DOI: 10.15838/esc.2024.3.93.15
UDC 338.27(571.60), LBC 65.054

Development of Inland Waterway Transport in Russia and the Experience of China

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Abstract. In Soviet times, inland waterway transport played a decisive role in the exploration of the country's remote areas. The year 1985 witnessed the peak of its development, when the world's highest volume indicators were achieved. Currently, China is the world leader in this sector, having managed to transform inland waterway transport from an inconspicuous economic sector into a dynamically developing means of transport within 45 years. China's achievements deserve attention, especially in terms of the scale and speed of the process. While Russia and China differ significantly in population density, production volumes, and seasonality of water transport, they have certain similar characteristics as well (vastness of territory, length and configuration of inland waterways, possibility to reach poorly developed areas). The article identifies four stages in the development of inland waterway transport, differing in goals, objectives, financing mechanisms and tools for the implementation of development

For citation: Leonov S.N., Zaostrovskikh E.A. (2024). Development of inland waterway transport in Russia and the experience of China. *Economic and Social Changes: Facts, Trends, Forecast*, 17(3), 258–274. DOI: 10.15838/esc.2024.3.93.15

goals set for a specific stage. It is shown that the development of inland waterway transport in the Russian Federation is determined by the complex economic and geographical characteristics of the country and by accumulated system-wide problems in the development of the sector. The latter include insufficient financing of inland waterways; shortage of modern vessels; low investment attractiveness and insufficient investment in the industry; poor interaction with other means of transport, which deprives inland waterway transport of part of the cargo base; shortage of modern transshipment complexes; outflow of skilled personnel from the industry. In order for the Russian inland waterway transport to regain its influence on the country's territorial development, it is necessary to use China's experience in organizing financing projects in this area, developing a training system, and combating interspecific competition in transport. Scientific significance of the study lies in the theoretical analysis and comparative assessment of the level of development of inland waterway transport in Russia and China. Proposals for addressing the accumulated problems of Russian river transport based on the use of China's experience in promoting the activities of inland waterway transport are of practical importance.

Key words: inland waterway transport, backbone network of inland waterways, Russia, China.

Introduction

The importance of transportation infrastructure is always manifested at crucial moments of the country's development. Increased attention to the development of infrastructure of inland waterway transport (hereinafter – IWT) in Russia is currently associated with the sanctions against the Russian Federation, which requires the creation of highways of special importance that will not only contribute to the development of domestic transportation, but also ensure the effective functioning of international transport corridors[1]. In this regard, the Government of the Russian Federation has developed documents providing for the "debottlenecking" and development of the backbone network of inland waterways of the country[2].

The Russian IWT played a determining role in the development and exploration of territories, especially in remote and hard-to-reach regions, and its development peaked during the Soviet era, when the highest volume indicators were reached in 1985 (Miloslavskaya, Trotsenko, 2007).

China is currently the world leader in inland waterway transportation, having succeeded in transforming the IWT, which 40 years ago was a low-profile sector of its economy, into a dynamic mode of transportation as a result of successive multi-year reforms in the triad of "cargo base, river vessels, waterways". The dramatic growth of China's IWT has facilitated the development of areas along riverbanks and turned inland waterways into economic corridors for the development of the PRC's western territories (Aritua et al., 2020).

China's achievements in IWT development are noteworthy, especially in terms of the scale and speed of this process. It is definitely difficult to compare the IWT of different countries in terms of transportation volume, ship size and shipping lanes. Nevertheless, China's experience is being explored in many countries to revitalize the IWT system[3] (Amos et al., 2009).

[1] Muzlova G.I. (2024). Highways of special importance. *Morskie vesti Rossii*, January 12, 2024. Available at: https://morvesti.ru/analitika/1690/106978/ (accessed: February, 15, 2024).

[2] Draft Concept for the Development of Inland Waterways of the Russian Federation until 2024. Available at: https://mintrans.gov.ru; Transport Strategy of the Russian Federation up to 2030 with a forecast for the period up to 2035, 3363-r, dated November 27, 2021.

[3] Promoting inland waterway transport in the People's Republic of China. Mandaluyong City, Philippines: Asian Development Bank, 2016. Available at: https://www.adb.org/publications/promoting-inland-waterway-transport-prc (accessed: February 15, 2024).

Undoubtedly, Russia and China differ significantly in terms of population density, industrial production volumes, and seasonality of the IWT operation. However, there are similar characteristics: vastness of territory, uneven development of productive forces, as well as the length of inland waterways in use, their configuration, the ability to serve the deep and underdeveloped regions of the country.

Let us try to answer the questions of how and why such a serious failure in the development of the IWT was formed in the Russian Federation over the last 45 years. Is the Russian IWT destined to suffer the fate of the cart transportation that befell the latter in the early 20th century? Under what conditions can the period of revival of inland waterway transport come in Russia, and what conclusions should Russia draw from China's lessons in the IWT development?

Research materials and methods

The methodological basis of the work is system and comparative analysis, methods of statistical analysis. The information base is the data of state programs for waterway transport development, state and departmental statistics of Russia and China, as well as analytical documents of federal authorities, official reports of the administration of Russia's water basins.

Literature review and problem statement

Studies on the impact of waterway transport on the development of regional economy form a significant section of works on classical infrastructure topics. The presence of the developed transport infrastructure is noted to have a positive impact on the region and can be manifested in the reduction of transport costs, increase in the level of transport accessibility, development of logistics services for the population, growth in the volume of foreign trade, increase in the turnover of money in the region, increase in the volume of investment in infrastructure development, improvement of labor productivity, attraction of other types of economic activities, growth of employment and welfare of the population, growth of agglomerations (Fujita, Mori, 1996; Notteboom et al., 2009; Shcherbanin, 2011; Witte et al., 2014; Isaev, 2015; Park, Seo, 2016; Krasnopol'skii, 2018; Mel'nikov, 2019; Leonov, Zaostrovskikh, 2021; Xiao et al., 2022).

