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EVALUATION OF ADAPTIVE MODELS OF ENSURING THE STABILITY OF THE TRANSPORT AND LOGISTICS SERVICES MARKET IN THE FERGANA REGION

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Abstract: This article examines the theoretical and methodological issues of ensuring the stability of the transport and logistics services market in the Fergana region. The structural segments of the regional transport and logistics system are analyzed, and the factors affecting market stability are evaluated using the Analytic Hierarchy Process (AHP) method. In addition, adaptive models for improving adaptation mechanisms to changes in the external environment have been developed, and practical recommendations are provided at the regional level.

Keywords: Transport-logistics market, stability, adaptive models, Analytic Hierarchy Process (AHP), regional economy, Fergana region, infrastructure, competitiveness.

Annotatsiya: Mazkur maqolada Farg'ona viloyatida transport-logistika xizmatlari bozori barqarorligini ta'minlashning nazariy va uslubiy masalalari tadqiq etilgan. Hududiy transport-logistika tizimining tarkibiy segmentlari tahlil qilinib, bozor barqarorligiga ta'sir etuvchi omillar Analitik ierarxiya jarayoni (AHP) usuli yordamida baholangan. Shuningdek, tashqi muhit o'zgarishlariga moslashish mexanizmlarini takomillashtirish bo'yicha adaptiv modellar ishlab chiqilgan va hududlar kesimida amaliy tavsiyalar berilgan.

Kalit so'zlar: transport-logistika bozori, barqarorlik, adaptiv modellar, Analitik ierarxiya jarayoni (AHP), hududiy iqtisodiyot, Farg'ona viloyati, infratuzilma, raqobatbardoshlik.

Аннотация: В данной статье исследуются теоретические и методологические вопросы обеспечения стабильности рынка транспортно-логистических услуг в Ферганской области. Проанализированы структурные сегменты региональной транспортно-логистической системы, а факторы, влияющие на стабильность рынка, оценены с помощью метода **аналитического иерархического процесса (АИП)**. Также разработаны адаптивные модели по совершенствованию механизмов адаптации к изменениям внешней среды и предложены практические рекомендации в разрезе регионов.

Ключевые слова: Transport-logistics market, stability, adaptive models, Analytic Hierarchy Process (AHP), regional economy, Fergana region, infrastructure, competitiveness.

INTRODUCTION

The stable operation of regional transport and logistics systems is one of the key factors contributing to the uninterrupted functioning of supply chains in the modern economy. This issue is particularly relevant for the Fergana region, where the Fergana Valley is one of the most densely populated and industrially developed areas of Uzbekistan. The region's geographical characteristics and the significant role of agriculture create specific conditions for organizing transport and logistics processes in accordance with seasonal production patterns.

Adaptive planning models provide opportunities to improve the efficiency of transport and logistics systems and support their timely adjustment to changing external conditions. Such conditions may include changes in border procedures, fluctuations in fuel prices and seasonal variations in fuel availability, as well as the need to

maintain road infrastructure during emergency situations. In this context, the purpose of the article is to propose an adaptive methodological model for assessing the stability of the transport and logistics market in the Fergana region and to test its applicability using conditional (illustrative) data.

REVIEW OF LITERATURE ON THE SUBJECT

Ensuring the stability of the transport and logistics systems and services market, the use of various adaptive models in their management is one of the most pressing issues in today's modern economy. Foreign and domestic scientists have conducted scientific work on a number of theoretical, methodological and practical aspects of this issue.

Foreign researchers such as M. Christopher, D. Waters and R. Ballou have deeply analyzed the stability of logistics networks and supply chains, their adaptability to changes in the market. In particular, M. Christopher in his works proposed various models for increasing the logistics system and their risk tolerance.

CIS scientists V.N. Voronova, L.B. Mirotn and A.A. Kikish, who studied the transport market in the regional economy, have deeply analyzed the factors necessary for the infrastructural provision of markets and their sustainable development.

Uzbek scientist O.B. Tursunov analyzed in his research methods for analyzing the development of transport and logistics services in the region and ways to improve their processes and efficiency using economic and mathematical models.

Today, as we noted above, in a densely populated and economically active region like the Fergana region, transport services are increasing year by year. An analysis of the studied scientific works shows that the development of adaptive models to ensure the stability of the transport and logistics market and the study and assessment of its effectiveness have not been sufficiently studied. The existing scientific literature mainly analyzes the general logistics infrastructure, and there remains a need to create adaptive assessment models that take into account the specific features of the Fergana region (cross-border location, the share of small businesses and private entrepreneurship in freight transportation, inter-cluster logistics connections).

