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Message

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Dr. P. S. Bhadouria

WAYS AND PROSPECTS OF USING MARKETING STRATEGIES TO INCREASE THE ATTRACTIVENESS OF REGIONAL TRADE ENTERPRISES

Otakhonova Dinora Musaboy qizi¹

ABSTRACT

This article discusses the ways and prospects of using marketing strategies to increase the attractiveness of regional trade enterprises. It also presents conclusions and proposals for studying the prospects of using marketing strategies to increase the attractiveness of trade enterprises.

Keywords. Trade, Trade Enterprise, Marketing, Marketing Strategy, Prospects, Forecast.

In a market economy, trade enterprises are an important structural component of the regional economy. They perform an intermediary role between producers and consumers, ensuring the efficient circulation of goods and services. The development of trade enterprises plays a significant role in increasing employment, raising household incomes, supplying the domestic market, and stimulating regional economic activity. Under current competitive conditions, it is no longer sufficient for trade enterprises to rely solely on price or product assortment. Their market attractiveness directly depends on the correct selection and effective implementation of marketing strategies. A marketing strategy enables a trade enterprise to adapt to the market environment, identify consumer needs, and create sustainable long-term competitive advantages. The attractiveness of a trade enterprise reflects how appealing and reliable it is for consumers, investors, and partners. This attractiveness is demonstrated through key criteria such as the breadth of product and service assortment, flexibility of pricing policy, quality of service, convenience of location, brand image and reputation, as well as the availability of digital services and innovative solutions. Marketing strategy serves to systematically develop each of these criteria and is aimed at strengthening the market position of trade enterprises.

Various studies have been conducted on the use of marketing strategies to enhance the attractiveness of regional trade enterprises. In particular, some studies analyze the theoretical and methodological foundations and specific features of developing marketing strategies to increase the export potential of enterprises and countries [1]. Other studies examine the mechanisms for applying marketing strategies to enhance the attractiveness of regional trade enterprises. Specifically, the socio-economic mechanisms of using marketing research in the process of increasing competitiveness in the trade services sector have been analyzed [2].

According to other studies, the formation of marketing strategies aimed at regional development is directly based on methodological approaches. That is, as a foundation for the activities of regional authorities in increasing territorial attractiveness, a methodological approach is developed that enables more comprehensive, concentrated, and targeted actions within the strategic directions of territorial marketing [3]. According to other sources, the use of marketing strategies to enhance the attractiveness of regional trade enterprises is implemented directly at the level of regional marketing. In this regard, one of the main problems of the regional marketing model is that it leads to significant inefficiency and ineffective competition [4].

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According to research, under conditions of intense competition among territories to attract investors, residents, and other consumer groups, the issue of developing effective marketing strategies for the development of countries, regions, and cities becomes increasingly important. Accordingly, territorial marketing plays a special role in defining strategic directions as a specific type of activity aimed at creating competitive advantages for the benefit of consumers within a particular region [5].

Other studies indicate that the current goals and priorities of regional governance create a foundation for exploring new methods and tools to enhance regional attractiveness and competitiveness, including territorial marketing. In this context, the competitive orientation of regional marketing is reflected in the creation of better conditions for investment, business, education, tourism, and living compared to other regions [6]. This implies ensuring investment, educational, and financial attractiveness, as well as facilitating the inflow of various consumer groups, including investors, into the region.

According to further studies, functional strategies are developed and implemented with consideration of business strategies for territorial development [7]. In particular, the purpose of functional strategies is to identify effective actions of local authorities within the framework of the overall strategy of municipalities.

It is necessary to take into account the demographic, cultural, and economic characteristics of each region. Accordingly, incorporating regional mentality, consumer traditions, as well as transport and logistics capacities into marketing strategies enhances the efficiency of trade enterprises. Thus, the effective implementation of marketing strategies leads to outcomes such as increased trade turnover, job creation, the development of small business and entrepreneurship, expansion of the regional tax base, and the improvement of consumer culture among the population. These processes contribute to strengthening regional economic stability.

In particular, the development of marketing strategies for trade enterprises in a region is directly determined by the products created by these enterprises. In this regard, econometric modeling was carried out based on indicators of the volume of products sold by trade enterprises. The following indicators were selected for the modeling process (Table 1).

Table 1 : Economic indicators for 2010–2025 aimed at developing marketing strategies for trade enterprises in the region [8]

Years	Y – Volume of products sold by trade enterprises, in thousand soums	X₁, Savdokorxonalarisoni, mingdona	X1 – Number of trade enterprises, thousand units	X3 – Number of employees in trade enterprises, thousand people
2010	1276,8	5412,0	856,0	30961,0
2011	1694,2	6079,0	961,0	34776,0
2012	2076,1	6322,0	1001,0	36164,0
2013	2568,4	6297,0	997,0	36020,0
2014	3017,4	5937,0	1193,0	33960,0
2015	3446,1	6407,0	1287,0	36651,0
2016	4123,2	7500,0	1507,0	42902,0

2017	4825,0	7299,0	1487,0	42623,0
2018	6837,7	8122,0	2370,0	46994,0
2019	8918,1	9956,0	3041,0	61001,0
2020	11691,0	10222,0	4334,0	67894,0
2021	12807,5	10315,0	9638,0	75318,0
2022	17370,5	11144,0	13517,0	86252,0
2023	21119,8	11137,0	17842,0	87316,0
2024	25392,6	12081,0	19570,0	92105,0
2025	29736,8	13105,0	21397,0	95692,0

Based on Table 1, the calculated values of the number of trade enterprises (X1), the number of trade enterprises with websites (X2), and the number of employees in trade enterprises (X3) were used to determine the forecasted values of the volume of products sold by trade enterprises (Y). Initially, the selection criteria for the ARMA (p, q) model were determined based on the indicator of the number of trade enterprises, and the optimal value for each criterion was chosen. For reference, the log-likelihood ('loglik') was calculated. Based on this criterion, the following 1-ARMA model was developed to determine the forecasted values of the volume of products sold by trade enterprises (Table 2).

