

Innovative transportation system as a regional development condition

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Abstract. The article covers the possibility of innovative transportation system development on base of airfoil boats in regions with low density of population and special climate conditions. The place and the role of innovative transportation system in regional development are defined. Innovative projects of transportation development are analyzed. Indicators of innovative modernization of transportation system are proposed. Comparative analysis of operational and economic characteristics of different transportation means has been made. Main economic indicators of the program of development of innovative transportation system in the regions of Siberia and the Far East of Russia and Arctic are presented.

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Introduction

Creating the vision of perspectives of new transportation means development is one of the most complicated tasks of long-term forecasting. All the factors should be divided into groups relating to demand, offer and regulation. Need for developing of new territories, developing of the base of mineral raw materials, for high speed and available means for cargo and people transportation especially in regions with low density of population and special climate conditions relate to demand factors. Research and development of new transportation technologies, new transportation means relate to offer factors. Normative and legal documents that regulate regional development, transport and transportation system relate to regulation factors.

Among the major challenges of new transportation means deployment in transportation system there is an obsolescence of existing transportation means and reduction of growth rate of demand for these means. River transport is striking example of this situation. It is characterized by low speeds (lower than 70 km/hour), low passability and seasonal character. Considering existing demand on all-the-year-round high speed transportation river transport can not compete with other transportation types. On the other hand demand on air transport is limited due to high tariffs on cargo and people transportation. Railway and motor transport are main ways of cargo transportation in the country. Despite a certain level of demand for these types of services there are limitations due to the lack of well developed railway and motor-road infrastructure especially in the regions of Siberia and Far East of Russia. So one may suppose that functional niche for the new type of transportation mean exists and this transportation mean is based on the new technologies allowing satisfying social and economic demand for high

speed, available, all-the-year-round transportation with maximum reach that does not require significant investment in transportation infrastructure.

According to innovative variant of “The transportation strategy of Russian Federation up to 2030 year” transportation system development will be based on accelerated and balanced development of transportation system of the country that allows provisioning transportation conditions for development of innovative component of economy and improvement of the quality of life of people and the shift to polycentric model of spatial development of Russia.

Siberia, Far East and arctic area are supposed to become the areas of priority development. Considering the problem of new transportation means capable to solve the problem of transportation services provisioning is important side of this work.

Unlike target demand that satisfies specific requirements demand for new transportation means will be created by offering innovative transportation means and technologies. Availability of new transportation means will create preconditions for production of these means and will promote positive demand dynamics.

Analyzing the place of new transportation means in existing transportation system it is important to understand what niche their competitive advantages may be better demonstrated in.

Modern transportation system is comprised of air, railway, motor, river and sea transport. Functional specific of air transport is its capability to organize high speed transportation for long distances. High tariffs make this kind of transport mainly (about 90%) passenger transport. Air transportation growth rate is stable. It reflects the growth of the income of population. No one transportation mean cannot

compete with air transport in speed (up to 700 km/hour). Railway transport traffic does not depend on weather conditions, its functional specific is also acceptable tariffs and well developed infrastructure (especially in Central Russia). Cargo transportation growth rate tends to grow. But high power consumption, capital intensity, insufficient level of logistic chains management has serious effect on development of this transport in new territories. Motor transport is characterized by well developed transportation infrastructure, low dependence of weather conditions and relatively low tariffs on transportation, but it requires significant investments in building and maintaining motor-roads and it is also characterized by high fuel costs ratio. River transport has almost ceased to exist due to high costs of channel dredging, canal track support, low speeds of traffic, obsolescence of ships. River transportation ratio to all types of transportation is low and these type of transport is developed usually in regions where using other types of transportation is limited. Sea transport has also serious problems with development due to world trend to high speed transportations and low demand for a part of fleet.

Introduction of a new type of transportation capable to fill the former niche of river and sea transport is not expected to make serious disturbances in freight traffic in existing types of transportation but may be capable to leverage river and sea shipping operations. Existing river transportation network may become perspective canal tracks of the new mean of transportation in case it does not require channel dredging and building additional infrastructure.

