **2.4 Railway system in Kazakhstan**

Railway transport is the most crucial sphere of community production and occupies a specific place in the system of the Kazakhstan economic complex. As the basis of the division of labour in society, it implements a diverse relationship between production and consumption, industry and agriculture, the mining and manufacturing industries, between different economic regions, which can realize the export potential of the country.

Kazakhstan possesses a ramified network of railways with a total length of about 15529,8 kilometres. 5 thousand kilometres of which are double-track and nearly 4 thousand – electrified (see Figure 2). The overall length of the main tracks is 18,8 thousand kilometres, stationary and special routes – 6,7 thousand kilometres. The importance of rail transport in Kazakhstan is very distinguished. The share of railways among other modes of transportation is more than 68% of all cargo turnover and over 57% of the country's passenger turnover. Moreover, 16 border points (11 with Russia, 2 with Uzbekistan, 1 with Kyrgyzstan, 2 with China) connect the railway system of Kazakhstan with adjacent states. (Elyubayev 2015.)



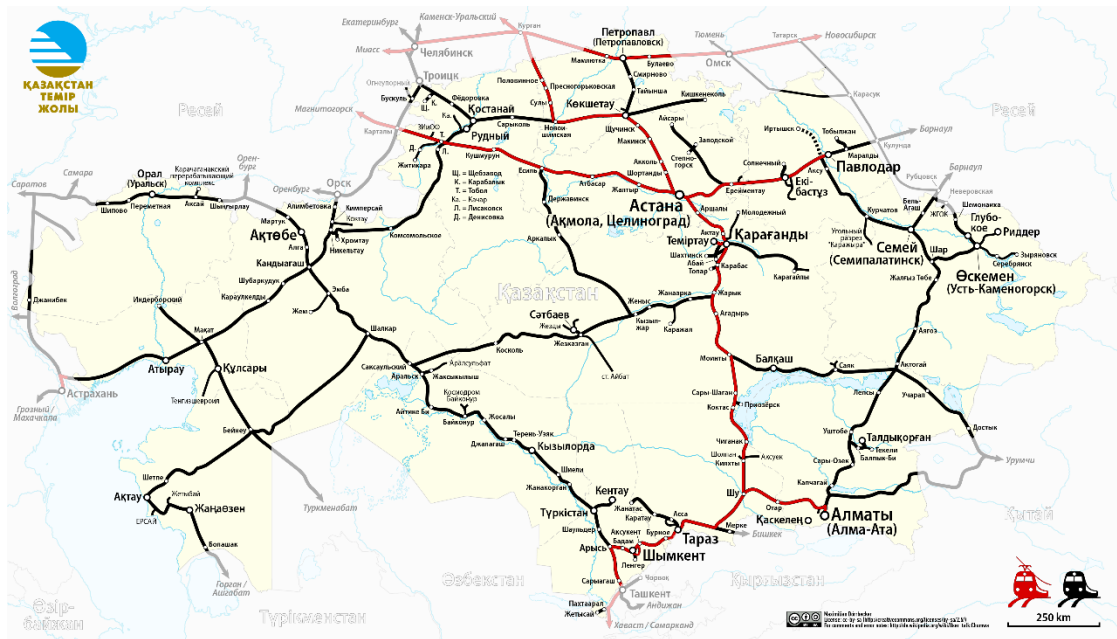


Figure 5. Kazakhstan railways 2016 (adapted from Elyubayev 2015)

In 2016, the fleet of locomotives contained 1725 locomotives, including 539 electric trains and 1186 diesel locomotives. The condition of the locomotive fleet is characterized by high deterioration, reaching 72%. More than 37% of the locomotive fleet is operated with a regulatory overrun, and 50% of the fleet reached the expiration of their service life. (Ministry of national economy of the Republic of Kazakhstan 2017.)

Following the results of 2016, the total amount of railway carriages of the Republic of Kazakhstan is 129352 units, of which 56504 units or 43,7% are inventory, and 72848 units or 56,3% are individual. The share of the fleet in operation field in the total number of inventory wagons is 93% (50,777 units). The fleet of freight wagons of independent owners increased almost two times and by more than 30 thousand cars. (ibid., 2017.)

#### 2.4.1 International transport corridors

The transport corridor is a constant direction of cargo transportation with large volumes. The transport corridor is sometimes considered only as a stream of goods,

but often this term is also used to indicate some organizational structures and technical means that ensure the efficiency of transportation processes. (Aidarova 2011.)

International transport corridors in recent years have become one of the main directions for the development of world trade. Large flows of goods between countries and between regions within countries move along them. The main advantages of the transport corridor are:

- reduction of the cargo delivery time;
- reliability and safety of freight;
- lower delivery cost in comparison with other routes of transportation.

International transport corridors are important for each country. This is assessed not only from the point of view of commercial profit, but from broader positions of national security, such components as military, economic, industrial, technological, food, and demographic (Korzumbayeva 2011).

The Republic of Kazakhstan is an active participant in international transport projects in the field of rail transportation. In 2000, was developed the scheme for railway lines in the Europe-Asia communication under the guidance of OSJD (The Organization for Cooperation of Railways). Five corridors and their branches from 13 routes defined by OSJD pass through Kazakhstan territory:

**The transport corridor of TRACECA** (Transport Corridor Europe-Caucasus-Asia) with the length of 4389 km passes through the territory of Ukraine, Bulgaria, Romania, Georgia, Azerbaijan, Uzbekistan, Turkmenistan, Kyrgyzstan, Kazakhstan, Tajikistan. This transport route (1,097 km) has a branch line passing through Kazakhstan, which includes Aktau-Beyneu-Makat-Kandagach-Arys-Druzhba stations (see Figure 3). Since May 1993, Kazakhstan has been participating in the TRACECA project. The most important task for the countries participating in the European Commission's TACIS-TRACECA program is to fully realize their geopolitical and economic opportunities

through the development of transport networks of the international transport corridor TRACECA, officially recognized by the world community and leading international organizations (UNESCAP and ECMT) as a natural transit bridge between Europe and Asia. In 2012 the trade turnover between Asia and Europe already exceeds 2 trillion USD per year, with a share of transport costs of \$ 200 billion. Based on the materials of TRACECA projects, it can be concluded that the total transit through the territory of the Republic of Kazakhstan by all types of transport (including pipeline transport) in 2012 was about 15-16 million tons per year. (International Transport Corridors in Kazakhstan: Study 2011.)