As a rule, transport development in conjunction with the regional economy is sequential: at the first stage, the skeleton of transport communications is formed; at the second stage, the volume of transportation is increased due to the development of production; at the third stage, transportation services are created; at the fourth stage, international transport corridors are formed. The sequential replacement of one stage by another leads to the formation of a balanced unified transportation system and its adequate elements, where the key is the creation of a backlog ahead of the infrastructure elements, to support the stable and sustainable development of the economy of the region and the country as a whole (Bely, 2009; Persianov, Sakul'eva, 2014; Krasnopol'skii, 2018).

At present, Russia's IWT is a significant infrastructure complex that provides transportation links with 52 constituent entities of the federation. Inland waterways have an extensive network of water communications, which makes it possible to use them both for transportation services to remote areas and for areas located at the intersection of the country's main highways. There are 117 ports functioning on inland waterways, eight of which are open for international traffic and are transportation hubs for multimodal transportation. The river fleet has 12.7 thousand vessels of various purposes, the average age of which is 33 years[4]. The Unified Deep Water System (hereinafter – UDW) of European part of the Russian Federation, which unites eight of the thirteen basins of the country, occupies a special place in the IWT structure. A significant part of

[4] Transport Strategy of the Russian Federation up to 2030 with a forecast for the period up to 2035, 3363-r, dated November 27, 2021.

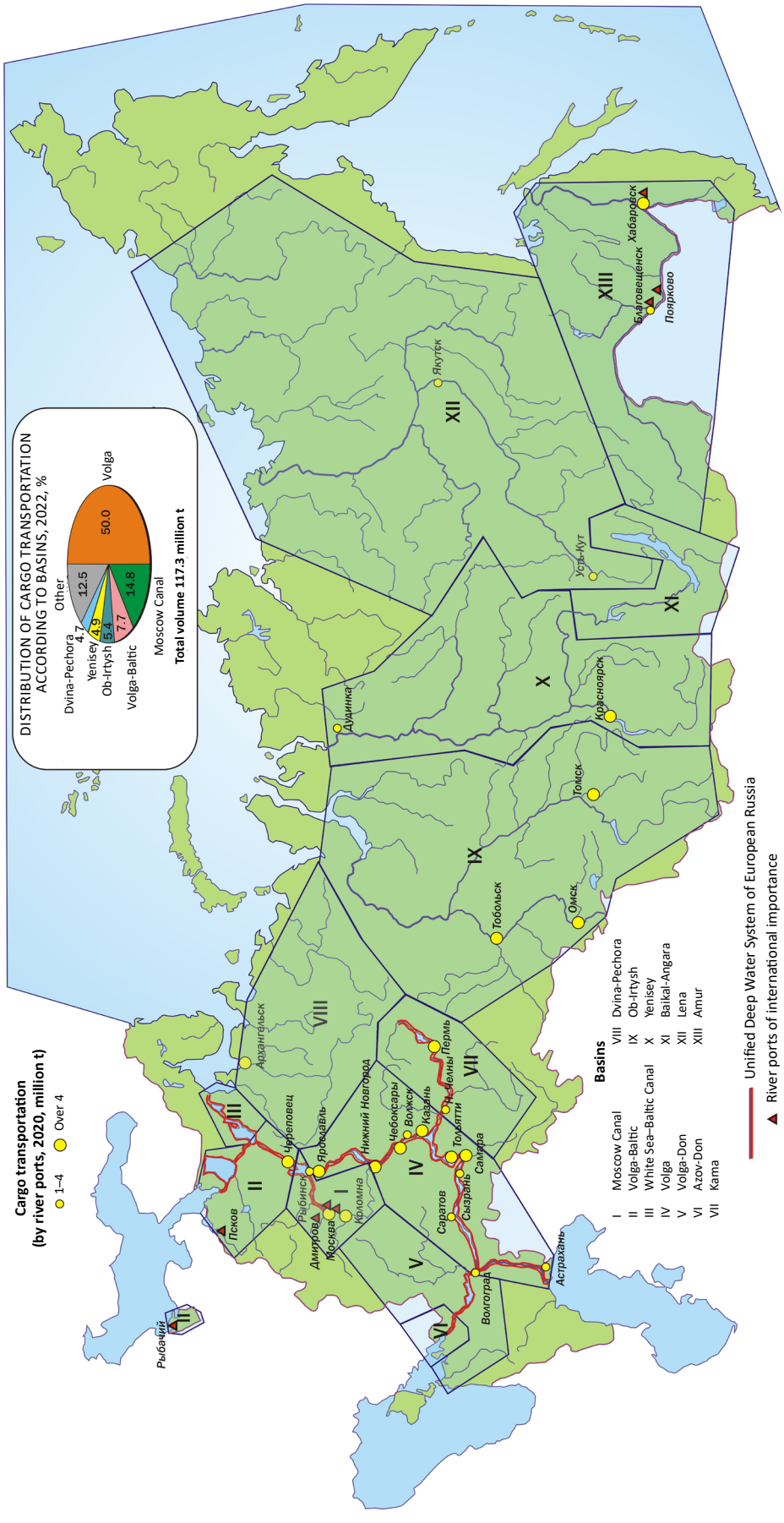


Figure 1. Scheme of federally managed inland waterways basins in Russia

According to: On the definition of basins of inland waterways of the RF: Order of the Ministry of Transport of the RF 316, dated August 17, 2012 (with amendments and additions from September 29, 2023); (Dmitrieva, Maslova, 2023).

