

## Methods of Forecasting the Development of Transport in Uzbekistan

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### **Abstract**

*The article describes the main tasks of the development of the transport system in accordance with the sustainable development goals of the country, justifies the need for strategic planning and forecasting of transport development. On the basis of the correlation method, a multifactorial model of the dependence of cargo turnover on macroeconomic indicators was constructed and a forecast of its development until 2030 was made.*

**Keywords:** *The results of the forecast, as well as methodological approaches to its development can be used by ministries and transport departments when developing a development strategy.*

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**Introduction.** The country's transport policy is based on the conceptual provisions and operating conditions approved by the Government of the country and possible scenarios for the development of the national economy in the long term. The strategic goal of the functioning and development of the country's transport system is to ensure, through the advanced development of transport infrastructure, the accelerated and stable development of the national economy, the growth of its competitiveness, improving the well-being of people and the quality of life in each region.

In order to prevent irreparable mistakes in making managerial decisions fraught with material and financial damage, provoking economic shocks and crises, it is necessary to evaluate possible alternatives to solutions in a market economy and predict various trends in dynamics in different areas of transport services for the population and cargo customers in the regions, taking into account the impact of various factors - from the development of scientific and technical progress to the behavior of counterparties and competitors in the domestic and foreign markets. That is why strategic planning becomes a necessary element in the formation of a competitive market strategy and tactics at any level of management. The main systemic error of the current system of forecasting the development of the country's transport system is that in the process of such planning there are no components that determine the complexity and consistency of the process, providing logical forward and backward links.

Plakandaras et al. (2019) forecast air, road and train transportation demand for the U.S. domestic market based on econometric and machine learning methodologies, specifically, a Support Vector Regression (SVR) and from econometrics, the Least Absolute Shrinkage and Selection Operator and the Ordinary Least Squares regression. As a result of the study, they found that the transportation demand is influenced by fuel costs, except for road transportation where macroeconomic conditions affect transportation volumes only for specific forecasting horizons.

A new method of traffic flow forecasting based on quantum particle swarm optimization (QPSO) strategy for intelligent transportation system (ITS) was presented Zhang et al. (2020). They created a corresponding model based on the characteristics of the traffic flow data. Outcomes demonstrate that compared with other models, the proposed algorithm can diminish forecast errors and receive more stable prediction results.

The main objectives of the development of the transport system aimed at achieving this goal are directly related to the long-term socio-economic and geopolitical priorities of the state:

creation of a unified transport system in the country, elimination of administrative barriers in the movement of goods and people, elimination of imbalances in the development of the transport system as conditions for the formation of a single economic space, acceleration of the delivery of goods and passengers, reduction of the transport capacity of the economy;

fuller realization of the transit potential of the country, increasing the competitiveness of domestic carriers and the development of exports of transport services based on the modernization of transport infrastructure, contributing to the integration of Uzbekistan into the world economy and the diversification of foreign trade;

improving the reliability and accessibility of mass public passenger transport services as one of the factors of ensuring the quality of life and social stability, the development of interregional relations and the national labor market;

development and implementation of systemic measures (modernization of transport,

electrification of railways and other types of transport using more advanced energy carriers, in order to ensure its efficiency and environmental friendliness, etc.) aimed at limiting the environmental and other negative consequences of increasing motorization, with the maximum possible realization of its advantages and benefits;

ensuring the formation and development of the transport system in accordance with the new requirements for it as an element of national security in connection with the changing geopolitical situation and positioning of Uzbekistan in the world community;

Construction of a transport policy aimed at accelerated and sustainable economic development and improvement of living conditions and quality of life, taking into account the increasing demands of society for ecology and conservation of natural resources.

With the development of transport, there are positive changes in the macroeconomic situation. An increase in the number of trips and passenger turnover indicates an increase in demand for passenger transportation, and a decrease in trips indicates a drop in the level and quality of life in the regions. Cargo turnover is an indicator of the development of the production sector. It is revealed that the distribution of cargo and passenger flows by types of transport is quite closely related, on the one hand, to the quality of regulation of the economy, and on the other hand, to changes in competitive conditions in the domestic and foreign markets of transport services.

**Materials and Methods.** Some experience has already been accumulated in the world practice of forecasting cargo and passenger flows. The extrapolation, statistical, economic-mathematical and other formalized methods used in this case have a number of disadvantages. Thus, the disadvantages of the heuristic method include: subjectivity of assessments of patterns and criteria by experts, a limited number of factors taken into account in forecasts, insufficient degree of reliability of predictive models. The use of a particular method is effective if there is some initial information about the factors affecting freight and passenger transportation, which is not always possible.

The methodology of the research is based on systematic approaches to the study of problems using statistical, heuristic methods and techniques for analyzing the world practice of studying the principles of sustainable development of industrial enterprises, as well as the analysis of the program of sustainable development of a modern enterprise.