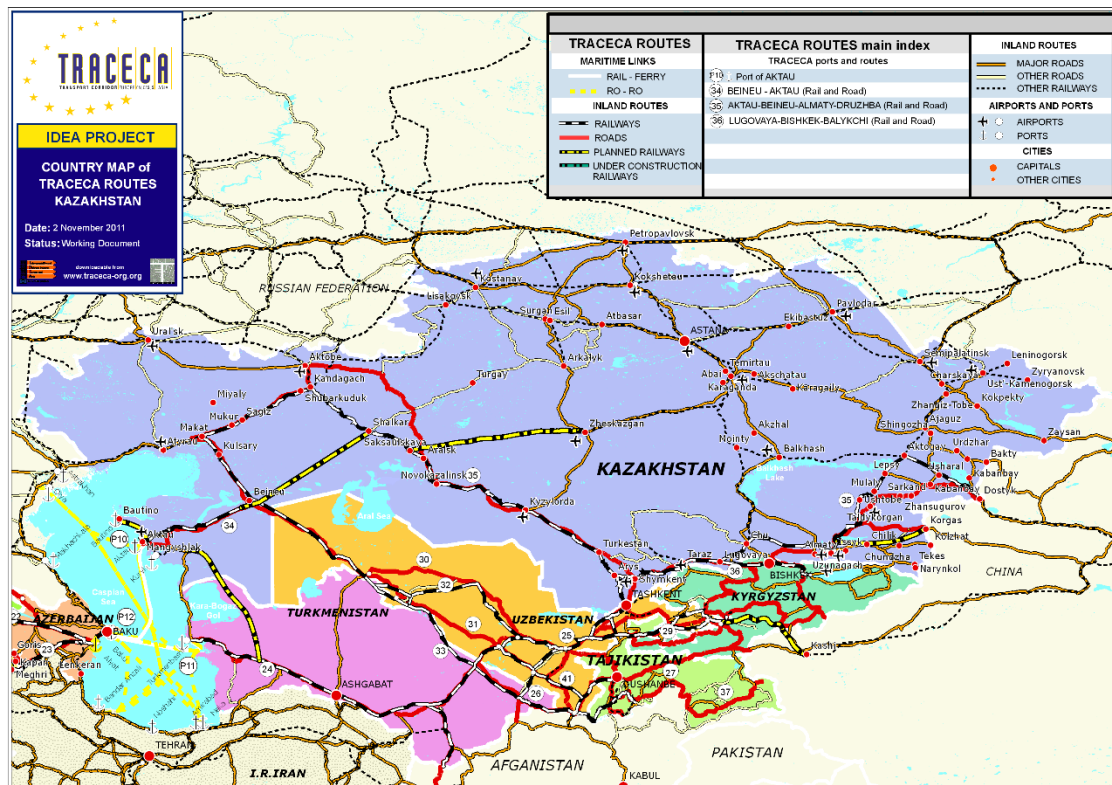


Figure 6. Map of TRACECA routes in Kazakhstan (adapted from TRACECA 2011)

**Northern Corridor of Trans-Asian Railway Main (TARM)** length of 8048 km, runs through the territory of Russia, Kazakhstan and China. This corridor passes through Kazakhstan across Petropavlovsk-Astana-Druzhba stations (1,718 km) and has a

branch of Dema-Kartaly-Tobol-Astana (1,308 km). Transit traffic along this corridor is mainly carried out between Russia and China. In 2012 the volume of transit import cargo in the Republic of Kazakhstan was 1977 thousand tons (see Figure 4). It should be noted that there is no alternative to Kazakhstan transport corridors on the way of commodity exchange between Russia and the Western regions of China.

Kazakhstan's railways provide the shortest route from Russia to China. (Zhaksygulova 2015.)

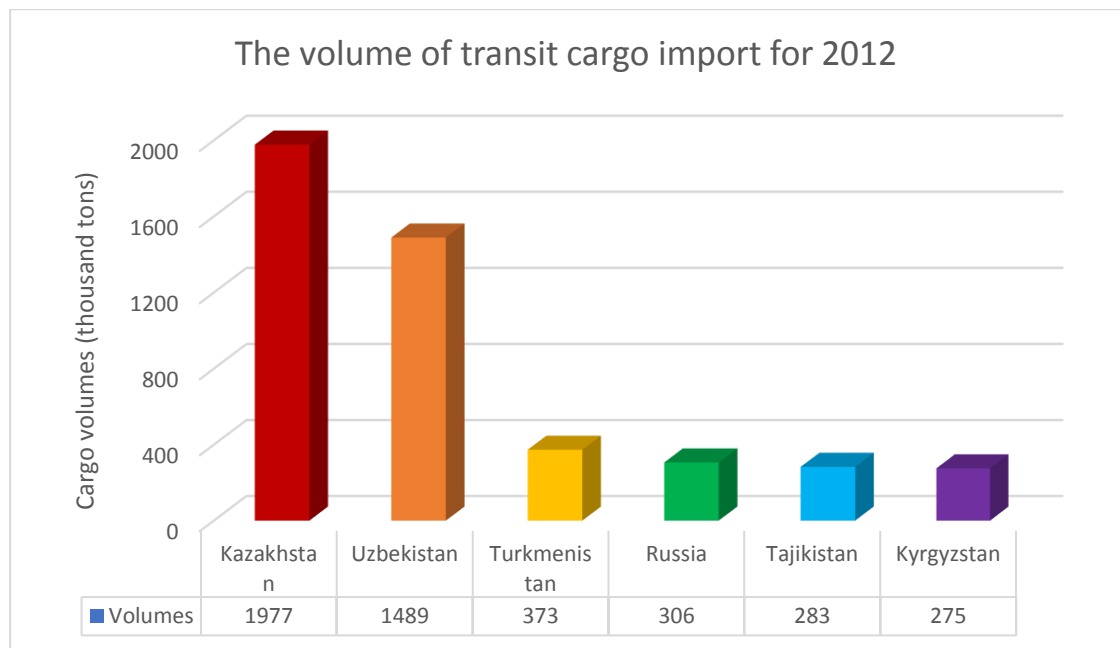


Figure 7. The volume of transit cargo import for 2012 (adapted from Zhaksygulova 2015)

**The transport corridor NORTH-SOUTH**, which is based on the powerful and extensive network of transport communications of Russia, Iran, India and other countries, is one of the directions of continental connections development in the system of transport corridors in Euro-Asian communication (see Figure 5). The use of this route for the delivery of transit cargo from the Pacific and Persian Gulf countries through Iran, the Caspian region, Russia and further to the countries of Eastern and Western Europe allows three times shortening the current route of the same destination

through the Suez Canal. The development of transit through the Aktau Sea Commercial Port relates to the formation of international transport corridors TRACECA and NORTH-SOUTH. (Ahmetov 2016.)

The volume of rail transportation with the countries of the "Ashgabat Agreement" in 2014 increased by 2.3 million tons (approximately 10 %), compared to 2013, and amounted to more than 25 million tons of cargo. At the same time, more than 41% of transportation was formed at the expense of Kazakhstan's export freight flows that followed to these countries and transit through their territories. (ibid., 2016.)