Table 2 : The form of the 1-ARMA model, based on observations from 2010 to 2025 (t = 16).

Dependent variable: Y – Volume of products sold by trade enterprises

	<i>Coefficient</i>	<i>Standarderror</i>	<i>z-statistic</i>	<i>p-value</i>	
const	27545.6	17094.4	1.611	0.1071	
phi_1	1.37715	0.197123	6.986	<0.0001	***
phi_2	0.177298	0.399205	0.4441	0.6570	
phi_3	-0.575301	0.204500	-2.813	0.0049	***
Mean of dependent variable	9806.325		Standard deviation of dependent variable	9099.028	
Mean of innovations	46.06646		Standard deviation of innovations	852.2932	
R-squared	0.991946		Adjusted R-squared	0.990707	
Log-likelihood	-135.2801		Akaike Information Criterion (AIC)	280.5602	
Schwarz Criterion	284.4232		Hannan-Quinn Criterion (HQ)	280.7580	
		Real Part	Imaginary Part	Module	Oscilation

AR					
	1-root	1.0044	0.1158	1.0110	0.0183
	2-root	1.0044	-0.1158	1.0110	-0.0183
	3-root	-1.7005	0.0000	1.7005	0.5000

Table 2 presents the results of the autoregressive (AR) model developed based on the analysis of the economic time series. The model includes three lagged variables ($\varphi_1, \varphi_2, \varphi_3$), and their effects on the dependent variable were statistically evaluated. According to the results, the coefficient φ_1 is positive and highly statistically significant ($p < 0.0001$), indicating a strong influence of the first lag on the dependent variable. The coefficient φ_3 is negative and significant ($p = 0.0049$), reflecting an inverse effect at the third lag. The coefficient φ_2 , however, is not statistically significant.

The model demonstrates a high degree of fit, with an R-squared value exceeding 0.99. This indicates that the majority of the variation in the dependent variable is explained by the model. The Akaike, Schwarz, and Hannan-Quinn criteria provide satisfactory results for model selection. The modulus values of the AR roots being greater than 1 indicate that the model is non-stationary and that oscillations are present in the time series. Although the model has a high explanatory power, special attention should be paid to the issue of stationarity when applying it. Based on the results of the selected 1-AR model, the forecasted values of the volume of products sold by trade enterprises were determined (Table 3).

Table 3 : Forecasted Values of the Volume of Products Sold by Trade Enterprises in Khorezm Region for 2026–2030

For a 95% confidence interval, $z(0.025) = 1.96$

Years	Y – Volume of Products Sold by Trade Enterprises	Forecast	Standard Error	95% Confidence Interval
2026	not available	33878.2	852.293	(32207.8, 35548.7)
2027	not available	37893.7	1450.53	(35050.7, 40736.7)
2028	not available	41658.6	2286.51	(37177.1, 46140.1)
2029	not available	45172.8	3139.87	(39018.8, 51326.8)
2030	not available	48369.8	4077.64	(40377.7, 56361.8)

Table 3 presents the forecasted values of the volume of products sold by trade enterprises for 2026–2030. According to the forecast results, this indicator shows a steady growth trend over the years, increasing from 33,878.2 units in 2026 to 48,369.8 units by 2030. This reflects the expansion of trade enterprise activities and the growth of market volume. At the same time, as the forecast horizon extends, the standard error increases and the 95% confidence interval widens, indicating a higher level of uncertainty in long-term forecasts. The confidence intervals represent the probable range of forecasted values and suggest that the results should be interpreted with caution. Overall, the table demonstrates a positive dynamic in the volume of products sold by trade enterprises in the coming years.

Additionally, to determine the forecasted values of the number of trade enterprises, the following 2-ARMA model was developed (Table 4).

Table 4 : Form of the 2-ARMA Model Based on Observations from 2010–2025
(t = 16) Dependent variable: X1 – Number of Trade Enterprises

	<i>Coefficient</i>	<i>Standarderror</i>	<i>z-statistic</i>	<i>p-value</i>	
const	9513.34	748.133	12.72	<0.0001	***
phi_1	1.96794	0.0161305	122.0	<0.0001	***
phi_2	-0.998957	0.00528805	-188.9	<0.0001	***
theta_1	-0.939984	0.567768	-1.656	0.0978	*
theta_2	-0.939977	0.987579	-0.9518	0.3412	
theta_3	0.999994	0.566537	1.765	0.0775	*
Mean of dependent variable	8583.438		Standard deviation of dependent variable	2513.576	
Mean of innovations	squared-42.32570		Standard deviation of innovations	376.0846	
R-squared	0.977134		Adjusted R-squared	0.968819	
Log-likelihood	-123.3790		Akaike Information Criterion (AIC)	260.7581	
Schwarz Criterion	266.1662		Hannan-Quinn Criterion (HQ)	261.0350	
		Real Part	Imaginary Part	Module	Oscillation
AR					
	1-root	0.9850	-0.1756	1.0005	-0.0281
	2-root	0.9850	0.1756	1.0005	0.0281
MA					
	1-root	0.9700	0.2431	1.0000	0.0391
	2-root	0.9700	-0.2431	1.0000	-0.0391
	3-root	-1.0000	0.0000	1.0000	0.5000