I think that innovative transportation system is transportation system characterized by quality development based of ecological, technological and economic improvement of transportation means, transportation technologies and transportation process in general.

Or

$$ITS=(k, s, p, e)$$

where

K= capital investments min

S – traffic speed max

P – price of transportation min

E – environmental pressure min

In general innovative transportation system for the regions with low density of population and severe climate conditions should satisfy the following requirements:

- support all-the-year-round transportation and be relatively independent of weather and climate conditions;

- does not require significant investments in building of ground permanent structures;

- be high cost efficient;

- support relatively high speeds;
- has high penetrability;
- create the lowest possible environmental pressure.

Development of innovative transportation system is based on analysis of modern trends in science and its perspectives [1,3,5,6,7,8,9,10,11,12,13]. It is necessary to study alternative (innovative) variants of transportation that may lay the foundation of high effective transportation system in regions with specific climate conditions and low density of population. Innovative decisions in transportation should solve the problem of regional development and increase attractiveness of a region for investors and competitiveness.

All the mentioned make study of innovative decisions in transportation pressing problem. A number of scientific works [2,3,4,8,9,10], may be mentioned that may offer either additional or alternative way of transportation to existing means.

Table 1. Innovative development in transportation technologies (compiled by author)

Transportation mean	Possible alternative solutions
Railway transport	- Younitski string transport - transportation system with vertical track structure and others
Air transport	- “Dingo” aircraft - “AKIP” aircraft - new generation dirigibles and others
River (sea) transport	- second generation air-cushion amphibian ships; - airfoil boat and others

In general study of innovative development in transportation allows making the following conclusion: 1) Russian scientists have designed competitive with traditional transportation means; 2) the most perspective and realistic may be considered deployment of “EKIP” aircraft [9] (that is actually airfoil boat) and airfoil boats [2,8,10].

Indicators for justification of selection of transportation system innovative development direction are provided in Table 2. Selecting indicators it is necessary to fully consider regional specifics.

Development possibilities of innovative transportation system depend on strategic choice in a region that may vary under the influence of external and internal factors.

Existing transportation system may function and develop but it will require significant resources for state support of socially valuable directions and seasonal transport. Alternative variant, regional development strategy is aimed on deployment of innovative transportation structure.

Table 2. Indicators of innovative improvement of regional transportation system (compiled by author)

Indicators	Expected change
Economical	- GRP (GDP) share increase; - external trade revenue growth; - retail commodity turnover and paid services for citizens growth; - fixed capital investments growth; - increase of economy sectors basis funds share
Social	- migration decrease; - unemployment decrease; - standard of live improvement.
Industry specific, including:	
Support of global standards of safety and environmental protection	- Maintaining of power and ecological effectiveness on developed countries' level - Reduction of power intensity of transportation (electric power, gasoline, aviation fuel) to global standards level - CO ₂ discharge reduction to international norms - Noise level decrease to international norm - Reduction of a number of emergency situation in transportations
Transportation network throughput increase	- Cargo tariffs speed increase - High-speed routes percentage increase - Reduction of reloading operations in transportation.
Increase of the level of population mobility and cargo transportation ability to global standards	- Population mobility growth up to global standards - Increase of the number of all types of settlements in RF with regular traffic - Increase of traffic volume in rural areas - Increase of population mobility via public transportation - Cargo transportation cost price reduction (in % of products cost price)
Integration in global economy	- Increase of the share of companies providing transportation services into global economy (WTO, Custom Union, UES, APEC)

Table 3. Comparative analysis of some operational and economic characteristics of different transportation means (compiled by author)