Figure 8. The section of the North-South corridor through the territory of Kazakhstan (adapted from Elyubayev 2015)

**Central Corridor of Trans-Asian Railway Main (TARM)** passes through the industrialized regions of South-Eastern and Southern Kazakhstan. Within the corridor there is a railway network with an alternative site and sorting stations Aktogay, Almaty, Shu, Lugovaya, Zhambyl, Shymkent, Arys. Large container terminals carrying

out the processing of large-capacity containers are located at the stations Dostyk, Almaty, Zhambyl and Shymkent. The creation of transcontinental highways is beneficial for international trade. In 2016 within the Central Corridor TARM the volume of container transportations through the Republic of Kazakhstan was 105 thousand tons (see Figure 6).

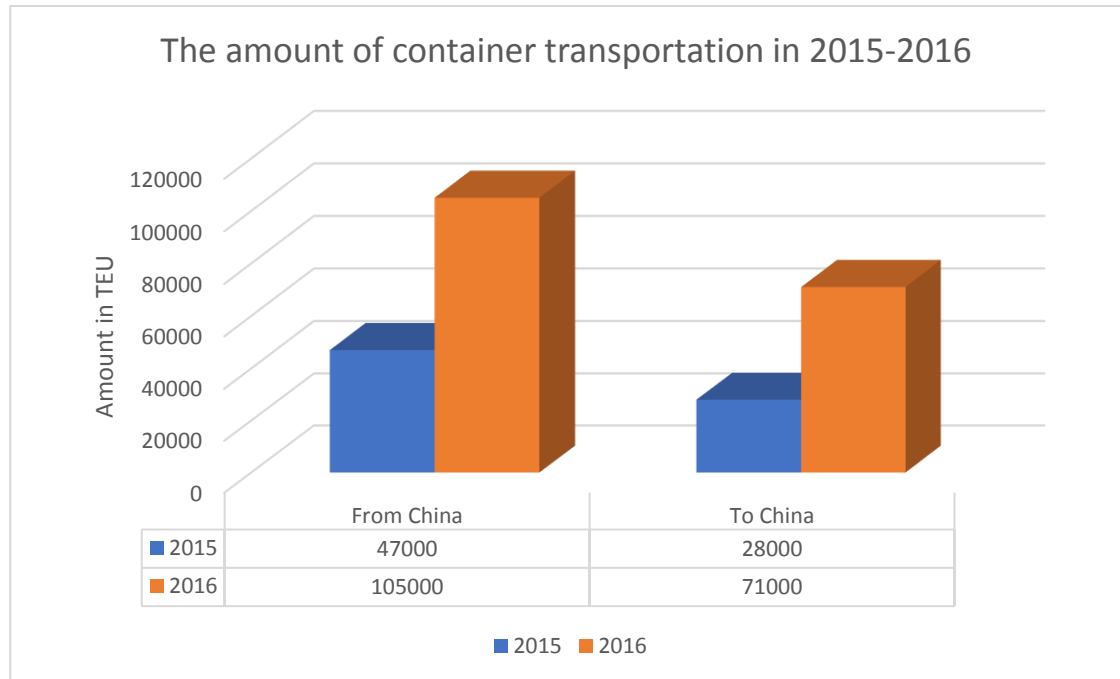


Figure 9. The amount of container transportation in 2015-2016 (adapted from Ministry of investments and development 2017)

**Southern Corridor of Trans-Asian Railway Main (TARM)** is the connection between South-Eastern Europe, China and South-East Asia through Turkey, Iran, Central Asian countries and Kazakhstan. It passes Kazakhstan across Dostyk-Aktogay-Almaty-Shu-Arys-Saryagash sections. (Ahmetov 2016.)

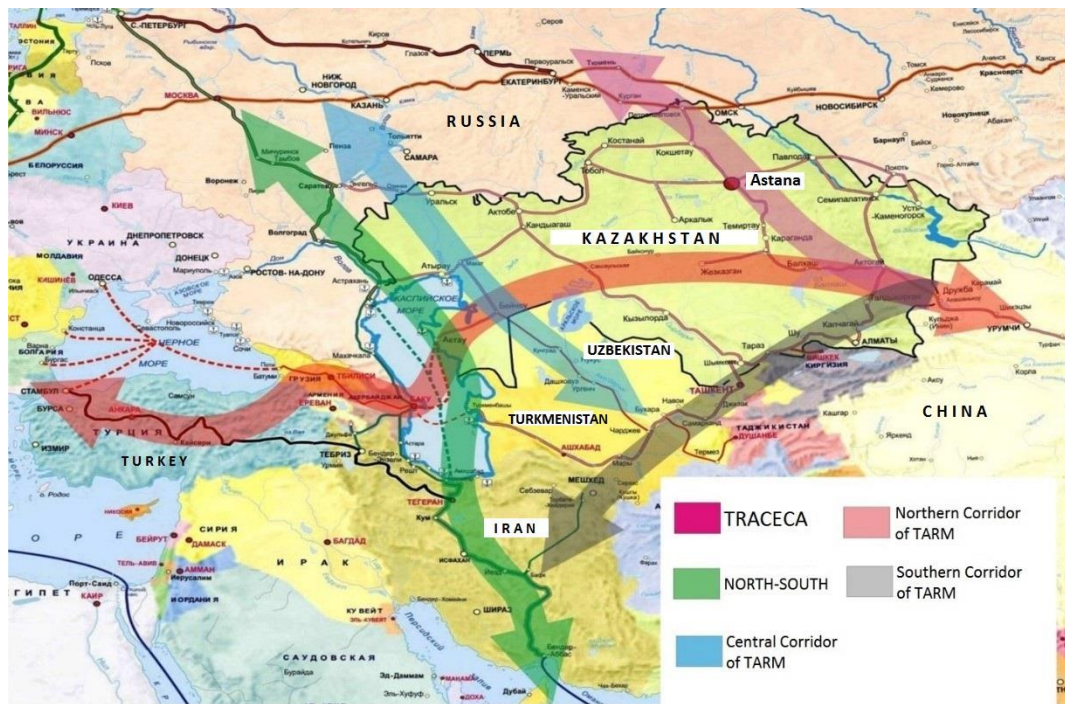


Figure 10. The overall view on five international corridors on the territory of Kazakhstan (adapted from Ministry of investments and development 2017)

#### 2.4.2 Transit potential

After the collapse of the USSR, Kazakhstan's transit dependence on Russia and other post-Soviet countries on the European foreign trade direction has sharply increased, since the country's main sales markets are outside the post-Soviet space. Over the period 2000-2014, the share of the EU in Kazakhstan's exports increased from 26% to 56.8%, while the CIS declined from 30.8% to 12.5% (including Russia from 19.5% to 6.6%). But at the same time, the transit potential of Kazakhstan, understood as an aggregate of external demand for transportation of goods and travel of passengers on national communications, also increased. This demand is determined by the internal situation in Kazakhstan, the location between Russia and China, the rapid growth of the Caspian littoral states and the Central Asian states. (Mukanova 2017.)