Table 4 presents the results of the ARMA model (autoregressive and moving average components). According to the results, the coefficients const, ϕ_1 , and ϕ_2 are highly statistically significant (p -value < 0.0001), indicating that the dynamics of the dependent variable are strongly influenced by the values from the previous two periods. The coefficients θ_1 and θ_3 are significant at the 10% level, reflecting partial effects of random shocks, while θ_2 is not statistically significant. The model demonstrates a high level of goodness-of-fit, with an R-squared value close to 0.98, meaning it explains a substantial portion of the variation in the

dependent variable. Information criteria (AIC, Schwarz, and Hannan-Quinn) confirm that the overall fit of the model is satisfactory. The moduli of the AR and MA roots being close to 1 indicate oscillations in the system, but overall the model is close to a stable state.

This model reliably characterizes the time series and has practical significance for forecasting. Based on the results of the selected 2-ARMA model, the forecasted values of the number of trade enterprises were determined (Table 5).

Table 5 : Forecasted Values of the Number of Trade Enterprises in Khorezm Region for 2026–2030
For a 95% confidence interval, $z(0.025) = 1.96$

Years	X1 – Number of Trade Enterprises	Forecast	Standarterror	95% Confidence Interval
2026	Not available	12924.9	376.085	(12187.8, 13662.0)
2027	Not available	13083.5	539.349	(12026.4, 14140.6)
2028	Not available	13182.6	540.274	(12123.7, 14241.5)
2029	Not available	13167.9	542.778	(12104.0, 14231.7)
2030	Not available	13039.8	547.390	(11966.9, 14112.6)

Table 5 presents the forecasted values of the number of trade enterprises (X1) for 2026–2030. According to the forecast results, a slight upward trend in the number of trade enterprises is observed from 2026 to 2028, reaching 13,182.6 units in 2028. In the following years, the indicator stabilizes, with a slight potential decline in 2029–2030. At the same time, as the forecast horizon extends, the standard error steadily increases and the 95% confidence interval remains relatively wide, indicating a certain level of uncertainty in long-term forecasts. The confidence intervals reflect the probable range of forecasted values and highlight the need for cautious interpretation of the results. Overall, the table suggests that the number of trade enterprises will remain close to a stable level in the coming years. Furthermore, to determine the forecasted values of the number of trade enterprises with websites, the following 3-ARMA model was developed (Table 6).

Table : 6-jadval Form of the 3-ARMA Model Based on Observations from 2010–2025
(t = 16) Dependent variable: X2 – Number of Trade Enterprises with Websites

	Coefficient	Standarderror	z-statistic	p-value	
const	8693.59	5336.43	1.629	0.1033	
phi_1	1.76079	0.118838	14.82	<0.0001	***
phi_2	-0.814450	0.129384	-6.295	<0.0001	***
Mean of dependent variable	6312.375		Standard deviation of dependent variable	7492.569	
Mean of innovations	107.3590		Standard deviation of innovations	1222.923	

R-squared		0.972303	Adjusted R-squared		0.970325
Log-likelihood		-138.9570	Akaike Information Criterion (AIC)		285.9140
Schwarz Criterion		289.0044	Hannan-Quinn Criterion (HQ)		286.0723
		Real Part	Imaginary Part	Module	Oscillation
AR					
	1-root	1.0810	-0.2436	1.1081	-0.0353
	2-root	1.0810	0.2436	1.1081	0.0353

Table 6 presents the results of the autoregressive (AR) model describing the time series. According to the results, the coefficients φ_1 and φ_2 are highly statistically significant (p -value < 0.0001), indicating that the current value of the dependent variable is strongly influenced by the values from the previous two periods. The effect of the first lag is positive, while the second lag has a negative effect, suggesting some oscillations in the dynamics. The const coefficient, although close to the 10% significance level, is not strictly statistically significant. The model demonstrates a high level of goodness-of-fit, with an R-squared value above 0.97, indicating that it explains a substantial portion of the variation in the dependent variable. Information criteria (AIC, Schwarz, and Hannan-Quinn) confirm that the overall fit of the model is satisfactory. The moduli of the AR roots are greater than 1, indicating that the model is dynamically stable while exhibiting minor oscillations in the system. This model reliably characterizes the dynamics of the analyzed indicator and has practical significance for forecasting. Based on the results of the selected 3-ARMA model, the forecasted values of the number of trade enterprises with websites were determined (Table 7).