Russia's cargo transportation (82%) falls on these eight basins of the UDW, located in the developed regions of the country, where the directions of transportation flows mainly coincide with the "north–south" inland waterways *(Fig. 1)*.

The features of Russia's IWT development are determined by complex economic and geographical characteristics: limited navigation period (240 days in the south of the country due to river shoaling, 120–150 days in the north due to ice drift); meridional location of main rivers with latitudinal direction of main transportation routes; low density of population and industrial enterprises along the banks of main rivers; small dimensions of ship passage; long payback period of river vessels due to limited navigation period (Egorov, 2021).

Along with the noted economic and geographical features, there are a number of systemic problems in the development of Russia's IWT: insufficient financing of inland waterways and hydraulic structures; shortage of modern ships, the need for which by 2035 will amount to 500 units[5]; low investment attractiveness of industry enterprises and the level of investment insufficient for cardinal modernization of their fixed assets; poor interaction with other modes of transport, which deprives the IWT of a part of the cargo base; shortage of modern transshipment facilities; lack of modern cargo transportation facilities; outflow of skilled personnel from the industry (Shcherbanin, Golubchik, 2017)

Given the enormous tasks set before the IWT to ensure domestic and international transportation[6], in the near future Russia will have to make a "quantum" leap in the construction and modernization of transport infrastructure, as well as the transformation of the systems of financing, management and training of personnel for this industry.

[5] Huge, but as yet unrealized potential. *Morskie vesti Rossii*, June 20, 2023. Available at: https://morvesti.ru/news/1679/103357/ (accessed: February 15, 2024).

[6] Transport Strategy of the Russian Federation up to 2030 with a forecast for the period up to 2035, 3363-r, dated November 27, 2021.

Let us consider how problems in the development of inland waterway transport in Russia have arisen and why they have accumulated.

Periodization of the formation of the Russian IWT

The problems peculiar to the Russian IWT have been forming for many years. During almost half a century (1980–2023) four stages of the Russian IWT development are distinguished, differing in the declared targets, solved problems, financing, management and personnel training systems for the industry *(Table)*.

The first stage (1980–1990) is associated with the formation of a unified transportation system and the creation of large-scale infrastructure projects in the country. The tasks of ensuring interconnection between the IWT and other branches of the national economy, as well as between different modes of transportation were put in the foreground. The Central Research Institute of Water Transport Economics and Operation (TsNIIVET) played a key role in the elaboration of the General Scheme of River Transport Development. The main objective of this scheme, based on regional and sectoral specifics, was to develop a comprehensive approach that took into account the ratio of freight traffic volumes, the number and structure of river vessels, and the specialization of ports and ship repair enterprises (Grigor'ev, 1982; Zolotarev et al., 1986; Zaostrovskikh, 2017). As part of the accelerated industrial development of the Far North, Siberia and the Far East, the task was set to form river communications with access to the Northern Sea Route (Goncharenko et al., 2017). Under the influence of the container revolution that unfolded in the world, the second task was formulated by the middle of this stage – the development of transport hubs and the formation of the general scheme of the container transportation system of the country. In fact, this stage was characterized by "competition" not only in quantitative indicators

Description of the main stages in Russia's IWT development

	First stage 1980–1990	Second stage 1991–2000	Third stage 2001–2013	Fourth stage 2014–2023
Main goal	Formation of the Unified Water Transport System of the country	Overcoming disproportions in the development of the IWT, resulting from changes in transportation links	Modernization of infrastructure, improvement of efficiency and competitiveness of the IWT	Creation of highways for the development of domestic and international transportation
Main tasks	Creation of the UDW; formation of the General Scheme of the container system of the country	Modernization, increase of efficiency and competitiveness of the IWT	Reorientation of mass cargoes from land to inland waterways	Formation of river transportation corridors to support the Northern Sea Route and the North-South direction
Interrelation of the IWT and regional economies	Close relationship between production and transportation	Transportation is distinguished as an independent system		Revitalization of production and transportation systems
	Comprehensive development of the IWT in coordination with the country's needs; balanced development of cargo transportation, ships, inland waterways, ports and ship repair base	Changes in transportation links, emergence of intraspecific and interspecific transportation competition; haphazard development of transportation infrastructure facilities		Attempt to comprehensively justify the development of cargo transportation, vessels, inland waterways, ports and ship repair facilities; interspecific competition
Funding	Planned state funding of transport infrastructure facilities of the IWT	Emergence of financial security problems. River steamship companies and ports corporatization	The total amount of financing for 2001–2009 amounted to 3.6 billion rubles Federal subsidies for passenger transportation on interregional routes and cargo transportation to the Far North	Total funding for the period 2019–2024 is 281.96 billion rubles Subsidies from the federal budget for passenger transportation on interregional routes and the importation of socially important cargoes to the Far North regions
Regulatory documents for the IWT development	General scheme of river transport development	Program of revival of the Russian merchant fleet for 1993–2000.	Subprogram "Inland Waterway Transport" of the Federal Target Program "Modernization of the Transport System of Russia"	The IWT development strategy of Russia's waterways for the period until 2030; Concepts for the development of Russia's inland waterways for the period until 2024.
IWT status for the last year of the phase	Cargo transportation volume 516.7 million tons	Cargo transportation volume 116.8 million tons	Cargo transportation volume 137.3 million tons	Cargo transportation volume 108.7 million tons
	Volume of passenger transportation 89.8 million people	Volume of passenger transportation is 27.7 million people	Volume of passenger transportation 13 million people	Volume of passenger transportation is 10.5 million people
	Volume of transportation of the IWT cargoes to the Far North 49 million tons	Volume of transportation of the IWT cargoes to the Far North 14 million tons	Volume of transportation of the IWT cargoes to the Far North 18 million tons	Volume of transportation of the IWT cargoes to the Far North 16 million tons
	Cargo transshipment in ports 917 million tons	Cargo transshipment in ports 150 million tons	Cargo transshipment in ports 176 million tons	Cargo transshipment in ports 125 million tons