From the north, Kazakhstan is adjacent to the industrialized regions of Russia: West Siberian, Ural and Volga regions; it is connected to them by a rather dense transport network, inherited from the Soviet era. From the south-east, Kazakhstan adjoins the

rapidly growing Xinjiang Uygur Autonomous Region of China. The growth of mutual trade relations between Kazakhstan's neighbors, as well as their trade with third countries, primarily with the EU and China, causes the constant increase of transit traffic through the Republic of Kazakhstan. The important factor of strengthening the transit potential of Kazakhstan is the rapidly growing volume of reciprocal market between the EU and China, which exceeded \$ 615 billion in 2014. (ibid., 2017.)

Another component is the nature of the transit policy in the country. Over the years since independence, Kazakhstan has gradually evolved from the country that depends on transit to the transit country.

One of the directions of the country transit policy was the reduction of dependence on Russian communications. Russia and Kazakhstan are connected by many railways: Almaty - Astana - Chelyabinsk, Almaty - Barnaul - Novosibirsk, Almaty - Chimkent - Orenburg. Some of them, built in the conditions of the unified country, several times cross the common state border. Large delays at border checkpoints and transit costs forced Kazakhstan to build the number of railway lines, bypassing Russian territory. In 2001, the 185 km Aksu-Degelen road was put into operation in the north-east of the republic, which directly connected Pavlodar and East Kazakhstan regions, bypassing the Altai Territory. Then the railway Altynsarino-Khromtau (402 km) was built, connecting Kostanai and Aktobe regions. (Zhaksygulova 2015.)

A key role in development of the transit potential of Kazakhstan performs the Caspian port of Aktau, through which the country has access to the Black Sea (via Azerbaijan and Georgia, as well as inland waterways of Russia), to the Indian Ocean and the Persian Gulf (via Iran). The port occupies an important place in the transport development program along the corridor Europe-Caucasus-Central Asia. To improve its transit position, several railroads were built: in 2012 - Zhetygen - Khorgos, which provided the second connection of the railways of Kazakhstan and China. In 2014, the laying of the canvas of the railway Zhezkazgan-Beynau was completed, which shorten the way and significantly accelerate the transportation through Kazakhstan from China to Europe. (ibid., 2015.)



In 2014, the Arkalyk-Shubarkol railroad was opened, which provided a shorter distance to the northern regions of Kazakhstan, as well as the adjacent Siberian regions of Russia with the Kazakh ports in the Caspian. At the end of the same year, the Uzen-Gorgan railway (the border of Iran and Turkmenistan) was opened, which creates a convenient exit to the western and northern areas of Kazakhstan, as well as to the sections of the Russian Volga, the Urals and Western Siberia to the markets of Iran, Pakistan, India, and the Gulf countries. (ibid., 2015.)

In February 2015 Kazakhstan joined the Ashgabat Agreement of Iran, Oman, Turkmenistan and Uzbekistan, which regulates the creation of the international transport and transit corridor between the countries of Central Asia and the Persian Gulf. (Ministry of investments and development 2015.)

The constructed railways have significantly increased the transit potential of Kazakhstan. But its more complete use requires the improvement of the quality of logistics services.

## **2.5 International transit development**

Nowadays, the world is divided by more than 600 interstate borders. Accordingly, the demand for transit services is growing and the market for these services is expanding.

In transit, economy and politics are closely intertwined. Therefore, the world community after the First World War began to make efforts to streamline transit and provide free access to the world market for landlocked countries. The Versailles Treaty of 1919 included several articles touching on transit connections, primarily in terms of the freedom to implement them. At the international conference in 1921, Barcelona adopted the final version of the Convention on Freedom of Transit. And in 1965 the United Nations adopted the Convention on the transit of landlocked countries. In this Convention, in addition to freedom of choice of transport modes, the ban is provided for countries on the routes of which transit is carried out, to

introduce customs and other additional payments of discriminatory nature. (Visser, & Schoorl 1987, 213 – 217.)

The economic significance of transit is not limited only to the balance of income and expenditure of countries for transit operations. Its volumes reflect the national level of transport development and its international competitiveness. The activities of the related sectors are closely connected with it: insurance, logistics, energy. In this sense, the volume of international transit is an indicator of the level of development of transport and logistics, and national rules, managing transportation.

Today, the global economic space has become more accessible and convenient to use. The most important role in "squeezing" the world space was played by the "container revolution", which made it possible to reduce the time and costs of cargo transshipment. At present, about 90% of the so-called "general cargo" (industrial products - appliances, non-bulky equipment, household appliances, food, textiles, semi-finished products, technological components) are transported in containers. (Bernhofen 2013.)

The main links of the world container transport system are the largest seaports, connected by a multitude of container (feeder) lines with regional ports, and those with local ones (ibid., 15). These are multi-level systems, operating on the principle of hub and spoke, which ensure the delivery of goods between senders and recipients in the shortest possible time.

### **3 Research**

#### **3.1 The effectiveness of international transport corridors as a component of the external transport market**

With the help of international transport corridors (ITC), the country and its regions have the opportunity to participate in international transport links and, therefore, in international business through the export and import of transport services. At the

same time, the ITC is obliged to fulfil the tasks of territorial development as well as internal requests of the countries' economies on which they pass. The effect of using the corridors to strengthen the connections with foreign countries is structurally divided into two parts: the national economic effect, and the effect obtained by the owners of the rolling stock and the infrastructure of the ITC. The basic requirement for justifying the effectiveness of the development of international transport is the compliance with national economic interests. It means that the use of the ITC should be effective for the national economy. Simultaneously, the efficiency of transport organizations and enterprises should also be considered.

The value of national economic costs in determining the effectiveness of international transportation is defined by the price of transport services production using the formula for reduced costs:

$$RC = OC + C * ROC$$

where OC is the operating costs associated with the international transport operations by the ITC in tenge or foreign currency; C - capital investments in fixed and circulating funds associated with the export, import or transit of cargo flows; ROC is the rate of return on capital. (Goncharenko 2015.)

Based on the financial statements, the national economic costs of the overall use of ITC from 2010 to 2016 were calculated:

Table 1. The value of national economic costs of ITC for the period 2010 - 2016

	2010	2011	2012	2013	2014	2015	2016
Operating costs (in thousands of tenge)	₸ 206 033 921	₸ 338 914 446	₸ 497 685 779	₸ 466 475 313	₸ 353 536 388	₸ 209 055 211	₸ 269 421 794
Capital (in thousands of tenge)	₸ 205 420 530	₸ 364 842 959	₸ 473 885 448	₸ 429 272 449	₸ 399 357 466	₸ 289 158 600	₸ 320 089 998
ROC	20%	20%	20%	20%	20%	22%	22%
<b>National economic costs</b>	<b>₸ 247 118 027</b>	<b>₸ 411 883 038</b>	<b>₸ 592 462 869</b>	<b>₸ 552 329 803</b>	<b>₸ 433 407 881</b>	<b>₸ 272 670 103</b>	<b>₸ 339 841 594</b>

Note: calculations are made by the author and the data is retrieved from the relevant company's annual reports

In calculating the effectiveness of international transportation at the national economic level, both direct and all related additional effects and costs must be considered. In particular, when comparing existing (replaced) vehicles with advanced technology associated with the development of container transport of goods and the introduction of specialized vehicles, it is necessary to take into account the economy of mechanization and automation of handling operations, reduction loss of cargo in transit, reduction of costs for packaging.

