

METHODOLOGICAL FOUNDATIONS OF SCENARIO BASED FORECASTING OF THE DEVELOPMENT OF UKRAINE'S TRANSPORT- ROAD COMPLEX

МЕТОДОЛОГІЧНІ ЗАСАДИ СЦЕНАРНОГО ПРОГНОЗУВАННЯ РОЗВИТКУ ТРАНСПОРТНО-ДОРОЖНЬОГО КОМПЛЕКСУ УКРАЇНИ

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Under the conditions of uncertainty and considerable changes, which are characteristic for the modern stage of the development of Ukraine's economy, the elaboration of the development strategy of Ukraine's transport-road complex (TRC) based on a single probabilistic forecast is insufficient. In today's world, there often happen sudden changes and events, which are absolutely impossible to foresee.

Under unstable economic conditions, there exist a few possible future scenarios, so, when taking decisions, it is advisable to use scenario based forecasting, which provides for the construction of feasible structured and logical scenarios. In this case, strategy is no longer a strict plan and acquires a necessary flexibility to make the system to successfully function under any conditions.

The subject-matter of the given investigation is economic processes in Ukraine's TRC. The article's purpose is elaboration of development scenarios of Ukraine's TRC under modern economic conditions. The investigation's task is, based on theoretical and methodological provisions of scenario based forecasting, defining external and domestic factors of the development of Ukraine's TRC; formulating possible scenarios of its development; elaborating forecasting models of the volumes of investments in fixed capital of the activity of Transport and Communications for the period until 2015 for the proposed scenarios.

The problems of the investigation of the functioning of complex economic systems with the use of scenario based forecasting are considered in the works of many Ukrainian and foreign scientists.

The methodological foundations of the modeling of the long term development of regional fuel-and-energy complex, the author's technique of the modeling of development scenarios of regional power sector in the long term period are dealt with in Gulidov's article (2007). With the use of the developed methodology, two scenarios of the development of the regional fuel-and-energy complex of Russia's Far East are simulated for the period until 2030 the author carries out a comparative analysis of the scenarios by the main target Indicators.

Urgent problems of the macroeconomic forecasting of Russia's economy are considered by Uziakov (2008). The article tackles various issues of forecasting methodology and tools, and the problems of the reconciliation between different scenarios and the results of forecast based calculations, and sets the task of the creation of a single system of economic forecasting.

The development of the scenario based forecast of the development of Khanty-Mansi Autonomous District with the use of the input-output development model of the economy of the Russian Federation

CONTO and macro structural regional model is the topic of Yantovsky's article (2006).

The scientists of the Institute for Economics and Forecasting, NAS of Ukraine (Fedulova, Bazhal, Osetsyki et al, 2011) presents various methodological approaches to the scenario based forecasting of investment provision of Ukraine's economy. The scientists have elaborated various forecasting models of the indicators of investment activities of Ukraine's high tech sectors for the period until 2020 with the scenarios of moderate, traditional and prospective development.

Various methodological approaches to the formation of the informational analytical base of scenario based financial planning and forecasting of the functioning of Ukraine's railway transport and the sequence of the realization of its main stages are considered in Kravchenko's work (2012).

It should be noted that, despite the great number of scientific works devoted to the development of development scenarios of complex economic systems, the need of scenario based forecasting of the development of Ukraine's TRC is a high-priority and very urgent scientific task.

This article is a continuation of the author's researches devoted to the development of economic and mathematical models of the development of Ukraine's TRC. The author's monograph (2013) presents various multifactorial forecasting models of the volumes of investments in fixed capital of the activity of Transport and Communications (I) elaborated with the use of program SPSS 16.0 for Windows with the following factors: capital intensity (K), accumulation rate (N), discount rate of the National Bank of Ukraine (S), inflation rate (i), and average wage (D). The equation of the five-factor model is as follows:

$$I = -0.047K + 1383.1N + 430.2i - 1231.6S + 8.68D - 22484.6 \quad (1)$$

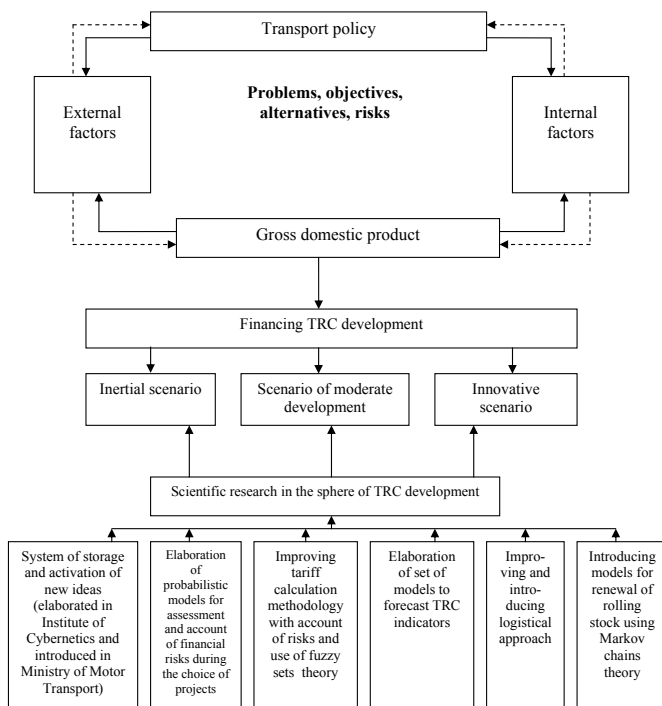
The paper presents methodological foundations of scenario based forecasting of the development of Ukraine's transport-road complex under modern economic conditions. The development characteristic is provided by three scenarios: inertial, moderate development and innovative. The author provides a forecast of the volume of investments in fixed capital of the activity of Transport and Communications in Ukraine for the period until 2015 with the use of two approaches based on expert estimates of the forecast of Ukraine's gross domestic product presented by the British audit company Ernst & Young and Institute for Economics and Forecasting, National Academy of Sciences of Ukraine.

У статті представлено методологічні засади сценарного прогнозування розвитку транспортно-дорожнього комплексу України в сучасних економічних умовах, дано характеристику розвитку за трьома сценаріями: інерційним, помірною розвитку та інноваційним. Розроблено прогноз обсягів інвестицій в основний капітал економічної діяльності «Транспорт і зв'язок» України на період до 2015 року з використанням двох підходів, заснованих на експертних оцінках прогнозу валового внутрішнього продукту України, представлених британською аудиторською компанією Ernst & Young та Інститутом економіки та прогнозування Національної академії наук України.

As a result of the investigations, the statistical characteristics of the model (1) were defined: coefficient of multiple correlations is equal to 0.980, Durbin-Watson criterion – to 0.997, and Fisher criterion (F-statistics) – to 14.429, i.e. the model has a sufficient level of reliability and significance.

A characteristic feature of Ukraine's economy affecting the efficiency of the functioning of both its individual structural sectors, and the system as a whole, is the uncertainty of the processes taking place in its external and internal environment, which is directly related to the need of its reforming and the absence of a high quality development strategy for the transport sector. That is why, with the existing level of uncertainty, scenario based forecasting may be used as an efficient planning instrument, which could make it possible to "get ready" for future negative and positive changes.

Fig. 1. The principal diagram of the scenario based forecasting of TRC development allowing for the main research guidelines



Source: Composed by the author

The main principles of scenario based forecasting (Gulidov, 2007) are:

- conceptual description of the connections between factors and variable shaping the structure of the scenario;
- focusing on strategic issues related to attaining the objectives, which cannot be attained within inertial functioning;
- consistency and the absence of internal contradictions in the assumptions, which comprise the scenario's basis;
- construction of the future as a result of a purposeful choice, and of economic and technological reconstruction of the economy;
- applicability of the conclusions about the object's prospective development for decision making.

Let us consider the main stages of scenario based forecasting:

1. Defining the objectives, setting the main parameters, identifying the key issues. In the process, it is necessary to define:

- optimal time horizon of the scenarios;
- their geographical scale;
- limits of the future plan.

2. Separating the key and uncertain factors on the part of external environment. At that stage, it is necessary:

- to define the most important factors and tendencies, which will affect the process;
- to divide the factors into certain and uncertain ones;
- to reveal the relationship between those two groups of critical factors.