The statistical base of the study was the information materials of the State Statistics Committee of the Republic of Uzbekistan and the Ministry of Economy and Finance of the Republic of Uzbekistan. We used data expressed, among other things, in growth rates, from 2000 to 2019. Freight traffic volumes and cargo turnover are accepted as endogenous variables.

**Results.** The issues of forecasting and planning of socio-economic systems were dealt with by such outstanding scientists as I.Ansoff (2009), N.D.Kondratiev (2016), K.Marx (2016), H.Mintzberg (2009), Strickland-III A J. (2006), M.Mescon (1997), Russian scientists V.I.Muntiyan and S.A.Nechaev (2018) investigated the issues of strategic planning as the main structural element of the system of state regulation of the economy.

Currently, statistical forecasting methods are increasingly being used, in particular, **the methods of paired and multiple correlation**, which have the following advantages: *comparative simplicity, the availability of well-developed methods and programs for calculating on a computer; relatively high prevalence of the method among specialists in the field of transport system design; ease of obtaining predictive dependence in general and comparative versatility in*

*its application; small time spent on obtaining partial solutions with known values of arguments, on which the forecast value depends; the ability to study the influence of individual factors and relationships on the forecast value; the ability to assess the uncertainty of the initial information on the degree of accuracy of the forecast; a high degree of objectivity, etc.*

In this study, we use a multivariate correlation and regression model. Forecasting traffic flows using *multivariate linear models* allows us to expand the range of factors under study, the number of which is practically unlimited with the modern capabilities of computer programs. The selection of factors affecting the size of cargo traffic has a great impact on the quality of the forecast. Socio-economic phenomena, under the influence of which cargo flows are formed, are complex in nature and are determined by a multidimensional system of some factors.

The study of the patterns of passenger traffic formation using statistical methods is usually based on the use of single- or multi-factor models. The most important stages in the construction of passenger traffic forecasting models are as follows: (1) *selection of factors that most strongly affect the forecasted value of traffic flow*; (2) *selection of the most accurate form of functional connections*.

Although the growth of global air traffic turned out to be significantly higher than global economic growth, economic theory and analytical studies of foreign economists show that there is a high degree of correlation between them. Changes in personal income affect the level of consumer purchasing power and the ability to carry out recreational travel. Other factors that have influenced the demand for transportation "are changes in airline costs and, accordingly, in air fares, the availability of air transportation, changes in the regulation and development of tourism" (Basovskiy, 2003).

Based on the methodological approaches developed by the author to predict the development of the transport system, a multifactorial correlation and regression model was built. Using the Eviews program, designed for calculating regressions and forecasting on personal computers, we investigated the influence of the following main factors on cargo transportation: *the population of the republic; the number of employed people; gross domestic product; GDP per capita; GDP by PPP; investments in fixed assets; indicators of industry, exports, imports*.

A significant part of the known methods is intended for the analysis of stationary processes, the statistical properties of which do not change over time. In Eviews, the stationarity of processes is checked using UnitRootTest. If the distribution of data in the sample is close to the law of normal distribution, then it is possible to assess the presence of a linear relationship between the variables using the relationship indicator – the Pearson correlation coefficient. A small value of the coefficient indicates a weak connection. A close relationship takes place at a coefficient close to 1.0 and often suggests the presence of a functional causal relationship (Uldjabaev, Yarashova, 2013). For stationary time series, when constructing a regression equation, special attention should be paid to the results and estimates obtained, namely:

- expected values of coefficients and their signs, they should not contradict the logic and economic essence of the relationship;
- standard errors of coefficients, with a large number of data, they are equal to the standard deviations from the expected values;
- the level of significance of the hypothesis of zero values of coefficients and the absence of a connection between the independent variable and the function;

- the coefficient of determination, showing how much of the variable change explains this regression equation;
- the standard error of regression in the range of data values;
- the value of Fischer's F-statistics, which shows whether the use of the model is justified from the point of view of increasing accuracy, or the average value characterizes it better than the constructed model;
- The value of Durbin-Watson statistics, characterizing the absence/presence of autocorrelation of residues, to obtain a reliable regression.