According to: Program for revival of the Russian merchant fleet for the period 1993–2000 1034, dated December 30, 2000; Subprogram "Inland waterway transport" of the federal target program "Modernization of the transport system of Russia (2002–2010)" MK-P-10-13850, dated November 19, 2003; Strategy for the Development of Inland Waterway Transport of the Russian Federation until 2030 372-r, dated February 29, 2016; draft concept for the development of inland waterways of the Russian Federation until 2024 (https://mintrans.gov.ru); Transportation and communications in Russia: Statistical compendium. Goskomstat of Russia. Moscow, 2001; Transport in Russia. 2022: Statistical compendium. Rosstat. Moscow, 2022; (Zolotarev et al., 1986; Kostygina, 2004; Miloslavskaya, Trotsenko, 2007; Dmitrieva, Maslova, 2023).

(tons, t/km, pass/km), but also in qualitative ones, such as the speed of container handling in the port, the coefficient of technical equipment, etc. (Kilin, 1980; Krivoshei, 2010).

Thanks to the created balanced transportation system, a radical re-equipment of the IWT was carried out. The 6.5 thousand km long and 365 cm deep UDW made it possible to use river-sea vessels and develop international transportation. With the help of canals, the UDW had access to five seas: the White, Baltic, Black, Azov and Caspian seas (Aksenov, 1980). The development peak of the Russian waterways was in 1985, when the length of the operated inland waterways was 126.6 thousand km, the cargo transportation volume was 632.6 million tons, and 26.3 thousand technical vessels were on the balance of the administrations of inland waterways basins. Passenger transportation amounted to 132 million people, passenger turnover – 5.9 billion passengers/km. Such indicators made Russia a world leader in the IWT development (Miloslavskaya, Trotsenko, 2007).

The second stage (1991–2000) was initiated by the collapse of the Soviet Union, which led the transportation sector, like other economic spheres, to a deep systemic crisis. Due to the abolition of the unified system of cargo transportation provision, approaches to the formation of demand for cargo transportation and its planning changed. And the law adopted in 1992 on the abolition of supplies of products and goods for state needs[7] finally consolidated the rejection of centralized distribution of material and technical resources, which gave rise to large-scale problems in providing transportation to the Far North, Siberia and the Far East.

The primary tasks in the IWT development during this period were overcoming the crisis and creating a transportation infrastructure to meet the needs of the country's economy[8].

As competition appeared on the market of transportation services, the IWT developed within the framework of market requirements, increasing infrastructural limitations. To survive, many enterprises were forced to engage in activities that were not typical for them before. River ports, for example, began performing not only transshipment operations, cargo storage and repair of used equipment, but also cargo transportation. River vessels had the hardest time, as the cost of river transportation was 25–30% higher than that of railroad transportation (Krivoshei, 2010).

At the same time, the unfolding process of corporatization and privatization of the IWT enterprises disrupted the planned work on renewal of river vessels, reconstruction of previously operating communications, as well as increasing the guaranteed depth on the UDW from 365 to 400 cm (Belov et al., 1987). The reform process took place under conditions of a sharp decline in the volume of transportation, massive mutual non-payments, and rising prices for all material and technical resources. It is no surprise that the decline in production volumes in the main cargo-forming industries sharply affected the final indicators of the IWT. In turn, the population outflow from the northern regions, as well as the closure of a number of industrial production facilities led to a 3.5-fold decrease in cargo delivery to the Far North. During the period under consideration, not only the nomenclature of cargoes, but also the transportation volume by basins of the country changed (Miloslavskaya, Trotsenko, 2007). The volume of freight transportation decreased 4.4 times compared to 1990 and amounted to 116.8 million tons in 2000 (see Table).

[7] On the organization of work to implement RF Law 2859-1, dated May 28, 1992 "On the supply of products and goods for state needs": RF Government Resolution 638, dated August 27, 1992.

[8] Federal target program "Revival of the merchant fleet of Russia (1993–2001)", federal target program "Modernization of the transport system of Russia (2002–2020)".

The third stage (2001–2013) of inland waterway transport development was aimed at overcoming the negative trends of the 1990s and differed from the previous two stages by increasing the level of competitiveness of inland waterway transport due to the reorientation of a part of mass cargo from land routes to inland waterways. From the methodological point of view, it was important not only to improve the IWT system, but also to develop economic methods to provide a "reserve" of transport infrastructure in accordance with the international requirement of the transportation services market. In other words, it was important to take into account not only the operational costs of transportation, but also the external costs of society for the IWT functioning (Bugromenko, 2009).

The key objectives of the stage were declared to be modernization, improvement of efficiency and competitiveness of the IWT through construction of new generation ships and development of ports with due regard to modern requirements. For this purpose, it was planned to replace transshipment equipment in the ports of Samara, Ust-Donetsk, Azov, Yeisk, Astrakhan, and to dredge up to 4 m along the entire length of the UDW[9].