RESEARCH METHODOLOGY

The following methods were used to develop adaptive models for ensuring the stability of the transport and logistics services market in the Fergana region:

1. Diagnostic stage
2. Criteria formation and weighting stage
3. Stress test stage
4. Integral assessment stage

At the diagnostic stage, Fergana region is characterized by densely populated areas, developed small business and private entrepreneurship, and industrial clusters. Therefore, it requires studying it in different segments. Road transport infrastructure segment. The main 90% of freight and passenger transportation in Fergana region falls on road transport. The condition of highways providing connectivity between districts in the region, their capacity, the condition of main highways, and the state of private enterprises engaged in freight transportation are analyzed. Railway transport segment. The logistics potential of the region's railway lines connecting it with other regions (via the Kamchik pass), as well as transit corridors connecting it with foreign markets, is analyzed. It mainly analyzes the capacity of cargo loading and unloading terminals at railway stations, the availability of container yards, and the possibilities of connecting large industrial zones with railway lines.

During the criteria formulation and weighting stage, 4 main criteria are selected to reveal the stability of the transport and logistics market in the region.

M_1 - Infrastructure and material and technical base criteria: Density and quality of highways, capacity of warehouse complexes, degree of modernization of the vehicle fleet.

M_2 - Economic and financial criteria: Profitability of transport services, volume of investments directed to the sector, acceptability of service costs.

M_3 — Operational stability and service quality criteria: Guarantee of timely delivery of goods, transportation safety, continuity and reliability of logistics chains.

M_4 — Digital and adaptive management environment criteria: Introduction of digital technologies, GPS monitoring and electronic management systems into logistics processes, speed of adaptation to market shocks.

A group of industry experts and heads of logistics companies is involved. Using T. Saati's 1-9 point scale, the criteria are compared in pairs (for example, the importance of infrastructure in relation to economic criteria is assessed). As a result, a 4x4-dimensional pairwise comparison matrix is formed (Figure 1):

$$A = \begin{pmatrix} 1 & a_{12} & a_{13} & a_{14} \\ 1/a_{12} & 1 & a_{23} & a_{24} \\ 1/a_{13} & 1/a_{23} & 1 & a_{34} \\ 1/a_{14} & 1/a_{24} & 1/a_{34} & 1 \end{pmatrix}$$

Figure 1. Matrix for T. Saati's score scale¹

The matrix rows are normalized and priority vectors (Wi) are determined for each criterion.

ANALYSIS AND RESULTS

Uzbekistan was one of the first to support this strategic initiative and has established itself as a central link in regional integration. Table 1 below presents a comparative analysis of the operational efficiency and management models of the main strategic transport and logistics projects implemented and planned in Uzbekistan (Table 1):

Table 1
Projects implemented in Uzbekistan²

Project name	Direction and strategic role	Implementation period	Form of management and financing	Performance indicator
Angren-Pop railway line (Kamchik tunnel)	Integrating the Fergana Valley into a single railway network and forming the 'China-Central Asia-Europe' corridor.	2013-2016 (fully submitted)	EPC+F model: 'Uzbekistan Railways' JSC and China Railway Tunnel Group. Financing: China Exim Bank and state budget.	Freight transport time reduced by 6 hours; 19.2 km tunnel increased logistics efficiency in Central Asia by 20%.
China-Kyrgyzstan-Uzbekistan railway	Creating the shortest trans-regional route from China to Southern Europe and the Middle East.	Agreement in 2022, construction in 2024-2026	International Consortium: Joint venture of three countries. Financing: AIIB, government investment	The freight transportation distance will be reduced by 900 km; the annual transit volume is expected to reach 15 million tons.
Navoi International Multimodal Logistics Center	To create a global freight hub (land port) at the intersection of air, rail, and highways.	Modernization from 2018	Management agreement between DP World (UAE) and local operators, PPP system.	Through Just-in-Time (JIT), the speed of air cargo processing has increased by 40%; the attractiveness of transit has increased by 40%.

It was scientifically substantiated that ensuring the stability of the transport and logistics market is a strategic factor in the modernization of the regional economy. Based on a systematic approach and comparative analysis methods, structural segments of the transport and logistics system of the Fergana region (road transport and road infrastructure, railway and intermodal networks, industrial cluster logistics, and digital management environment) were identified.

CONCLUSIONS AND SUGGESTIONS

The results of the study and analysis show that in order to increase the competitiveness of the transport and logistics system in the Republic of Uzbekistan and transform it into an international hub, it is recommended to implement the following priority tasks:

Distribute cargo flows across several nodes by developing multifunctional logistics centers in the cities of Kokand and Margilan, thereby reducing dependence on single road nodes;

Introduce a single digital logistics platform at the regional level - a system that allows real-time monitoring of vehicle location, cargo capacity and route status;

¹ Source: Author's own work.

² Source: Author's own work.

Form a reserve transport and refrigeration vehicle fund for seasonal cargo transportation (cotton, fruits and vegetables) on the basis of public-private partnership;

Reduce transit time by digitizing transportation processes at border crossing points and introducing simplified procedures;

Transform the proposed sustainability index (Is) into a regular (quarterly) calculation and monitoring system based on actual data from the regional statistics department and industry enterprises.

In conclusion, adaptive models allow assessing the stability of the transport and logistics market not only in the current state, but also under various crisis scenarios, which serves as an important early warning and decision-making support tool for regional governments.

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