Table 7 : Forecasted Values of the Number of Trade Enterprises with Websites in Khorezm Region for 2026–2030 For a 95% confidence interval, $z(0.025) = 1.96$

Yillar	X2 – Number of Trade Enterprises with Websites	Forecast	Standard error	95% Confidence Interval
2026	Not available	22203.4	1222.92	(19806.5, 24600.3)
2027	Not available	22135.3	2476.35	(17281.7, 26988.8)
2028	Not available	21358.6	3734.61	(14038.9, 28678.3)
2029	Not available	20046.4	4897.69	(10447.2, 29645.7)
2030	Not available	18368.6	5907.06	(6791.01, 29946.3)

Table 7 presents the forecasted values of the number of trade enterprises with websites (X2) for 2026–2030. According to the forecast results, the indicator is expected to reach 22,203.4 units in 2026, followed by a consistent downward trend, potentially decreasing to 18,368.6 units by 2030. This reflects certain changes in the share of enterprises with digital infrastructure or market saturation processes. As the forecast horizon extends, the steadily increasing standard errors and widening 95% confidence intervals indicate a higher level of uncertainty in long-term projections. In particular, the notably wide confidence intervals for 2029–

2030 highlight the need for cautious interpretation of the forecast results. Overall, the table suggests relative short-term stability in the number of trade enterprises with websites, but a potential decline over the long term. In addition, to determine the forecasted values for the number of employees working in trade enterprises, the following 4-ARMA model was developed (Table 8).

Table 8 : 4. ARMA Model Specification, based on observations from 2010–2025

(t = 16). Dependent Variable: X3 – Number of employees in trade enterprises¹

	<i>Coefficient</i>	<i>Standard error</i>	<i>z-statistic</i>	<i>p-value</i>	
const	63120.3	6760.03	9.337	<0.0001	***
phi_1	1.95243	0.0227734	85.73	<0.0001	***
phi_2	-0.989258	0.0112772	-87.72	<0.0001	***
theta_1	-0.999999	0.209384	-4.776	<0.0001	***
Mean of dependent variable	56664.31		Standard deviation of dependent variable	23761.78	
Mean of innovations	-457.0317		Standard deviation of innovations	3538.141	
R-square	0.978123		Adjusted R-squared	0.974757	
Log-likelihood	-157.0149		Akaike Information Criterion (AIC)	324.0298	
Schwarz Criterion	327.8927		Hannan-Quinn Criterion (HQ)	324.2276	
		<i>RealPart</i>	<i>Imaginary</i>	<i>Modulus</i>	<i>Frequency</i>
AR					
	Root 1	0.9868	-0.1925	1.0054	-0.0307
	Root 2	0.9868	0.1925	1.0054	0.0307
MA					
	Root 1	1.0000	0.0000	1.0000	0.0000

Table 8 presents the results of the ARMA-type time series model. According to the results, the coefficients const, ϕ_1 , ϕ_2 , and θ_1 are all highly statistically significant (p -value < 0.0001). This indicates that the dynamics of the dependent variable are strongly influenced by the values from the previous two periods, as well as by random shocks captured by the moving average (MA) component. The effect of the first lag is positive, while the second lag is negative, reflecting rapid changes and short-term oscillations in the series. The model demonstrates very high explanatory power, with an R-squared value close to 0.98, meaning that

¹ Standard errors were calculated based on the Hessian matrix

a large portion of the variation in the dependent variable is accounted for by this model. Information criteria (AIC, Schwarz, and Hannan-Quinn) confirm that the overall model fit is satisfactory. The AR roots having moduli slightly greater than 1 indicate that the model is dynamically stable, while the MA root being close to 1 reflects the strong influence of shocks in the system. This ARMA model provides a precise and reliable description of the analyzed time series and is suitable for forecasting purposes. Based on the results of the selected 4th model, the forecasted values for the number of employees working in trade enterprises have been determined (Table 9).

Table 9 : Forecasted values of the number of employees working in trade enterprises (X3) in Khorezm region for 2026–2030 For 95% confidence intervals, $z(0.025) = 1.96$.

Years	X3 Number of employees in trade enterprises	Forecast	Standard error	95% Confidence Interval
2026	not available	97513.2	3538.14	(90578.6, 104448.)
2027	not available	98048.3	4886.13	(88471.7, 107625.)
2028	not available	97291.4	5775.47	(85971.7, 108611.)
2029	not available	95284.2	6366.30	(82806.5, 107762.)
2030	not available	92114.1	6730.24	(78923.1, 105305.)

Table 9 presents the forecasted values of the number of employees (X3) in trade enterprises for 2026–2030. According to the forecast results, the number of employees is expected to remain relatively stable and even show a slight increase during 2026–2027. However, a downward trend is projected in the subsequent years. Specifically, while 97,513 employees are forecasted for 2026, this figure may decline to 92,114 by 2030. The increase in standard errors and the widening of the 95% confidence intervals over time indicate higher uncertainty in long-term projections. The confidence intervals reflect the probable range of forecasted values and highlight that changes in the labor market are sensitive to external factors. Overall, the table suggests that the labor force in trade enterprises is likely to remain stable in the short term but may exhibit a tendency toward optimization or reduction in the long term.

In conclusion, the use of marketing strategies in enhancing the attractiveness of regional trade enterprises holds significant scientific and practical importance. Marketing strategies enable trade enterprises to adapt to market demand, increase their competitiveness, accelerate regional economic development, and contribute to improving the population's standard of living. Based on the above analyses and forecast results, we believe that for the effective application of marketing strategies in trade enterprises, it is necessary to implement measures such as: improving assortment and product policies, adjusting pricing strategies, enhancing service quality, developing digital marketing and e-commerce, and strengthening the role of marketing strategies in brand and image formation. Accordingly, we consider that marketing strategies should be further developed and expanded in the following directions in the future:

- Analysis of consumer behavior based on artificial intelligence and Big Data.
- Introducing various types of trade models;
- Automating trade processes through digital platforms;
- Implementing ecological and sustainable marketing concepts.