The indicator of the national economic efficiency of export, import and transit passes through the section of the ITC is determined by the formula:

$$x = \frac{\text{Income}}{\text{National economic costs}}$$

where the numerator is the income from the use of ITC in budgets of different levels (federal, regional, municipal); the denominator is the national economic costs of ITC. (Goncharenko 2015.)

Based on the financial statements, the coefficients of effectiveness of international transport corridors for the period 2010 – 2016 were determined:

Table 2. The indicator of the national economic efficiency for the period 2010 - 2016

	2010	2011	2012	2013	2014	2015	2016
Income from the use of ITC (in thousands of tenge)	₸ 65 162 420	₸ 123 228 819	₸ 118 862 725	₸ 118 435 566	₸ 33 556 791	-₸ 459 981 709	₸ 41 276 619
National economic costs (in thousands of tenge)	₸ 247 118 027	₸ 411 883 038	₸ 592 462 869	₸ 552 329 803	₸ 433 407 881	₸ 272 670 103	₸ 339 841 594
<b>Coefficient of effectiveness</b>	<b>0,26</b>	<b>0,30</b>	<b>0,20</b>	<b>0,21</b>	<b>0,08</b>	<b>-1,69</b>	<b>0,12</b>

Note: calculations are made by the author and the data is retrieved from the relevant company's annual reports

The values of the indicators should be more than one in order to confess the impact of ITC on national economy as an effective way of development. According to the calculations (see Table 2), the efficiency coefficients reach the maximum of only one third of the desired value. This means that the transport corridors do not satisfy the needs of the national economy and their internal economic expediency of use is highly questionable.

### **3.2 The main problems of international transportation along international transport corridors**

Productivity and compatibility of technologies from different countries depend on improving the parameters of vehicles. This, in turn, will develop the transportation process and make it more secure and cost-effective. To achieve this, it is necessary to concentrate efforts on eliminating the infrastructural and technical barriers that arise in the transport activities between different countries.

According to the statistical data, the volume of trade between the European Community (EU) and the Asia-Pacific region is on average over €1 billion a day (European Commission 2017). However, only about one percent of the total volume of cargo transportation between these regions is used by the international transport corridors.

The use of transport potential and the development of it along the transport corridors is of great importance. However, several difficulties arise during the implementation of these actions. At the same time, the fact that for different types of transport in the transit business there is a different set of problematic issues should also be considered.

Based on the data and available scientific literature, the main problems creating difficulties for the full development of the rail transport integration between Kazakhstan and neighboring countries were defined:

- low level of harmonization and unification of legislations in the field of transport infrastructure;

- technical incompatibility of transport processes;
- the lack of unified competition rules in the field of transport and the inefficient operation of its transit potential;
- the presence of difficulties in the transportation of passengers, baggage, cargo and vehicles. (Muhtar, & Madenova 2015.)

Regarding the last point, two types of such problems - non-physical and physical barriers that hamper the development of the transit resource were identified.

**Barriers of non-physical nature:**

- delays in crossing the border without justified reasons;
- various duties and additional taxes from local authorities and control bodies;
- slow customs clearance at border crossings, significantly delaying transport;
- constant systematic check to determine the weight of the goods;
- unintended checks in the form of inspections in transit (opening of sealed transit containers in a compulsory manner);
- poorly harmonized tariffs for transportation in the CIS countries (significant differences in prices for transportation in CIS countries, despite existing agreements at the international level);
- incomplete harmonization of the migration policy.

**Physical barriers** include the following types of difficulties:

- outdated and dilapidated fleet of rolling stock (locomotives, wagons) that do not have high capacity. Consequently, there are difficulties in increasing the speed and volume of traffic;

- deviation of the railways quality from established international quality standards (multidisciplinary - CIS countries use gauge widths of 1520 mm, while in Europe and Asia the railroad gauge is 1435 mm);
- insufficiently satisfactory condition of communication routes – railways and artificial structures on them;
- low throughput of crossings and logistics centers;
- undeveloped logistics and communication networks.

The research is focused on the analysis of the first two most important aspects of transportation physical barriers. Moreover, the ways of solving these problems in the theoretical view are suggested.

### **3.3 Analysis of transportation activities of JSC “Kazakhstan Temir Zholy” for the period of 2012-2016**

Currently, the only carrier of goods and the operator of the backbone railway network in the country is JSC "Kazakhstan Temir Zholy" (KTZ). The corporation fully controls the railway networks, markets for locomotive traction and rental of wagons. 68% of all cargo and about 60% of passenger transportations of the republic are accounted for by KTZ.

Based on the analysis of the Company's transportation activities for the period 2012-2016 (see Figure 10), there is an annual reduction in the volume of traffic - loading, unloading, and handling (it is 5% on average).