Since 2001, there has been a positive trend in the development of the IWT freight transportation, the volume of which increased 1.5-fold to 151 million tons between 2000 and 2008. However, the economic crisis had a strong impact on the IWT indicators. In 2009, the volume of transportation fell to 97 million tons (64% of the 2008 level), and compared to 1989, the volume of the IWT transportation in Russia decreased almost six times. The shortage of modern transshipment complexes and port terminals with an excess of outdated and inefficient transshipment equipment hampered the development of container transportation by waterways (Miloslavskaya, Trotsenko, 2007). This forced cargo owners to refuse to transport cargo through river ports, so it was impossible to switch mass cargoes from land routes to inland waterways. As a result, the transportation process of a single production and technological complex (river vessels, ports, ship repair bases) was disrupted.

In addition, due to the merger of maritime and river services of the Russian Ministry of Transport[10], the structure of river transport management underwent serious changes and actually dissolved into the Federal Agency of Maritime and River Transport in 2004 (Krivoshei, 2010). As a result, the Research Institute of Water Transport Economics (TsNIIVET) actually ceased its activities.

At the same time, such transportation issues of the 1990s as rational distribution of freight flows by individual modes of transportation, door-to-door management of transportation services, and comparison of the system of the IWT indicators with other modes of transportation were left unattended and unresolved (Zaostrovskikh, 2017).

During the fourth stage (2014–2023), it was planned to reorient mass cargo from land routes to inland waterways. In the future, the focus was supposed to shift toward the creation of thoroughfares of special importance for the development of domestic and international transportation. This was supposed to ensure the growth of competitiveness of the IWT in relation to other modes of transportation, increase the availability and quality of its services for shippers[11].

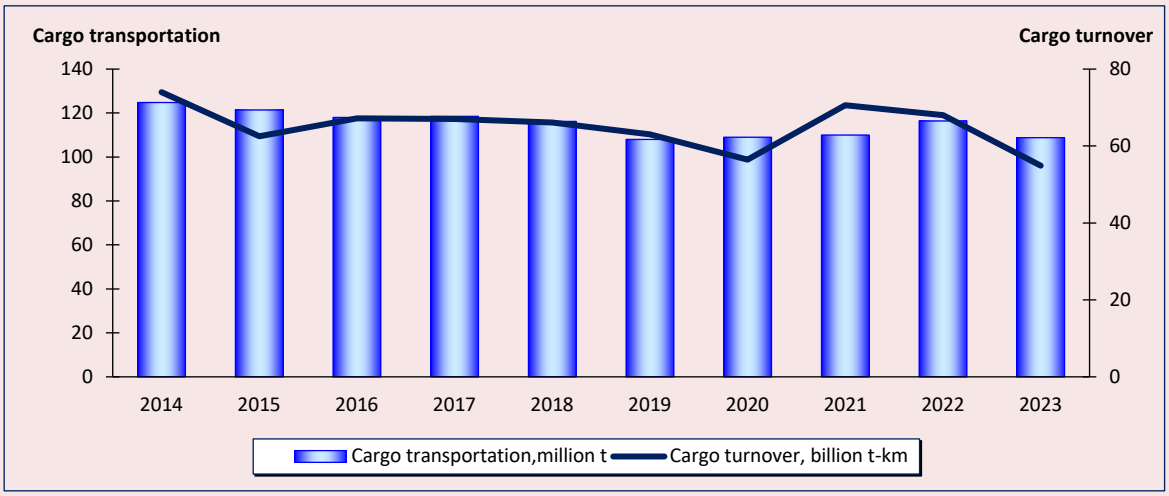
However, it is impossible to realize these tasks of the IWT. The volume of cargo transportation decreased by 12.8% and cargo turnover by 25.8% compared to 2014 with the unchanged total length of inland waterways (100–101 thousand km) by 2024 *(Fig. 2)*.

[9] Subprogram "Inland waterway transport" of the federal target program "Modernization of the transport system of Russia (2002–2010)", dated November 19, 2003. We should say that the task of ensuring guaranteed depths of 400 cm at the UDW has not been solved so far.

[10] On the system and structure of federal executive bodies: Presidential Decree 314, dated March 9, 2004.

[11] Strategy for the Development of Inland Waterway Transport of the Russian Federation until 2030 372-r, dated February 29, 2016.

Figure 2. Dynamics of cargo transportation and cargo turnover of Russia's IWT



According to: Transportation and communications in Russia: Statistical compendium. *Goskomstat of Russia*. Moscow, 2001; Transport in Russia. 2022: Statistical compendium. *Rosstat*. Moscow, 2022.

The prerequisites for the decrease in indicators by 2024 were, on the one hand, international economic sanctions, on the other hand, internal reasons caused by low water levels in the rivers (river vessels operated underloaded), as well as the reorientation of cargoes to land transport modes after the completion of a number of large oil and gas projects.

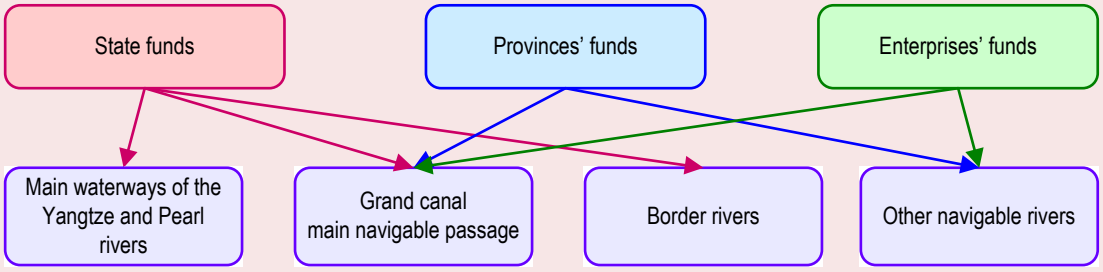
In fact, it is at this stage that a certain "fading" of the IWT activities in Russia takes place. The main mass cargoes move from inland waterways to railroads and pipeline transport, and other cargoes – to road transport. During the analyzed years the Russian IWT has turned into a highly specialized type of transport for transportation of mineral and construction materials[12], and its share in the total volume of cargo transportation by the transport complex of the country has been steadily decreasing. If in 2000 it amounted to 4.5%, then by the end of 2023 it will be only 1.3%.