3. Creating the scenarios' "skeletons". At that stage, it is necessary to look for the answers to the following questions:

- the most important events, which can affect the development process;
- possible consequences of such events;
- probable chains of circumstances, which may lead to such events.

4. Filling and cleaning the raw scenarios. At that stage, scenarios acquire contents. In the process, a systemic approach is needed to analyze crises, evolutionary and revolutionary changes, possibilities and dangers to the object's development.

5. Creating strategies. At that stage, the sequences of actions is as follows:

- identifying the strategy's elements;
- their checking in all scenarios;

□ making decisions on the scenarios, in accordance with which the events begin to evolve;

□ drafting plans on each scenario.

6. Choosing alternatives and creating the integrated strategy. At that stage, it is necessary:

- to compare the plans for each scenario and reveal the common elements to include into the radical business plan, which ensures success with any future developments;
- creating the radical plan;
- verifying the radical plan in all scenarios;
- checking the internal consistency of the synthesized new plan;
- checking the "sufficiency" (under given conditions) of the strategy's decisions.

The principal diagram of scenario based forecasting of the TRC development, allowing for the main research guidelines is presented in Fig. 1.

In the process of the elaboration of the scenarios of TRC development, often arises the question about transition from the predominantly extensive to the intensive model of its development based on innovative "break-through" technologies ensuring the rise in the quality of transport services.

Let us analyze the external and domestic factors of the development of Ukraine's TRC.

Among the external factors are:

- global competition involving the markets of goods, services, capital and other factors of economic growth. The restructuring of the world economy related to the change of the balance between the economic centers, the increasing role of the regional economic unions, propagation of new informational, nano- and bio-technologies will entail a change in the national and global cargo and passenger flows, and increased requirements to the quality of transport services;

□ reduced sources for the development of the raw export pattern, the need of the transition to intensive innovative development;

□ integration of Ukraine's transport system into the Eurasian transport space, development of multi-vector transport connections with the global economic centers.

The main domestic factors hampering the development of Ukraine's TRC are:

- the insufficient investigation of the problems of transport development in the existing normative and legal base;
- the imperfect tariff, depreciation and tax policies;
- the lack of effective mechanisms to attract investments from non-government sources;
- low development of the financial market (in particular, the market of securities);
- the low Ukraine's credit rating;
- political instability;
- insufficient legal guarantees for foreign and domestic investors;
- the over depreciation of the rolling stock
- the almost full absence of government investments (2-3% of the needed amount);

□ the impossibility, due to the lack of funds, of the introduction of new technologies, new types of transportations, and the new generations of rolling stock.

On the basis of the above, we have proposed three scenarios of the development of Ukraine's TRC: inertial, moderate development and innovative ones (Table 1).

The innovative scenario assumes accelerated and balanced development of the TRC, which would make it possible to ensure proper conditions for the development of the innovative component of the economy and raise the living standards.

Development of railway and maritime of transports, together with ensuring massive cargo transportation, (including exports) will increasingly focus on raising the quality of transport services provided for the cargo owners in the context logistical chains.

The measures to raise the competitiveness would make it possible to considerably expand exports of maritime transportation services (whose

Table 1 Characteristic of the development of Ukraine's TRC according to the proposed scenarios