These prospects not only enhance the attractiveness of trade enterprises but also strengthen the competitiveness of the regional economy.

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DIGITAL MODEL FOR MANAGING CONSTRUCTION SERVICES BASED ON SUBSYSTEM INTEGRATION AND CONSOLIDATED FORECASTING TO 2030

Dilafroz Abdullaeva¹

ABSTRACT

This paper develops a digital model for managing construction services based on the integration of key subsystems and consolidated forecasting of industry development. The model includes BIM design, platform-based management, e-procurement, and IoT-based quality monitoring, forming a closed-loop data-driven management system. Using econometric methods and ARIMA forecasting, the synergistic effect of digitalization and its economic efficiency are assessed. The findings demonstrate the significant potential of digital solutions to enhance efficiency and ensure sustainable development of construction services.

Keywords: *Digital Model, Construction Services Management, BIM, IoT Monitoring, Synergy Effect, Digitalization ROI, Consolidated Index F, ARIMA Forecasting.*

Introduction.

The digital transformation of the construction sector represents a strategic priority for the Republic of Uzbekistan, as outlined in the “Digital Uzbekistan – 2030” Concept.

Despite the acceleration of digital reforms, the actual level of digitalization of construction services remains insufficient. According to the results of the author’s survey (n = 140 construction service enterprises in the Samarkand region, 2024), the level of digitalization is estimated at 42.1%.

Existing approaches to the digitalization of the construction industry predominantly consider digital technologies as tools for automating отдельных operational processes rather than as elements of an integrated management system.

In contrast, the proposed model is based on an integrative approach, which enables the formation of a synergistic effect ($\kappa_{\text{syn}} = 0.18\text{--}0.22$), distinguishing it from fragmented digital solutions.

The purpose of this study is to develop the architecture of a digital model for managing construction services and to formulate a consolidated forecast for the development of construction services in the Samarkand region up to 2030.

Literature Review.

The theoretical foundation of the digital model for managing construction services (DMCSM) is based on four interrelated research directions.

The first direction is associated with the development of Building Information Modeling (BIM) as a system-forming technology for the digitalization of construction. Studies by Rafael Sacks, Chuck Eastman, and Paul Teicholz demonstrate that BIM implementation reduces design errors by 25–30% and shortens

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project delivery time by 15–20% [1]. Furthermore, Bilal Succar developed the BIM maturity framework, emphasizing the necessity of a phased implementation of digital technologies in construction [2].

The second direction focuses on digital platforms for construction project management. Research by A. Monteiro shows that the integration of platform-based solutions with BIM technologies reduces administrative costs by 18–22% [3], while studies by M. Kearns indicate that the use of IoT-based monitoring systems contributes to a 20–25% reduction in construction defects [4].

The third direction relates to the economics of digital integration. Erik Brynjolfsson and Andrew McAfee theoretically substantiated the existence of a synergistic effect in the joint application of digital technologies, where the combined outcome exceeds the sum of individual effects [5]. This concept forms the basis for introducing the author's synergy coefficient (κ_{syn}) within the proposed model.

The fourth direction highlights the role of public policy in the digitalization of the construction sector. Studies by J. Reilly [6], as well as analytical reports from OECD and FIDIC [7], indicate that sustainable outcomes of digital transformation are achieved through phased implementation programs lasting 5–7 years, leading to productivity gains of 14–15% in the construction industry.

In the context of the Republic of Uzbekistan, issues related to the digitalization of construction services have been addressed in studies by domestic researchers, as well as in official analytical materials from the State Committee of the Republic of Uzbekistan on Statistics and national strategic development documents [9]. However, the existing literature lacks an integrated digital model that combines a systemic management architecture, a formalized synergy coefficient, and a quantitative assessment of economic efficiency (ROI) for regional construction service markets. This research gap determines the relevance of the present study.

Methodology.

The methodological framework of the digital model for managing construction services (DMCSM) is based on a systems-cybernetic approach, which considers digital subsystems as elements of an integrated management system.

The overall effect of digitalization is formalized using an additive-multiplicative model:

$$E_{digital} = \sum_i (w_i \cdot E_i) \times (1 + \kappa_{syn}) \quad (1)$$

where E_i represents the effect of the i -th subsystem (%), w_i denotes its weight in the model, and κ_{syn} is the synergy coefficient reflecting the additional effect of integrating digital solutions.

The economic efficiency of the digital model is evaluated using the return on investment (ROI) indicator:

$$ROI = \frac{\sum Benefits - \sum Costs}{\sum Costs} \times 100\% \quad (2)$$

To construct a consolidated forecast of construction service development, an integral index is applied:

$$F = \frac{F_1 + F_2 + F_3}{3} \quad (3)$$

where F_1 is the institutional index, F_2 is the organizational and economic index, and F_3 represents the investment factor.

This index enables a comprehensive assessment of sectoral development, where the key objective is to reduce the structural imbalance between investment activity and organizational-economic efficiency ($F_3 - F_2$).

Results and Discussion.