[12] The predominant cargoes of the Russian IWT are mineral and construction materials (43%), coal (19%), cement (6%) and grain (3%).

Main problems of the Russian IWT

We should state that by now Russian inland waterway transport has lost its leading positions in the world, ceding them to China. On the one hand, on the whole, the IWT at the fourth stage to some extent repeats the development trajectory of the second half of the 1990s, when an important emphasis was placed on the balanced development of cargo transportation, ships, inland waterways, ports and ship repair facilities. On the other hand, there is a significant difference: the IWT development is reduced to the formation of highways of special importance from the interior of the country to the ports for the purpose of exporting raw materials. At the same time, the tasks of developing the Far North, Siberia and the Far East, development of transport communications to ensure the national security of the country are poorly taken into account. The most serious problems of the Russian IWT are the lack of financial resources, personnel shortage and destruction of the system of integrated development of the IWT in interaction with other modes of transportation.

Figure 3. Main sources of financing for the development of China's inland waterways



Source: (Aritua et al., 2020).

What makes China's IWT experience interesting for Russia?

Unlike Russia, China has managed to transform its own IWT system from an inconspicuous infrastructure industry into the busiest means of transportation in 45 years (1978–2023). The length of inland waterways during this period has increased by 19% and amounted to 128 thousand km; cargo transportation volume increased 10 times (from 436 million tons to 4.4 billion tons), and IWT turnover increased 14.5 times and reached 1.9 billion tons/km. The volume of cargo transshipment in PRC river ports in 2022 exceeded 5.5 billion tons of cargo, of which 58% in domestic traffic and 42% in overseas traffic. In fact, the IWT has become one of the key means of transport in providing transportation within China (17%), overtaking rail transport (10%) (Aritua et al., 2020). Modernization of China's IWT infrastructure required huge investments within the framework of the established multichannel system of financing the IWT reform, transforming the education and training system, and changing the IWT management system.

1. Changes in China's IWT management system. The existence of a large inland waterway network required a clear distribution of responsibilities at all levels of government, so China's IWT is under the jurisdiction of the Ministry of Transport and provincial transport departments. The Ministry of Transport has overall responsibility for the policy and administration of inland waterways, as well as for planning the operation of canals of national importance. The provincial departments of transportation are responsible for waterways of local importance. The Ministry of Water Resources is responsible for the development of inland waterway and port infrastructure, taking into account national, provincial and municipal plans (Aritua et al., 2020).

2. Financing of China's IWT reform. Orientation on large-scale development of China's waterways required huge capital investments for construction and maintenance of the emerging transportation infrastructure. During the reform period, China managed to create a multichannel extensive system of financial sources for investing in the development of waterways, which, despite its multi-element nature, had built-in mechanisms for controlling the targeted use of funds *(Fig. 3)*.

In general, China's IWT reform focuses on a range of project funding sources (Aritua et al., 2020; Lu, Aritua et al., 2023):

– state (central and local) budget funds;

– trust funds of the Ministry of Transport, which were formed from the tax on the purchase of vehicles, fees for the construction of ports and special allocations for the development of inland waterways;

– loans provided by Russian (mainly state-owned) and foreign banks;

– funds from local government budgets;
– enterprise and institutional funds.

Multi-channel fundraising opportunities have been widely utilized by the Chinese government at the provincial level of management, which has shaped preferential policies and a blended financing model to finance navigation and energy solutions based on co-investment, risk sharing and profit sharing. To this end, concession models have been used by financial organizations and the government. The benefits of such multidisciplinary projects were shared in proportion to each party's share of the investment. The experience has been successful, and local government investment platforms have been established in a number of places to invest in local waterways (Aritua et al., 2020).

Government funds are the determining financial source of support for the IWT development. China applies a hierarchical model of waterway management, in which central government agencies are responsible for the maintenance of navigation aids and lighthouses on the main waterways of the Yangtze and Heilongjiang (Amur) rivers and state-owned coastal main waterways; local governments are responsible for the maintenance of waterways and navigation aids within their jurisdictions. The main sources of funds for waterway maintenance are waterway maintenance fees, enterprise revenues, local financial subsidies, and other transportation and port charges for cargo transportation (Lu et al., 2023).

In August 1992, the Ministry of Transportation, together with the Ministry of Finance and the State Price Control Bureau of China, issued the "Measures on the collection and utilization of inland waterway maintenance fees". The document clarified the scope of waterway maintenance fees, adjusted the standard of the fee, and specified that waterway maintenance fees are collected and managed by divisions of transportation departments, which strengthened control over the targeted use of fees for waterway maintenance and development. The active establishment of trust funds for inland waterway development in China began under the Ninth Five-Year Plan (1996–2000), when the central government established trust funds for waterway development, requiring the Ministry of Transportation to allocate a portion of funds from the vehicle purchase tax and port construction fees to waterway construction and the IWT development[13].

It is worth noting the flexibility of the Chinese government's policy on the design of port service charges. In 2020, amid the COVID crisis, the Ministry of Transportation reduced the existing port service charges by 20% to help renew the business environment and restart the operation of logistics companies[14].