Inertial	Moderate development	Innovative
<ul style="list-style-type: none"> □ reconstruction and construction of important TRC facilities ensuring the security of the functioning of the transport systems, and modernization and renewal of the rolling stock; □ outstripping development of export cargo deliveries, first of all, through the development of sea ports and their entrance facilities; □ slow construction and reconstruction of the road network, retention of the disproportions of its development in Ukrainian regions; □ retention of the low mobility of the population, first of all, as regards air transportation, due to insufficient rates of households' incomes and ongoing ageing of the plane stock; □ the lack of vehicular and infrastructural reserves to raise the quality of transport services provided to individuals and companies and to introduce advanced logistical technologies; □ realization of large scale projects ensuring the development of Ukraine's transport system 	<ul style="list-style-type: none"> □ realization of large scale projects (including in the context of state-private partnership); □ development of the transport infrastructure ensuring the realization of the national transit potential ; □ increased volumes of transportation and assortment of processed raw materials (coal, ores, chemicals, metals etc.); □ low rates of the volume of export transportations and considerable increased volumes import transportations of high tech produce; □ increased number of personal cars with lower public transport traffic; □ increased need in the construction and reconstruction of the road network connecting the new residential areas in the megalopolises with the suburbs. 	<ul style="list-style-type: none"> □ development of the transport infrastructure ensuring the realization of the national transit potential , including joint projects with the EU and other countries; □ increased volumes of transportation of metal items, chemicals and machinery due to the expansion of innovative activities in the power sector, and the fuel and raw material sectors; increased export transportation of high tech produce; □ increased role of the logistical infrastructure in the organization of goods flow; □ increased public transport traffic; □ the need of the construction and reconstruction of the road network connecting the new residential areas in the megalopolises and suburbs with the areas with growing labor; □ increased demand, on the part of the economy and population, for high speed transportationThe need of the construction and reconstruction of the road network connecting the new residential areas in the megalopolises and suburbs with the areas with growing labor; □ for high speed transportation.

Source: Composed by the author

Table 2. Dynamics of the volumes of investments in the economic activity of Transport and Communications, mln Hrn

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
GDP, mln Hrn	827941	907423	1017221	1044686	1120948	1209503	1237322	1050486	1094607	1302079	1408889
Transports and communications, total	7004.2	10230.3	15015.3	16887.5	20328.5	31709.4	32558.4	24555.1	29084.5	39375.1	39635.4
Surface transports, including:	3121.4	4173.7	4685.5	5436.5	6666.3	11386	13366.3	6040.8	10485	12821.5	15151.3
□ railway	1249.3	1704.2	1809.1	2599.8	3463.1	6683.5	8549.3	3597.3	5734.8	6458.5	9071.1
□ other	685.1	862.1	1299.1	1462.6	1918	3442.7	3831.3	1651.8	3055.1	4717.8	3679.7
□ pipeline	1187	1607.4	1577.3	1374.1	1285.2	1259.8	985.7	791.7	1695.9	1645.2	2400.5
Water transports including:	102	103.3	73.8	58.5	34.4	52.3	56.8	34.8	52.4	103.7	117.3
□ maritime	71,9	96,4	27,6	22,5	16,9	14,6	34,3	18,3	14,6	21,7	42,8
□ river	30.1	6.9	46.2	36	17.5	37.7	22.5	16.5	37.8	82	74.5
Air transports	63.5	133.9	269.2	107	81.5	305	160.1	123.9	105.5	307.2	775.4
Additional transport services and auxiliary activities	1269.1	2151.9	4335.8	2744.2	3655.3	7477.3	8064.8	8787.2	12460.3	19497.8	16426
Post and communications	2403.1	3634.5	5609.4	8485.6	9891	12407.2	10790.8	9468.3	5884.5	6644.9	7165.2

Source: State Statistical Service of Ukraine

volume, in 2012, amounted to bln\$ 1.24), and the share of the vessels carrying traffic under Ukraine's national flag.

High development rates will be characteristic road transportations, which are the most flexible to economic demands, especially as regards high- and medium-tech sectors.

The measures to develop air transportation and the use of the advantages (first of all, environmental) of domestic water transport will make it possible to considerably increase their share in this country's transport balance.

Of decisive importance, for the development of Ukraine's TRC, will be the creation and integrated network of logistical facilities providing a wide range of competitive services, as well as accelerated development of intermodal transportation and the formation territorial-- and-production clusters.

A strong impetus will be given to the development of public transport. First of all, that applies to the development of high speed railway transportation, all kind of air transportation, and urban and suburban motor transports.

In the innovative scenario, the TRC should develop with outstripping rates as compared to the other economic sectors and social sphere in order to overcome the transport-related infrastructural restrictions of this country's socio-economic development.

Realization of the innovative scenario of the development of Ukraine's TRC would make it possible to solve the main tasks:

□ the indicators of population mobility will approach the level of the developed countries, which is one of the most important factors of the increase in the quality of human capital;

□ weaker differentiation in the availability of transport services for different regions and social groups;

□ higher competitiveness of domestic goods and services on the world markets due to the well balanced development of the transport system;

□ growth of economic efficiency of passenger and cargo transportation will make it possible to optimize transport costs in the economy and raise the accessibility of transport services for the population.