As a result of the conducted research, the architecture of the digital model for managing construction services (DMCSM) has been developed.

The structuring of the model into four interrelated subsystems allows for a systematic representation of the functional distribution of digital tools and their contribution to achieving target performance indicators in construction services.

The key components and characteristics of the proposed digital model are presented in Table 1.

Table 1. Architecture of the Digital Model for Managing Construction Services (DMCSM)¹

Subsystem	Technologies	Key Functions	Quantitative Effects	Weight (w _i)
1. BIM-based Design	Revit, ArchiCAD, Tekla Structures, Navisworks	3D modeling; clash detection; automated cost estimation; data integration into management systems	Design errors -25–30%; project duration -15–20%; cost estimation accuracy +12–15%; RFI reduction by 40%	0,28
2. Platform-based Project Management	MS Project, Primavera P6, Procore, Aconex	Resource planning; risk management; electronic document management; BIM integration; mobile access	Project duration -10–12%; administrative costs -18–22%; transparency for clients +35–40%	0,25
3. Digital Procurement and Subcontracting	xarid.uz; blockchain-based subcontracting systems; smart contracts	E-procurement; price monitoring; automated IR indicator calculation; qualification verification	Transaction costs -20–25%; subcontractor competition +15–18%; OR–IR gap reduction by 2.5–3.5 p.p.	0,22
4. IoT-based	Drones; IoT sensors	Real-time	Construction defects	0,25

¹.Source: Author's calculations. The weights (w_i) were determined using expert evaluation (n = 15); the effects are based on international BIM implementation practices and the author's estimates.

Quality Monitoring	(vibration, deformation, humidity); IP video surveillance; GIS platforms	monitoring; material quality control; digital asset passport formation	-20–25%; warranty costs -15–20%; client claims -30–35%
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The analysis of the data presented in Table 1 demonstrates that each subsystem performs not only an independent function but also enhances the effectiveness of other components of the model.

Their integration generates a synergistic effect, resulting in a higher overall efficiency of construction services management compared to the fragmented implementation of digital technologies.

Thus, the proposed DMCSM architecture facilitates the transition from partial digitalization to a comprehensive and integrated management system within the construction sector.

The implementation of the digital model requires a phased approach, ensuring a gradual transition from pilot adoption to large-scale deployment and subsequent widespread diffusion of digital solutions.

Particular attention within this strategy is devoted to government support mechanisms, including subsidies for digital technologies, human capital development, and the establishment of digital infrastructure within the construction ecosystem.

The key stages of the implementation strategy are summarized in Table 2.

Table 2. Three-Stage Implementation Strategy of the DMCSM in the Samarkand Region (2025–2030)¹

Stage	Period	Coverage	Key Measures	Target Indicators	Budget (billion UZS)
I. Pilot Stage	2025–2026	5–7 leading enterprises (≥50 employees)	Establishment of a BIM center at Samarkand State University of Architecture and Construction; 50% subsidies for software costs; training of 50–70 specialists; implementation of 3–5 pilot DMCSM projects	Digitalization: 45–48%; BIM adoption: 12–15%; platform usage: 20–25%	0,7–1,0
II. Scaling Stage	2027–2028	20–25 enterprises (cumulative)	Expansion to SMEs; development of a BIM library (500–700 items); integration with xarid.uz	Digitalization: 50–55%; BIM adoption: 30–35%; platform	2,5–3,5

¹Source: Author’s elaboration. Developed based on a synthesis of international experience in the digitalization of the construction sector (Singapore — eCONSTRUCT; the United Kingdom — BIM Level 2/3; the UAE — BIM Mandate 2021), taking into account the budget constraints of the Samarkand region.

			and RISS platforms; training of 200–250 specialists (cumulative)	usage: 40–45%	
III. Mass Implementation Stage	2029–2030	50–60 enterprises (cumulative)	Mandatory BIM for projects exceeding 10 billion UZS; large-scale IoT deployment; training of 400–500 specialists (cumulative); integration of FIDIC BIM standards	Digitalization: 60–65%; BIM adoption: 50–55%; platform usage: 65–70%; annual savings: 40–50 billion UZS	3,0–4,5

The three-stage strategy presented in Table 2 reflects a structured transition from limited pilot implementation to large-scale digital transformation of the construction sector.

Particular importance is attached to the balanced allocation of budgetary resources, ensuring the effective implementation of measures at each stage.

Thus, the proposed three-stage DMCSM implementation model contributes not only to the technological modernization of construction services but also to the establishment of a sustainable institutional and organizational framework for the sector’s digital development.

At the same time, the successful implementation of this strategy requires the development of a comprehensive system of government support aimed at reducing barriers to digitalization and stimulating the adoption of innovative solutions. The key mechanisms of government support are summarized in Table 3.

Table 3. Government Support System for the Digitalization of Construction Services (2025–2030)¹

Support Mechanism	Parameters	Funding (billion UZS)	Expected Effect
1. BIM Software Subsidies	50% cost compensation; maximum 100 million UZS per enterprise; priority for SMEs (20–50 employees)	2.0–2.7	Coverage of 80–100 enterprises; BIM adoption reaches 50–55% by 2030

¹**Source: Author’s calculations.** Total public expenditures are estimated at 4.7–6.8 billion UZS, with expected private investment inflows of 4.0–6.5 billion UZS. Additional tax revenues (1.5–2.0 billion UZS) offset the revenue losses from tax incentives (0.3–0.5 billion UZS), indicating the fiscal sustainability and economic efficiency of the proposed support system.