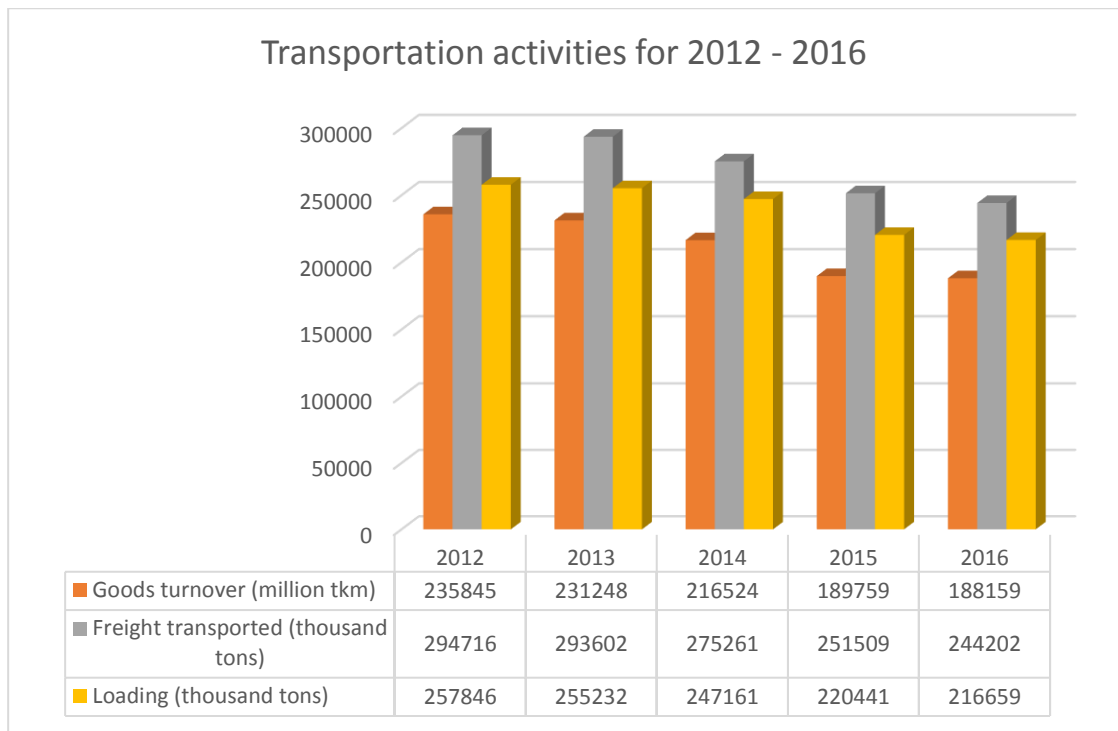


Figure 11. JSC "Kazakhstan Temir Zholy" transportation activities for 2012 – 2016 (adapted from the Kazakhstan Temir Zholy annual reports)

Note: calculations are made by the author and the data is retrieved from the relevant company's annual reports

However, the marketing research related to the world economy forecasted the much larger turnovers (298,4-338,2 million tkm) in the period from 2012 to 2016. The main reason for the recession is the moral and physical obsolescence of the equipment. Of course, there are other reasons such as the increased tariffs of natural monopolies, the lack of highly qualified personnel, and the lack of flexible marketing strategies. But under all circumstances, the main cause of the negative phenomena on the railway transport is the total wear of the equipment, which is not only ready to produce goods that can compete with imported analogues, but also makes it regrettable to recall the quality of Soviet-era products.

### 3.3.1 Analysis of the current state of locomotive traction operators

Currently, the services on the backbone network of JSC "Kazakhstan temir zholy" are carried out by locomotives of operators: JSC "Lokomotiv" (1559 units), JSC



“Locomotive Service Center” (64 units), LLP “Lokomotiv – 2030” (60 units), JSC “KedenTransService”(42 units), which have production infrastructures, locomotive crews and locomotives in the amount of 1725 units for their activities (see Table 3). Enterprises of the Association of Magistral and private companies that are not members of the Association (42 repair bases) are upgrading, overhauling and maintaining locomotives for the locomotive operators listed above.

Table 3. Technical passport of locomotive traction operators for 2010 – 2016 (adapted from the Ministry of national economy of the Republic of Kazakhstan 2017)

	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>
Total amount of locomotives	1 681	1 772	1 865,5	1 896,5	1 892,5	1 803,5	1 725,0
Electric locomotives	576	571	552	563	577	549,5	539,0
Diesel locomotives	1 106	1 202	1 313,5	1 333,5	1 315,5	1 254,0	1 186,0

Note: calculations are made by the author and the data is retrieved from the relevant company’s annual reports

The main part of the existing locomotive fleet was produced in the 1980s, the service life and quantity of which are distributed as follows: diesel locomotives - service life 25 years, inventory stock 715,5 units; electric locomotives - service life of 25 years, quantity 445 units.

The analysis of the current state of the locomotive fleet presented that, due to insufficient investment volumes over a long period, there was an accumulation of physical depreciation of fixed assets (see Table 4). As a result, most of the locomotives have a significant degree of deterioration in terms of service life (currently it is 72%). Maintaining the rolling stock in working condition requires high operating costs and high costs for their current repair. This, in turn, creates the danger of losing technological stability and determines a significant need for



<b>Freight wagons - total</b>	53 104	55 909	66 503	65 803	60 940	59 025	56 504
<b>covered wagons</b>	7 809	8 654	10 145	9 801	9 051	8 806	8 415
<b>open-top wagons</b>	23 727	26 298	32 413	32 329	30 982	30 797	30 146
<b>platform wagons</b>	4 823	4 246	3 992	3 725	3 360	3 000	2 280
<b>tanks</b>	6 280	6 152	6 634	6 492	5 769	5 657	5 438
<b>other wagons</b>	10 465	10 559	13 319	13 453	11 775	10 762	10 224

Note: calculations are made by the author and the data is retrieved from the relevant company's annual reports

The inventory park of JSC "KazTemirTrans" for the period 2010 - 2016 was reduced by almost 15%. This was mainly due to the alienation of freight cars from the number of long-standing cars and the exclusion of wagons from the inventory park at the end of their service life.

Table 6. Deterioration of the wagons fleet at the end of 2016 (adapted from the Ministry of national economy of the Republic of Kazakhstan 2017)

	<b>up to 5 years</b>	<b>5 - 10 years</b>	<b>10 - 15 years</b>	<b>15 - 20 years</b>	<b>20 - 25 years</b>	<b>over 25 years</b>	<b>Total amount</b>
<b>Freight wagons - total</b>	16 330	12 760	7 904	3 748	729	15 033	56 504
<b>covered wagons</b>	2 001	3 162	300	19	209	2 724	8 415
<b>open-top wagons</b>	300	159	-	-	112	1 709	2 280
<b>platform wagons</b>	10 056	6 622	7 453	1 555	96	4 364	30 146
<b>tanks</b>	820	909	1	2 172	133	1 403	5 438

<b>other wagons</b>	3 153	1 908	150	2	179	4 832	10 224
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Note: calculations are made by the author and the data is retrieved from the relevant company's annual reports

Average wear and tear of the inventory of freight cars of JSC "KTT" to date is approximately 60% (see Table 6). Despite the acquisition of new cargo wagons, the service life is approaching 100% in the significant part of the inventory park. Now about 26% of inventory stock have 100% wear, meaning that they have already worked out a standard service life.

### **3.3.3 The market state for private operators of freight cars**

The market of wagon operators in Kazakhstan is currently in the stage of active development.