To implement the development scenarios of Ukraine's TRC, considerable capital investments are needed. In order to make a forecast of the volumes of investments in fixed capital of the activity of Transport and Communications in Ukraine, the author used correlative and regression analysis and the method of expert assessment of the dynamics of Ukraine's gross domestic product (GDP).

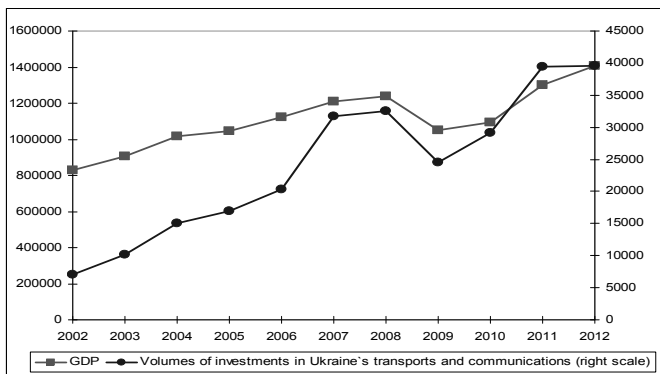
Let us consider the dynamics of Ukraine's DGP and the volumes of capital investments of the activity of Transport and Communications for 2002-2012. In 2002-2008, a positive dynamics of those indicators was observed. However, in 2009, due to the global economic crisis, there was a considerable drop (Table 2, Fig. 2).

In 2012, the share of the volumes of investments in fixed capital of the activity of Transport and Communications in the GDP constituted 2.8%; and 13.5% in total investments in Ukraine's economy, which is the second place among the economic activities after the industry (35.1%), which indicates to the priority of transports and communications in Ukraine's economy.

In order to make a forecast of the volumes investments in fixed capital of transports and communications, let us carry out a correlative analysis of that indicator and of Ukraine's GDP (Fig. 3). As a result of the analysis, we define that the coefficient of correlation between the two above indicators amounts to 0.952, which indicates to a close correlative connection.

That gives us grounds, in the process of the elaboration of the forecast of the volumes investments in fixed capital in the transports and commu-

Fig. 2. Dynamics of GDP and the volumes of investments in Ukraine's transports and communications, mln Hrn



Source: State Statistical Service of Ukraine

nications, to use expert assessments of the dynamics of Ukraine's GDP for the period until 2015.

The forecast (Table 3, Fig. 4) was made based on two approaches with the use of expert estimates of Ukraine's DGP for 2013-2015:

- provided by the specialists of the British audit company *Ernst & Young* (2012) (first approach);
- provided by the scientists of the Institute for Economics and Forecasting, NAS of Ukraine (Danylenko, Zymovets, Sidenko et al 2012) (second approach).

As a result of the research, the author has obtained mathematical models of the forecast of the volume of investments in the fixed capital of the activity of transports and communications:

$$\text{First approach: } I = 615.12x + 39196; \quad (2)$$

$$\text{Second approach: } I = 618.92x + 39538, \quad (3)$$

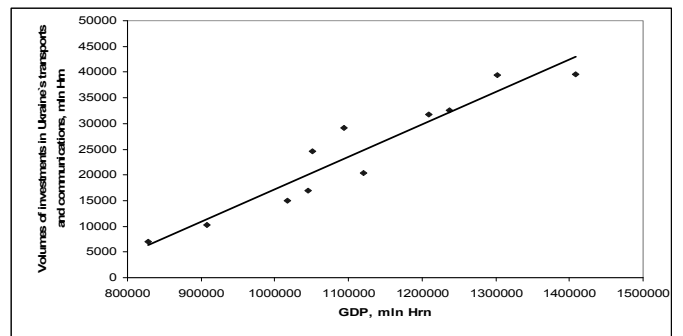
where x – is the scenario number by years.