Of all the above exogenous factors, the greatest dependence was found between cargo turnover and GDP per capita and investments expressed in growth rates compared to the previous year. Regression analysis based on sample data for the period from 2000 to 2019 (20 observations), allowed to construct the following dependence:

$$\mathbf{GRUZOOB} = \mathbf{2,79GDP\_CAP\_TEMP} + \mathbf{0,22INVEST\_TEMP} + \mathbf{24,6C} \quad (1)^1$$

*t*: (4,94) (4,21) (2,98) (2,32)

*p*: (0,0002) (0,0006) (0,0083) (0,0329)

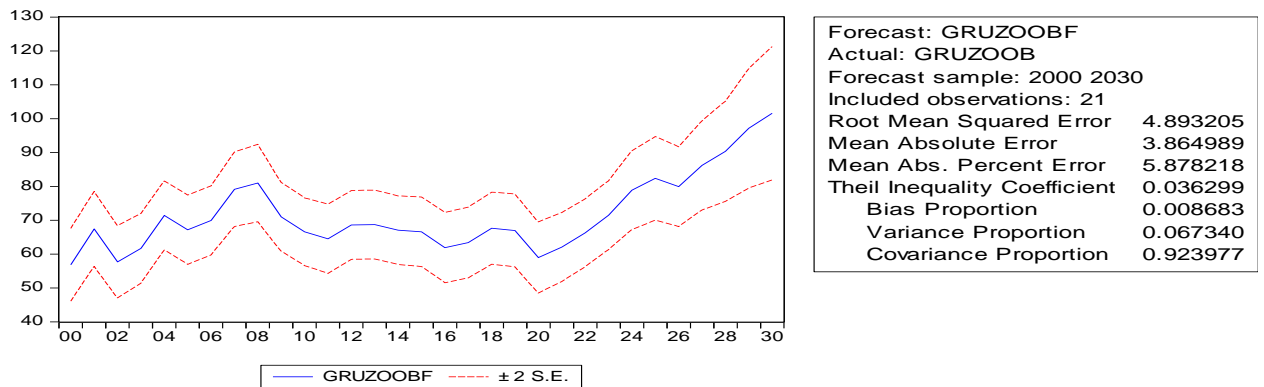
$R^2 = 0,61$ ;  $DW = 1,69$ ;  $F_R^2 = 13,73$ ;  $P_F = 0,0002$ .

*T* – Statistics for regression coefficients and error probabilities *p* are given in parentheses. The coefficient of determination  $R^2$  in equation (1) shows that the behavior of the volume of cargo turnover by 61% is explained by the value of GDP per capita and investments. With the value of *F*-statistics for the coefficient of determination  $F_R^2 = 13.73$ , it can be argued that the latter is significant at the significance level  $\alpha = 1\%$ . With a confidence probability  $p = 99\%$  and the value of the Darbin-Watson statistics  $DW = 1.69$ , we can accept the hypothesis that there is no autocorrelation of the 1st order residues. This means that the correct specification of the model has been made, and it can be used for forecasting. In equality (1), the exponents of 2.79 for *GDP\_CAP\_TEMP* are the coefficient of elasticity of the volume of cargo turnover in relation to GDP per capita. In other words, all other things being equal, an increase in GDP per capita by 1% will lead to an increase in cargo turnover by 2.79%.

The dissertation uses the forecast data of the Institute of Forecasting and Macroeconomic Research on GDP per capita and investments in fixed assets, which were used to build a forecast of cargo turnover in the republic. Based on the obtained forecast values of exogenous parameters, a cargo turnover forecast is made. Figure 1 shows the dynamics of cargo turnover development for 2000-2021 and its forecast value for the future.

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<sup>1</sup> Calculated by the author using a specialized computer program Eviews.



**Fig. 1. Actual and forecast values of cargo turnover<sup>2</sup>**

According to our calculations, the volume of cargo turnover of the country will amount to 122-141 billion tkm in 2035. In order to increase the number of observations of parameters, we decided to observe the dynamics of macroeconomic indicators in the context of regions. However, due to the fact that rail and air modes of transport, due to their characteristics, cannot be represented in regional statistics, we examined the cargo turnover by road transport and made a regression analysis of its dependence on many different factors, from which several of the most significant equations were selected. The influence parameters were grouped by their effect on supply factors, demand factors and quality factors (Table 1).

The calculations performed when compiling one-factor models of first-order auto-correlation AR (1) revealed a very high correlation coefficient of cargo turnover with the considered indicators (0.97-0.98), normal values of Darbin-Watson statistics confirming the hypothesis of the absence of autocorrelation of residues (1.58-1.90).

However, the coefficients of determination are quite low, the equations with GDP per capita and the provision of regions with a transport network have a negative value of the coefficient of determination, which contradicts logic. In addition, in

**Table 1 The main indicators of the revealed correlation dependencies of the freight turnover of motor transport on macroeconomic indicators by region for 2010-2021 (168 observations)<sup>3</sup>**

	Equation 1	Equation 2	Equation 3	Equation 4	Equation 5	Equation 6	Equation 7	Equation 8	Equation 9	Equation 10
<b>Supply factors</b>										
GDP	0,003 (0,0000)									
GDP per capita		- 6.94E-05 (0,8975)								
Income			0.005							

<sup>2</sup> Calculated by the author using a specialized computer program Eviews.