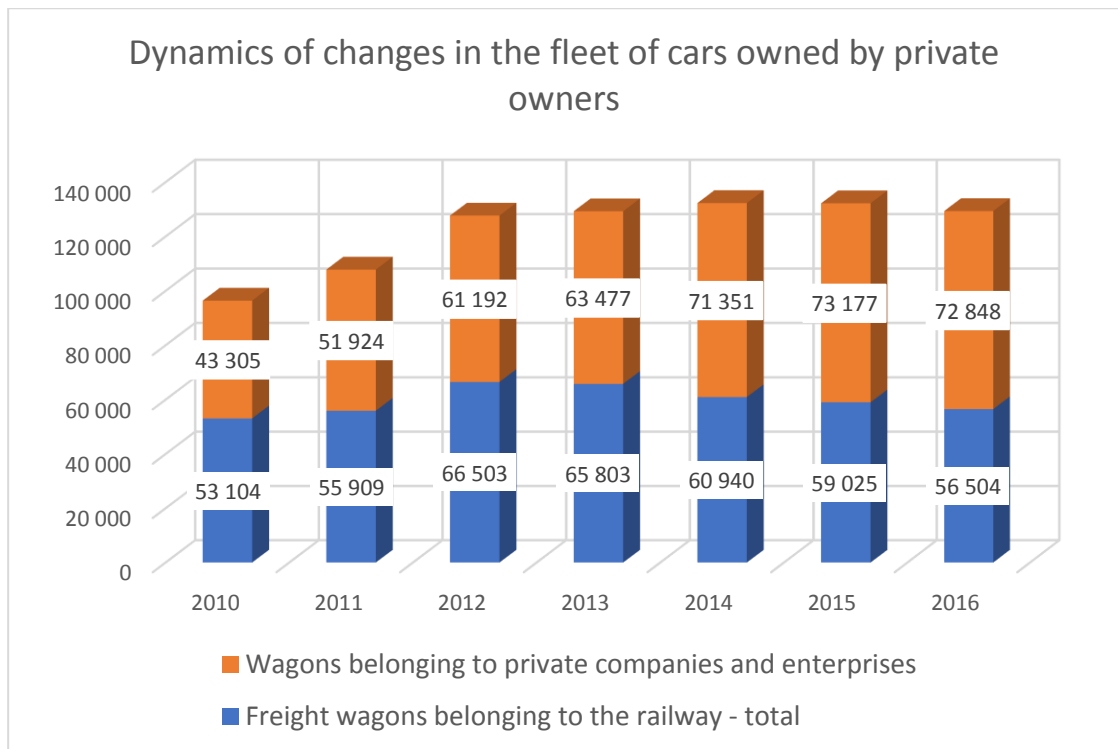


Figure 12. Dynamics of changes in the wagons fleet owned by private owners for 2010 – 2016 (adapted from the Ministry of national economy of the Republic of Kazakhstan 2017)

Note: calculations are made by the author and the data is retrieved from the relevant company's annual reports

Based on the chart, it is evident that the fleet of owners' wagons by the end of 2016 compared to 2010 increased almost 2 times, and the inventory of wagons is steadily declining (see Figure 11). Thus, there is a tendency of increasing the share of the private owners' wagon fleet by the acquisition of rolling stock and the decrease in the share of the cars inventory, as the disposal of freight wagons by service life and technical condition is much faster than the pace of updating and replenishment of the inventory park. Thereby, it can be concluded that today favorable conditions have been created in Kazakhstan for the functioning and development of private car operator services.

## 4 Theoretical implementation of solutions

### 4.1 Updating and modernization of rolling stock

Based on the presented analyzes, the current state of fleet parks is characterized by deterioration of the overall technical condition, the decrease in operational reliability and the sharp increase in operating costs. The average age of locomotives exceeds 25 years, their planned updating was not carried out during the last 5 years.

Therefore, updating the locomotive fleet is the main task. At the same time, when taking measures to update the traction rolling stock, the following objectives are pursued: reducing the cost of maintenance by reducing fuel and electric power consumption for traction of trains, increasing labor productivity through high efficiency of use, reducing the contingent of workers for maintenance, current repairs and equipment, locomotive brigades.

Several suggestions and improvements are presented by the author in order to decrease the current problems with updating the rolling stock:

- Electrification is one of the most possible way to develop the current situation with locomotives. Instead of spending a huge amount of money on maintenance and modernization of diesel locomotives, it is efficient and profitable to buy more electric locomotives. Electric traction is more efficient than diesel traction. It is indicated that the cost of energy carriers in diesel draft is 5-6 times higher than in electric traction. Other calculations show that the specific fuel consumption for diesel locomotives is 1,5-1,7 times higher than for electric traction, and electrification of the road will allow reducing the cost of traction maintenance by 40%. The consumption of energy carriers and their costs in monetary terms also shows the advantage of electric traction in comparison with the diesel one.
- The solution for the situation existing in the wagons area needs more creative point of thinking. Currently, the deficit of wagons in Kazakhstan's rail fleet is exceeding the amount of 22000 units. For repair and maintenance of cars in working condition, about 30 billion tenge are spent every year (Ministry for

investments and development 2017). In this case, a leasing instrument is becoming relevant.

There are three main advantages of this option:

1. Renting a freight railway car is much cheaper than buying a similar car;
2. scheduled repairs are usually made at the expense of the lessor;
3. leased freight cars do not stand idle waiting for cargo. (Egorov 2016.)

It should be remembered that the positive effect of using the leasing instrument is possible only if it is used in a significant amount for no more than several years in a row. Regular use of leasing schemes for the purchase of traction rolling stock will prove to be economically unprofitable, since year by year it will increase the burden on the company's budget. The company's expenses for renewal of the park in connection with the obligation to conduct annual payments will flow from investment to operational ones, which, in turn, may provoke the need to increase tariffs for the provision of infrastructure services and locomotive traction.

Since private enterprises, on the one hand, are not burdened with the need for mass and annual renewal of the park (in contrast to JSC "KTZ"), and on the other hand, do not have sufficient funds to update, the leasing instrument and its support from the state would be very appropriate. Nowadays, there is no program of state support for the acquisition of locomotives by means of a leasing mechanism, which does not facilitate its implementation in practice.

- Another possible solution is to attract private capital to upgrade the fleet of freight cars of the Republic of Kazakhstan. The involvement of private investments is most effective, since the renewal of the car fleet is achieved in a shorter period than with a budget subsidy or an increase in the tariff for the use of an inventory park. In order to attract private investment for the recovery of freight cars, and also in order to accelerate the elimination of "long-standing", it

is necessary to create enterprises together with private investors on the principles of public-private partnership.

Thus, it is proposed to distribute the inventory park as follows:

- to allocate a fleet of freight wagons with expired service life to affiliated companies of JSC "KTT" to establish market prices when using them in order to accumulate funds for the acquisition of new wagons;
- transfer to the created joint (with the participation of private capital) enterprises long-standing cars and repair bases for their restoration and cutting at the expense of private capital.

## **4.2 Implementation of the technology of changing the gauge in motion**

As it was identified earlier, one of the most important physical barrier in the development of the transport corridors is the question of docking the Chinese railway track with tracks located on the territory of Kazakhstan and Russia. After all, the European gauge has a standard size of 1435 millimetre, while the Kazakhstan railway track has a size of 1520 millimetre.