CONCLUSIONS

As a result of the research, the author formulates the main principles and stages of scenario based forecasting and defines external and internal factors affecting the development of Ukraine's TRC. The author elaborated forecasting models of the volume of investments in fixed capital of the economic activity of Transport and Communications with the use of correlative analysis, and expert estimates.

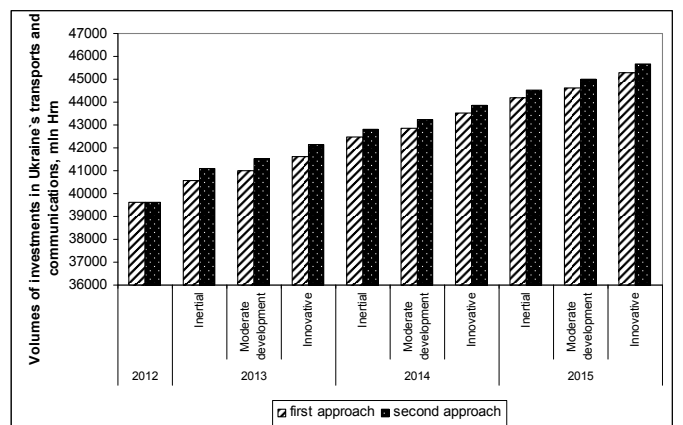
Comparison of the scenario variants allows to conclude that the innovative scenario of the development of Ukraine's TRC is a target for long

Fig. 3. Correlation field of the dependence of the volumes of capital investments in transports and communications from Ukraine's GDP



Source: Composed by the author

Fig. 4. Scenario based forecast of the volumes investments in fixed capital of the activity of Transport and Communications in Ukraine, for 2013-2015



Source: Composed by the author based on statistical data of the State Statistical Service in Ukraine

term national transport policy, because it allows to fully realize Ukraine's strategic interests.

During the transition to the innovative scenario of the development of the TRC, it is necessary to ensure:

- innovative activities of the transport organizations, radical renewal of transport and technical machinery taking into account the development of Ukrainian transport machine building, and a stronger role of the scientific and technical progress in the sector's development;

Table 3. Scenario based forecast of the volumes investments in fixed capital of the economic activity of Transport and Communications, mln Hrn

First approach

	2012	2013			2014			2015		
		scenarios			scenarios			scenarios		
		Inertial	Moderate development	Innovative	Inertial	Moderate development	Innovative	Inertial	Moderate development	Innovative
Transport and communications, total	39635.4	40586.6	40992.5	41601.3	42453.6	42878.2	43515.0	44194.2	44636.2	45299.1
Surface transports, including:	15151.3	15514.9	15670.1	15902.8	16228.6	16390.9	16634.3	16894.0	17062.9	17316.3
□ railway	9071	9288.7	9381.6	9520.9	9716.0	9813.1	9958.9	10114.3	10215.5	10367.2
□ other	3679.8	3768.1	3805.8	3862.3	3941.4	3980.9	4040.0	4103.0	4144.1	4205.6
□ pipeline	2400.5	2458.1	2482.7	2519.6	2571.2	2596.9	2635.5	2676.6	2703.4	2743.5
Water transports including:	117.3	120.1	121.3	123.1	125.6	126.9	128.8	130.8	132.1	134.1
□ maritime	42.8	43.8	44.3	44.9	45.8	46.3	47.0	47.7	48.2	48.9
□ river	74.5	76.3	77.1	78.2	79.8	80.6	81.8	83.1	83.9	85.1
Air transports	775.4	794.0	801.9	813.9	830.5	838.8	851.3	864.6	873.2	886.2
Additional transport services and auxiliary activities	16426.2	16820.4	16988.6	17240.9	17594.2	17770.1	18034.0	18315.5	18498.7	18773.4
Post and communications	7165.2	7337.2	7410.5	7520.6	7674.7	7751.4	7866.5	7989.3	8069.2	8189.1