N	Performance and economic characteristics	Transportation means					
		Ice-breaker in NSR	Ice class vessel	KAMAZ truck	Railway transport	IL-76 plane	L.A.A.-07-330
1.	Average cruising speed in ice, km/hour	2,5	2,5	40	70	900	800
2.	Transported commercial cargo mass, ton	50	15000	10	1100	50	230
3.	Power-plant output in cruising regime, hourse power	70000	4000	300	1200	30000	40000
4.	Specific fuel consumption, kg/hourse-power per hour	0.153	0.140	0.145	0.165	0.255	0.190
5.	Fuel consumption per hour, kg	10710	560	43.5	198	7650	7600
6.	Fuel consumption per 1 km, kg	4284	224	1.08	2.83	8.5	12.67
7.	Fuel consumption per 1 km and 1 ton of cargo, kg	85.68	0.015	0.108	0.003	0.170	0.055
8.	Mooring, stations, air stations required	Mooring	Mooring in port	-----	station	Air station	-----
9.	Number of operational days in per year	210	110	320	330	270	320
10.	Repair, maintenance of routes, moorings, air stations, stations	Channel dredging	Channel dredging, preventive maintenance, maintenance	Bridges, tunnels, roads repair, maintenance	Roads, power lines, stations maintenance and service	Air stations maintenance and service	Preventive maintenance
11.	Minimal number of cargo reloading, times	5	5	2	5	6	2
12.	Transportation mean crew, people	67	38	2	23	12	7
13.	Underway time for 1000 km, hour	400	400	25	14,3	1,1	1,7
14.	Risk level, 10 point scale	6	8	1	5	10	2

It is necessary to provide special functions and services of innovative transportation system that may allow reaching new level of guaranteed social service to people:

- emergency rescue
- emergency technical and medical aid
- patrol, ferry and tourist
- geological survey and post delivery
- other specialized tasks.

The choice of airfoil boat as a new transportation mean for a region and development of innovative transportation system on its base is determined by its unique ecological, technical and economical characteristics [1, 2, 3, 5, 6, 7, 9, 10, 11, 12, 13]: deployment without air stations, regular, all-the-year-round cargo delivery without reloading and population transportation; ability to stop in any place in the route without contact with the surface; helicopter way of soft landing; soft vertical landing on water; loading and unloading from many sides; reduction of the effects of sharp changes of barometric pressure inside the vehicle on a man; reduction of sound, vibration and heat; high speed of main movement (higher that 150 km/hour). This

transportation system does not require significant capital investments in building ground capital facilities; it is cost-efficient and has high permeability (see Table 3).

Key factor is airfoil boat deployment time. The task of development of a program of forced regional economic development on the base of deep modernization of transportation system by new high effectiveness transportation means like airfoil boats has the highest priority.

The program of production of airfoil boat of LAA (land-air amphibia) type is based in three types of transportation means [4]: continental (river), sea and inter-continental. River class of the new transportation means is aimed on regional and inter-regional traffic. Take-off mass range of 2.5 – 60 ton. Sea class of this type of transportation means was designed for take-off mass range 120 – 600 ton. Trans-polar and inter-continental traffic will be supported by ocean class LAA with take-off mass range 600 – 5000 ton. Specific of this class of transportation means is increased useful output up to 60% of take-off mass for long-distance flights up to 9000 km without refill of fuel. The program provides testing, serial production and exploitation. Total price of the program for deployment of 11 airfoil boats' dimension-types of LAA type is US \$ M722.5. Serial production program cost is US \$ M8950. Expected annual cargo turnover is M46.3 ton per year. Payback period is calculated for each dimension-type. Maximum payback period is 3.5 years.

New transportation means (airfoil boat) does not pretend to be dominating system and does not replace existing transportation means but merely take off the load from it, add it and increase its effectiveness. Innovative system may be compared with capillary system that supports living functions of the most remote and easy to access regions. In our case innovative transportation system promote living functions and development of regions where traditional transportation system is not effective and has low or sometimes negative profitability.

It is important that policy of development of innovative transportation system should be grounded and consistent. Innovative transportation systems may become on only development factor but active instrument of regional economical development.

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