<sup>3</sup> Calculated by the author using a specialized econometric package Eviews.

of the population			(0,2321)							
Investments in fixed assets				0.013 (0,0000)						
Investments in OK in transport					0.068 (0,0000)					
<b>Demand factors</b>										
Foreign trade						0.037 (0,0029)				
Industry							0.003 (0,1977)			
Construction								0.020 (0,0364)		
Retail trade									0.032 (0,6048)	
<b>Quality factors</b>										
Provision of a transport network										-0.694 (0,8771)
R-squared	0,98	0,98	0,97	0,98	0,98	0,98	0,98	0,98	0,97	0,98
Durbin-Watson stat	1,59	1,58	1,58	1,73	1,90	1,75	1,56	1,58	1,59	1,58

some equations, the confidence probability is higher than the norm. As a result, a two-factor model of first-order autocorrelation AR(1) was selected with the following indicators:

$$GRUZ = 0,09INVEST\_TRANS + 0,01 RETAIL + 0,74AR(1) + 874,8 \quad (2)^4$$

(7,20) (3,53) (14,25) (16,39)

(0,0000) (0,00006) (0,0000) (0,0000)

$R^2 = 0,98$ ;  $DW = 2,03$ .

<sup>4</sup>Calculated by the author using a specialized econometric package Eviews.

Equality (2) shows that, other things being equal, *an increase in investment in the transport industry by 1% will lead to an increase in cargo turnover by 0.1%, and an increase in retail trade by 1% will lead to an increase in cargo turnover by 0.01%.*

In order to develop a competitive transport policy of the country using the methodological approaches adopted in developed countries to formulate strategic transport development programs, methodological principles and conceptual foundations of strategic planning for the development of the country's transport system have been developed. It is proposed to balance the strategies and programs of transport development with the strategies of socio-economic development of regions and resource-providing sectors, compliance with environmental norms and standards based on minimum social norms, as well as expand transit and export services, taking into account the benefits of the country's geopolitical position.

In order to study trends in the volume of shipment and arrival of goods and their possible future changes, as well as for indirect regulation of the development of transportation of the most massive goods in the region, it is recommended to use transport and economic balances more widely on the basis of territorial material balances, which serve as a macrological guideline for regulatory authorities and market entities when studying the dynamics of supply and demand for goods and groups of goods sold (Uldjabaev, Yarashova, 2017).

Thus, we can say that in the strategic planning of the development of transport companies, all its components are important and the chain of logistics processes should not be interrupted. And the higher the level of the planning object, the more detailed the system of forecasts of socio-economic, scientific, technical, and geopolitical development of transport should be presented in the projects, taking into account all relevant factors and trends.

#### **REFERENCES:**

1. Vasilios Plakandaras, Theophilos Papadimitriou, Periklis Gogas, Forecasting transportation demand for the U.S. market, *Transportation Research Part A: Policy and Practice*, Volume 126, 2019, Pages 195-214, ISSN 0965-8564, <https://doi.org/10.1016/j.tra.2019.06.008>.
2. Degan Zhang, Jiayu Wang, Hongrui Fan, Ting Zhang, Jinxin Gao, Peng Yang. New method of traffic flow forecasting based on quantum particle swarm optimization strategy for intelligent transportation system. *International journal of Communication systems*. 03 November 2020 <https://doi.org/10.1002/dac.4647>
3. Ansoff I. *Strategic management*. Classic edition. S-Pb.: Peter, 2009 - 344c.
4. Kondratiev N.D. *Large cycles of conjuncture*. Selected works. Moscow: Yurayt, 2016 – 550 p.
5. Marx K. *Capital*. M.: Etalon, 2016 – 1665 p.
6. H.Mintzberg. *Strategic safari*. Excursion through the wilds of strategic management. Moscow: Skolkovo, 2009 – 530 p.
7. Thompson, Jr. Arthur A., Strickland III A. J. *Strategic Management*. Concepts and situations for analysis. 12th ed., Translated from English - M.: Publishing house "Williams", 2006. — 928 p.
8. Michael Mescon, Michael Albert, Franklin Hedouri - *Fundamentals of Management*. Moscow: Delo, 1997 – 502 p.



9. Muntiyani V.I., Nekhaev S.A. System of methodology and logic of strategic planning. Economic strategies. No.8. 2018.
10. Basovsky L.E. Forecasting and planning in market conditions: Textbook. – M.: INFRA-M, 2003. – 260 p.
11. Uldjabaev K.U., Yarashova V.K. Strategic planning of railway passenger transportation development. – Tashkent: Exstremum-Press, 2013. - 344 p.
12. Uldjabaev K.U., Yarashova V.K. Long-term planning of the development of railway freight transportation. – Tashkent: Extremumpress, 2017. – 216 p.