Second approach

Continued from Table 3

	2012	2013			2014			2015		
		scenarios			scenarios			scenarios		
		Inertial	Moderate development	Innovative	Inertial	Moderate development	Innovative	Inertial	Moderate development	Innovative
Transport and communications, total	39635.4	41101.9	41512.9	42129.5	42787.1	43215.0	43856.8	44541.4	44986.8	45654.9
Surface transports, including:	15151.3	15711.9	15869.0	16104.7	16356.1	16519.6	16765.0	17026.7	17197.0	17452.4
□ railway	9071	9406.6	9500.7	9641.8	9792.3	9890.2	10037.1	10193.8	10295.7	10448.6
□ other	3679.8	3816.0	3854.1	3911.4	3972.4	4012.1	4071.7	4135.3	4176.6	4238.7
□ pipeline	2400.5	2489.3	2514.2	2551.6	2591.4	2617.3	2656.2	2697.6	2724.6	2765.1
Water transports including:	117.3	121.6	122.9	124.7	126.6	127.9	129.8	131.8	133.1	135.1
□ maritime	42.8	44.4	44.8	45.5	46.2	46.7	47.4	48.1	48.6	49.3
□ river	74.5	77.3	78.0	79.2	80.4	81.2	82.4	83.7	84.6	85.8
Air transports	775.4	804.1	812.1	824.2	837.1	845.4	858.0	871.4	880.1	893.2
Additional transport services and auxiliary activities	16426.2	17034.0	17204.3	17459.8	17732.4	17909.7	18175.7	18459.4	18644.0	18920.9
Post and communications	7165.2	7430.3	7504.6	7616.1	7735.0	7812.3	7928.3	8052.1	8132.6	8253.4

Source: Composed by the author based on statistical data of the State Statistical Service of Ukraine

□ reliability and security of the functioning of the TRC, including with regard to the environment, lower number of traffic accidents and catastrophes, injuries and fatalities in traffic accidents;

□ development and use of efficient mechanisms of government regulation of the functioning and development of transports;

□ improvement of the investment climate in the transport sector;

□ development of a competitive market of transport services, expansion of their range and increase in their quality based on the use of modern transport, logistical, informational and communicational technologies, development of new forms of the organization of the transport process and interaction between the transport types;

□ accessibility of transport services for the population;

□ increased share of transit transportations and transportations of ready products in total transport balance;

□ increased labor productivity and energy efficiency in the transports;

□ people's territorial mobility;

□ increased skills and qualification of transport personnel, better material and social standards and labor safety.

ВИСНОВКИ

У результаті дослідження сформульовано основні принципи та етапи сценарного прогнозування, визначено зовнішні та внутрішні фактори, що впливають на процес розвитку ТДК України. Розроблено моделі прогнозу обсягів інвестицій в основний капітал за видом економічної діяльності «Транспорт і зв'язок» з використанням кореляційного аналізу та експертних оцінок.

Зіставлення сценарних варіантів дозволяє зробити висновок, що інноваційний сценарій розвитку ТДК України є цільовим для довгострокової державної транспортної політики, оскільки в повній мірі дозволяє реалізувати стратегічні інтереси України.

При переході до інноваційного сценарію розвитку ТДК необхідно забезпечити:

□ інноваційну активність транспортних організацій, кардинальне оновлення транспортних і технічних засобів з урахуванням розвитку вітчизняного транспортного машинобудування, посилення ролі науково-технічного прогресу в розвитку галузі;

□ надійність і безпеку функціонування ТДК, в тому числі у сфері екології, зниження кількості аварій і катастроф, травматизму та смертності в дорожньо-транспортних пригодах;

□ розробку й застосування ефективних механізмів державного регулювання функціонування та розвитку транспорту;

□ поліпшення інвестиційного клімату в транспортній галузі;

□ розвиток конкурентного ринку транспортних послуг, розширення номенклатури та підвищення їх якості на основі застосування сучасних транспортних, логістичних, інформаційних та комунікаційних

технологій, розвиток нових форм організації транспортного процесу та взаємодії між видами транспорту;

□ доступність транспортних послуг для населення;

□ збільшення питомої ваги транзитних перевезень та перевезень готової продукції в загальному транспортному балансі;

□ підвищення продуктивності праці та енергоефективності на транспорті;

□ територіальну мобільність населення;

□ зростання рівня професійної підготовки та кваліфікації працівників транспорту, підвищення їх матеріального й соціального забезпечення, створення безпечних умов праці.

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