The amount of foreign capital, which also began to be attracted during the years of China's Ninth Five-Year Plan (1996–2000), amounted to about 1 billion US dollars by 2019. Loans from international financial institutions accelerated infrastructure projects in China and helped standardize and modernize the management of inland waterways. The World Bank, Asian Development Bank and other international financial institutions have carried out project management and introduced standardized systems and practices from project preparatory work, project implementation (including bidding and tender management) and post-project evaluation to ensure smooth project implementation. The introduction of advanced international management concepts

[13] Between 2005 and 2007, 150–200 million US dollars was invested annually for inland waterway construction. Since 2008, annual investment has increased to 300 million US dollars, and in 2018, the Ministry of Transportation invested more than 1.5 billion US dollars in trust funds for inland waterway construction development. At the same time, local governments raised about 1.14 billion US dollars (Aritua et al., 2020, p. 57).

[14] Ageev A. China cuts port service charges to incentivize supply chains. Available at: https://glavpaluba.ru/ports/1271-kitaj-snizhaet-portovye-sbory-za-obsluzhivanie-chtoby-stimulirovat-logisticheskie-cepochki (accessed: February 11, 2024).

and experience has played an important role in bringing China's inland waterway construction and maintenance management in line with global practices (Lu et al., 2023).

The role of the central government is to develop and implement policies and measures, and to encourage and support parties investing in waterway construction. Tiered and multi-level and multi-channel project financing mechanisms are used for the construction of local waterways. Examples of such multi-channel financing sources include loans from banks (most often state-owned banks that implement economic and trade development financing policies for public investment projects), commercial bank funds, public funds, investment platforms and direct investment from enterprises.

Examples of regional initiatives to finance the construction and maintenance of inland waterways in China are numerous[15].

Investors putting into the construction of inland ports and waterways shall be allowed to carry out comprehensive land development through land reclamation and use the proceeds for the IWT development. Compensation fees for any damage or occupation of waterways and enclosing structures, as well as maintenance funds reserved for construction projects, should be used for the rehabilitation, construction and maintenance of waterways.

[15] For example, the Guangdong provincial government allocates about 70 million US dollars annually for the construction and maintenance of waterways, which covers a significant share of work related to waterway maintenance in the province; in Gansu and Jilin provinces, the main costs of waterway maintenance and management are directly included in provincial budgets; the central government authorizes the establishment of special IWT companies that are responsible for financing, operational asset management and loan repayment of the IWT projects (in Jiangxi and Hunan provinces, port and waterway investment and development groups have been established that are responsible for investment and financing, construction and operational management of IWT infrastructure); the central government is encouraged to canalize waterways by building dams with both power generation and navigation facilities, directing the revenue from power generation to further improve waterways (for more details, see Aritua et al., 2020, p. 59).

3. China's education and personnel training reform for the IWT was directly linked to the reform of the water transport market in the 1980s. The opening of the domestic market led to a sharp increase in the number of private ship owners whose crews lacked ship maneuvering experience and engine maintenance skills. This, along with the modernization of the IT sector, the growth of international trade and the introduction of new information and communication technologies, increased the need for logistics managers and middle and senior management staff in inland shipping companies. Modernization of the industry required continuous improvement of qualification of personnel and crews of inland shipping companies. To dilate the resulting problems, reform in the IWT training system was required, which "overlapped" with the overall development model of higher education in China in terms of university mergers (Li et al., 2023).

China's universities and vocational schools at all levels have been reoriented to meet the growing demand for skilled IWT personnel. An important point was that, as part of the reform process, the central government increased the autonomy of waterborne transport training institutions, leaving only the recommendation function.

To adapt more actively to the development needs of the water transportation industry, the Ministry of Transportation changed the structure of water transportation education institutions and established new higher education institutions. In 1992, Wuhan Maritime Engineering College merged with Wuhan Institute of Water Resources of Transportation, officially changing its name to Wuhan University of Transportation. Dalian Maritime College then changed its status to Dalian Maritime University. The establishment and development of the two universities has created a favorable environment for improving the quality of education to the academic level in shipping and water transport engineering in China (Aritua et al., 2020).

The Ministry of Transportation and local governments have jointly established several water transport vocational schools, including Guangzhou Maritime Institute, Jimei University Maritime College and Wuhan Transport University Water Transport Vocational College.

China's established system of inland navigation universities and schools is unique. China has become the only country in the world with inland navigation universities. In other nations in the world, inland navigation education is usually limited to vocational schools and training schools (Lu et al., 2023).

In fact, China has managed to revitalize the IWT over the previous four decades by implementing a long-term central government policy that was clearly oriented toward achieving the postulated goals, coordinating the central and provincial governments with strong central leadership, clearly supporting multichannelization and diversification of financial resources, and reforming the education and training system for the IWT.

Discussion

It is worth noting that there is no real continuity and consistency in solving problems by stages when analyzing the development of the Russian IWT. Unresolved problems of the Soviet period in the conditions of a deep system crisis in the 1990s did not allow the IWT to fully transition from the first stage of development to the second, where the main goal was to improve all structural elements as the volume of transportation grows. The third stage of the IWT development, like the second one, only partially corresponds to the set of necessary conditions (development of transportation services), so it can hardly be called complete. The fourth stage implies the formation of highways for the development of inland and international transportation. However, to implement this stage, it is necessary to build the supporting infrastructure that would meet the modern needs of the country's economy. There are no such obvious steps, so we cannot say that Russia has created a balanced unified transportation system of the IWT.

The situation is complicated by the fact that the Russian IWT, unlike the Chinese, has long been in the "shadow" of the country's strategic transportation priorities. As a result, the IWT problems were largely only declared and smoothly "flowed" from one strategy to another[16], thus acquiring a systemic character.