2. Tax Incentives	Zero VAT on imported BIM software; accelerated depreciation (x2); 100% deduction of training expenses from the taxable base	Revenue loss: 0.3–0.5	Reduction of the effective tax burden by 4–6 p.p.
3. Innovation Grants for DMCSM Projects	Up to 50 million UZS per project; mandatory co-financing ≥50%; competitive selection (innovation — 40%, scalability — 30%, impact — 30%)	0.8–1.2 (20–25 projects)	Development of 10–15 standardized BIM solutions for the region
4. Regional Competence Center (Samarkand State University of Architecture and Construction)	Training of 150–275 specialists per year; BIM library; IoT laboratory; SME consulting; staff of 15–20 employees	1.6–2.4 (capital and operating costs)	Elimination of the skills gap; dissemination of BIM competencies

The system presented in Table 3 demonstrates a comprehensive and balanced approach to government support for the digitalization of construction services.

The analysis indicates that the combination of financial and institutional measures produces the greatest effect by simultaneously reducing barriers to digital technology adoption and stimulating investment activity among enterprises.

Under these conditions, the assessment of the economic efficiency of the digital model for managing construction services becomes a key element in substantiating its practical relevance.

Within the framework of this study, a comprehensive evaluation of investment costs, expected economic benefits, and performance indicators has been conducted, including net present value (NPV), return on investment (ROI), and payback period.

The proposed approach enables a quantitative assessment of the effectiveness of DMCSM implementation, taking into account the synergistic effects of digitalization and the attraction of private investments.

The main results of the economic efficiency assessment are presented in Table 4.

Таблица 4 : Расчёт экономической эффективности ЦМУСУ (2025–2030 гг.)¹

Indicator	Value	Source of Calculation
Total investment in DMCSM, billion UZS	6.5	Sum of budgets across the three stages (Table 2)
including public expenditures, billion UZS	2.55–3.80	Subsidies + grants + Regional Competence Center (Table 3)
including private investments, billion UZS	3.65–5.20	Co-financing at a 50% rate
Annual savings per enterprise, million UZS	180–360	12–18% of current costs under BIM + platform solutions
Number of enterprises covered by 2030	140–180	Stages II–III (Table 2)
Total annual savings by 2030, billion UZS	40–50	140–180 × (180–360) million UZS
Cumulative economic effect over 6 years (NPV), billion UZS	18.0	NPV at a 12% discount rate
ROI of DMCSM, %	177	$[(18.0 - 6.5) / 6.5] \times 100\%$
Payback period, years	2.7	Based on cumulative annual effects

The results presented in Table 4 confirm the high economic efficiency of implementing the digital model for managing construction services.

The key performance indicator is the return on investment (ROI = 177%), with a payback period of 2.7 years, indicating the strong investment attractiveness of the proposed model.

Thus, the calculations demonstrate that the implementation of the DMCSM is not only technologically justified but also economically viable as a strategic direction for the development of construction services.

¹**Source: Author's calculations based on Equation (2).** The discount rate (12%) is determined as the sum of the Central Bank of Uzbekistan's key interest rate and a risk premium of 2 percentage points, reflecting sectoral and project-specific risks.

The estimated ROI of 177% confirms the high economic efficiency and strong investment attractiveness of the proposed digital model for managing construction services.

At the same time, assessing the future development prospects of the sector under digital transformation requires comprehensive forecasting that accounts for technological, institutional, and organizational-economic factors.

The proposed approach makes it possible to evaluate the dynamics of digital transformation and determine its impact on key structural parameters of the sector, including productivity, profitability, and the volume of construction services.

The results of the forecast calculations are presented in Tables 5 and 6.

Table 5 Forecast of Digitalization Indicators of Construction Services in the Samarkand Region up to 2030¹

Indicator	2024 (actual)	2026 (forecast)	2028 (forecast)	2030 (forecast)	Target benchmark
Digitalization level, %	42.1	46–48	52–55	60–65	65–70 (Strategy)
Enterprises using BIM, %	8–10	14–18	30–35	50–55	50–55
Projects using digital platforms, %	12–15	22–26	40–45	65–70	65–70
BIM specialists (cumulative, persons)	45–60	110–140	220–270	400–500	400–500
Annual savings from DMCSM, billion UZS	—	8–12	20–28	40–50	≥40
OR–IR gap (industry average), p.p.	9.1	7.8–8.2	6.5–7.0	≤5.0	≤5.0

The data presented in Table 5 demonstrate a stable and positive trend in the digitalization of construction services in the Samarkand region.

A consistent increase is observed across key indicators of digital development, including the level of BIM adoption, the use of digital platforms, and the expansion of the sector's human capital base.

Particular significance is attached to the growth in annual savings, reaching 40–50 billion UZS by 2030, which confirms the substantial economic impact of implementing the digital model for managing construction services.

¹Source: Author's calculations based on the implementation strategy (Table 2) and data from the State Committee of the Republic of Uzbekistan on Statistics. The forecast is validated through interregional benchmarking.

The results indicate that digitalization acts not only as a driver of technological modernization but also as a key factor in improving the economic efficiency of the sector. Taken together, these changes create the conditions for transitioning construction services to a higher level of development, which requires further analysis within the framework of an integrated sectoral assessment. The consolidated forecast of construction service development is presented in Table 6.