In order to ensure smooth movement of cargo flows from China to Kazakhstan, so-called "docking" nodes have been equipped in the border area where the carriages of one standard are moved to another one. On average, this operation takes up to 2 - 2,5 hours. At the same time, at the "docking" nodes, powerful jacks are used, raising the freight cars to the required height. There are also wheelsets which are mounted on the rolling stock and meets the required size of the railway's gauge.

However, by the author's opinion, a unique benefit can come from the Spanish development - a system for automatically changing the width of the gauge used. With it, the train does not need to stop at the border to change the wheel pairs. A special transfer device is placed at the border of the two railway lines. When passing



through it without stopping, namely at a speed of up to 15 km/h, the train's wheel track widens or contracts, depending on the direction of travel.

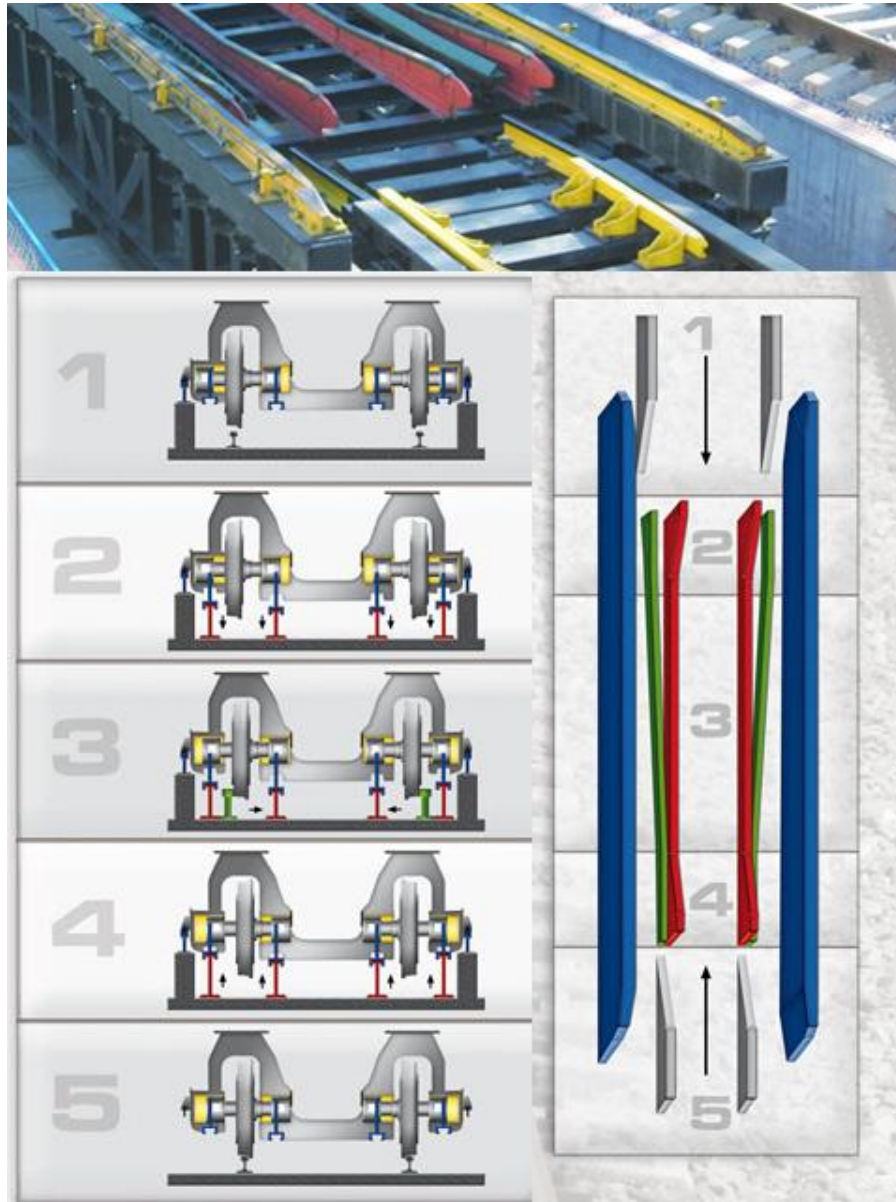


Figure 13. The system of changing the track's composition in motion without human intervention (adapted from Popov 2011)

There are five correction phases for each wheel pair when the train passes the transfer device.

1. The side parts of the trolley come into contact with the outer guides, the wheels are unloaded from the weight of the wagons;
2. The supports of the locks located at the bottom of the trolley are connected to the special guides and pressed downwards, at the same time they unlock the axle fastenings;
3. Special rails mounted at an angle, shift the wheels closer to each other or dilute them to the sides;
4. The locks move back up and fix the axles in the new position;
5. The wheels come into contact with the rails and the weight of the car is again transferred to them (see Figure 12).

Obviously, in addition to investing in this project, it is also necessary to purchase new types of freight cars capable of changing the widths of wheel sets. However, it is certain that with the financing of this idea, Kazakhstan will be able to significantly increase the turnover of goods and solve the problem of the car fleet deterioration.

## **5 Results**

The implementation of solutions for the two most crucial physical barriers were suggested in the theoretical view. Based on the empirical findings, the electrification opportunity was considered as the priority solution, since the reduction of costs comparing to diesel traction achieve 40% on average. The leasing instrument was taken as the second option, since the rent of locomotives and freight carriages is much cheaper than costs of maintaining. The third option was the attraction of private capital to upgrade the rolling stock based on the principles of the public-private partnership.

The expected results (if these actions will be considered) were presented below:

- Meeting the demand for rolling stock with high-quality technical characteristics for the transportation of the annually growing volume of cargo;
- Financial stability due to the huge savings through the involvement of more electric locomotives;
- Huge time savings because of implementation of new technologies on the border points;

In the author's opinion, all these actions will help to approach the fulfillment of the main goal - integration of Kazakhstan into the system of international transport corridors in the effective way.

## **6 Conclusion**

The primary goal of the thesis was to research and analyse the current state of railway transportation of Kazakhstan and identify the barriers that prevent the use of international transport corridors in the effective way.

During the study, the effectiveness of railway corridors as the component of external transport market from 2010 to 2016 was calculated. The results showed, that the transport corridors do not satisfy the needs of the national economy. Moreover, the author decided to go deeper into the topic. Therefore, the main problems of railway transportation were identified and divided into two sections: non-physical and physical barriers. The further analyses were focused on the barriers of physical nature: the outdated fleet of rolling stock and the distinction of the railways gauge width. The results defined, that these issues hamper the integration of Kazakhstan into the world transport market. The second research question was also answered, and the possible solutions were presented.

## **7 Further research suggestions**

As it could be noticed, the author researched and analysed only two physical barriers existing in railway transportation of Kazakhstan. Obviously, that in order to be the strong transport connection between Asia and Europe all barriers and problems should be considered and solved. In addition, the solutions were suggested in the thesis only from theoretical point of view, meaning that they are also needed to be researched deeper.

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