As part of the Transport Strategy, the idea of year-round navigation on inland waterways in the south is currently being developed. First of all, this is the so-called "Southern Horseshoe": the Caspian, Azov-Don and Volga-Don basins. The initiative is planned to be fully implemented by 2030[17]. This will require "a number of large technical developments". The prospects for the IWT development are mainly related to the modernization of infrastructure and fleet renewal, elimination of limiting areas on the UDW[18] .

The main emphasis in the development of Russia's IWT is shifting to the development of international transport corridors within the UDW framework. This explains the aspiration to organize year-round navigation on inland waterways in the Caspian, Azov-Don and Volga-Don basins by 2030[19]. At the same time, the potential of inland

[16] Subprogram "Inland waterway transport" of the federal target program "Modernization of the transport system of Russia (2002–2010)", 2004; Strategy for the Development of Inland Waterway Transport of the Russian Federation until 2030372-r, dated February 29, 2016; Transport Strategy of the Russian Federation until 2030 with a forecast for the period until 2035 3363-r, dated November 27,2021.

[17] Transport Strategy of the Russian Federation until 2030 with a forecast for the period until 2035 3363-r, dated November 27, 2021.

[18] Sidorov A. A comprehensive solution is being prepared for the IWT. *Morskie vesti*, April 20, 2021. Available at: https://morvesti.ru/analitika/1690/89290 (accessed: February 11, 2024).

[19] Transport Strategy of the Russian Federation until 2030 with a forecast for the period until 2035 3363-r, dated November 27, 2021; draft concept for the development of inland waterways of the Russian Federation until 2024 (https://mintrans.gov.ru).

water transport in Siberia and the Far East is still underestimated in strategic documents and insufficiently exploited in reality, so the prospects for the development of transport in Siberia and the Far East are largely confined to the plans for further economic development of these macro-regions.

However, in strategic terms, the interests of Siberia and the Far East can really cooperate with the development of international transportation corridors. This is the idea laid down in the new Northern Sea Route Development Plan until 2035[20], where the "river transport corridors" block has been added to the transportation tasks for the first time, which should form a "transportation grid" connecting the Trans-Siberian Railway and the Northern Sea Route. In fact, this means the recognition of the fact that the prospects for the development of the Siberian and Far East IWT are subject to a triune task: further economic development of these macro-regions, damping the insufficient development of other modes of transport here and the formation of transport links between the Northern Sea Route and the Trans-Siberian Railway (Leonov, Zaostrovskikh, 2023; Baklanov et al., 2023).

An important issue that has not been resolved in the Russian Federation to date is the possibility of returning to the IWT cargo flows previously developed by inland water transport, but lost in the post-perestroika period, and now served by other modes of transport. For instance, the Transport Strategy for 2016–2030 provides for the delivery of the following cargo flows, million cubic meters: sand – 1,700, sand and gravel mixture – 760, crushed stone – 880, cement – 520. These are traditional cargo flows of inland waterway transport, which until 1990 accounted for up to 400 million tons annually in the total volume of transportation. Their return to inland water transport can be ensured through preferential taxation of shipping companies and river ports, similar to what is practiced in China, which has developed inland water transport.

The current situation in the Russian river industry shows that river transport has already practically abstracted from the Russian transportation system and has no significant impact on the country's economy. Moreover, it continues to surrender its positions and, if cardinal measures are not taken in the near future, the IWT may actually cease to exist, which is unacceptable for Russia as a country with the longest, most extensive and in the recent past very effective network of inland waterways.

As we have already noted, China has been able to revitalize its IWT over the previous four decades for a number of reasons: first, it has demonstrated consistent, sustainable, predictable and adaptable central government policies that set long-term goals and objectives for economic and industrial development in line with the country's five-year plans and oriented long-term government policies to achieve the postulated goals and objectives; second, it synchronously coordinated the activities of the central and provincial governments at all levels under the strong central leadership; third, it clearly supported the step-by-step implementation of the IWT planning goals by multichannelization and diversification of necessary financial resources for the IWT development; fourth, it reformed the education and personnel training system for the long-term development of China's inland waterway transport.

Conclusions

The performed analysis has shown that for the previous 45 years inland waterway transport in the Russian Federation has lost its positions of the world leader, ceding them to China. Problems concerning the IWT development have accumulated and are still multiplying.

[20] Northern Sea Route Development Plan until 2035 2115-r, dated July 1, 2022.

Unlike Russia, over the same period China has managed to transform its IWT from an inconspicuous infrastructure industry into the busiest inland waterway transport system in the world, in fact making IWT one of the key modes of transport in ensuring the transportation of goods within the country (17%), overtaking even rail transport (10%).

The main lesson learned from the Chinese IWT development experience is that river transport, which is the world's most economical, most environmentally friendly and safest mode of transport, should once again become such in Russia, regaining its lost positions, especially since the fundamental conditions for this are still available.

To solve river transport problems accumulated in Russia, it is necessary cardinal measures to develop and systematically promote a clearly thought-out, consistent, adaptable state policy in the sphere of river transport and inland waterways; to improve the system of river transport management; to create a diversified system for attracting findings for Russia's IWT development; to improve the competitiveness of river vessels and optimize their structure, taking into account the world experience and real conditions of the Russian waterways; to develop the system of personnel training for the IWT, restore the industry science to perform prospective and advanced research and development.

It is necessary to use the Chinese experience in organizing financing of water transport projects, experience in developing the system of personnel training, fighting interspecific competition in transport and completing the large-scale dredging works declared long ago and actually expected to turn the Russian inland water transport into a real force of the country's territorial development.

The scientific significance of the research lies in the theoretical analysis and comparative assessment of the degree of development of inland waterway transport in Russia and China. The practical significance consists in the proposals to solve the accumulated problems of Russian river transport on the basis of using China's experience in stimulating the country's IWT activity.

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Received May 3, 2024.