**Table 6 Consolidated Forecast of Construction Service Development
in the Samarkand Region up to 2030¹**

Index / Indicator	2024 (actual)	2027 (baseline)	2030 (baseline)	2030 (optimistic)	Change 2024→2030 (baseline)
F ₁ (institutional)	0.64	0.72	0.81	0.85	+26.6%
F ₂ (organizational and economic)	1.402	1.52–1.55	1.62–1.68	1.72–1.76	+15.5–19.9%
F ₃ (investment)	2.153	2.25–2.30	2.35–2.42	2.45–2.52	+9.1–12.4%
Consolidated index F = (F ₁ + F ₂ + F ₃) / 3	1.398	1.50–1.52	1.59–1.64	1.67–1.71	+13.7–17.3%
Construction services volume, billion UZS	6,150	8,420–8,680	11,436– 12,180	13,200–14,100	+86–98%
Average IR in the sector, %	4.0	5.1–5.4	6.2–6.8	7.5–8.2	+2.2–2.8 p.p.
Digitalization level, %	42.1	50–55	60–65	65–70	+18–23 p.p.
Share of contract services, %	20.9	26.1	30.0	33.0	+9.1 p.p.

The consolidated forecast presented in Table 6 confirms the presence of a stable and positive development trajectory of construction services under the implementation of the proposed digital model. The integral development index F increases from 1.398 (2024) to 1.59–1.64 by 2030 under the baseline scenario and to 1.67–1.71 under the optimistic scenario, indicating a transition of the sector into the high development zone (1.50–2.00). This динамика reflects a balanced strengthening of institutional, organizational-economic, and investment factors.

¹**Source: Author's calculations.** The component F_1 is derived from the institutional model (Section 3.1), F_2 from the organizational and economic model (Section 3.2), while F_3 is estimated using trend extrapolation.

The integral index $F = (F_1 + F_2 + F_3)/3$ represents an author-developed aggregated indicator of the development level of construction services.

The baseline scenario assumes partial (approximately 70%) implementation of the set of measures proposed in Sections 3.1–3.3.

The integral development index F increases from 1.398 (2024) to 1.59–1.64 by 2030 under the baseline scenario and to 1.67–1.71 under the optimistic scenario, indicating a transition of the sector into the high development zone (1.50–2.00). This динамика reflects a balanced strengthening of institutional, organizational-economic, and investment factors.

Thus, the forecasting results confirm that digitalization acts as a system-forming driver of construction service development, ensuring not only quantitative growth but also qualitative transformation of the sector.

The proposed integrated mechanism provides a scientifically grounded pathway for the transition of the Samarkand region toward an intensive and sustainable growth model in construction services.

Conclusion

The proposed digital model for managing construction services (DMCSM) contributes three interrelated scientific advancements.

First, the synergy coefficient $\kappa_{syn} = 0.18\text{--}0.22$ is formalized, providing a quantitative representation of the additional effects arising from the integration of digital subsystems.

Second, the model demonstrates high economic efficiency: the return on investment reaches 177% with a payback period of 2.7 years, confirming its strong investment attractiveness.

Third, the consolidated index $F = (F_1 + F_2 + F_3)/3$ is introduced as a novel tool for the integral assessment of construction service development.

The practical significance of the study lies in the development of a comprehensive set of instruments that can be applied by public authorities in designing and implementing digital transformation programs in the construction sector. Thus, the proposed DMCSM provides a scientifically grounded and practically applicable framework for the transition toward a digital, efficient, and sustainable system of construction service management.

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SUPPLY CHAIN MANAGEMENT FRAMEWORK FOR IT PRODUCTS: STRATEGIC DESIGN, DIGITAL INTEGRATION, AND RESILIENCE IN A VOLATILE GLOBAL MARKET

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ABSTRACT

The supply chain ecosystem for information technology (IT) products has undergone profound structural change over the past decade, driven by accelerating digital transformation, geopolitical volatility, and increasing customer expectations for speed and transparency. This article develops a comprehensive, multi-layered Supply Chain Management (SCM) framework specifically designed for IT products — encompassing hardware, software, and managed services — and examines how organizations can build agile, resilient, and digitally enabled supply chains.

A systematic synthesis of academic literature, industry benchmarking reports, and practitioner case studies was conducted. The proposed framework integrates the Supply Chain Operations Reference (SCOR) model, Digital Twin methodologies, lean principles, and circular economy concepts. The framework identifies six interdependent layers — strategic planning, procurement, logistics, digital integration, governance, and sustainability — and demonstrates that organizations adopting an integrated, technology-driven approach achieve measurably higher resilience and cost efficiency.

Effective IT supply chain management demands the convergence of human expertise, advanced analytics, and sustainable practices. Organizations that treat the supply chain as a strategic asset — rather than an operational function — are best positioned to derive competitive advantage in an increasingly disrupted global landscape.

Keywords: *Supply Chain Management, IT Products, Digital Transformation, Procurement, Resilience, Sustainability, SCOR Model*

1. Introduction

The global market for IT products — spanning semiconductors, networking equipment, cloud infrastructure, enterprise software, and peripheral devices — is characterized by extraordinarily complex supply networks. Unlike many commodity industries, IT supply chains must simultaneously manage rapid product obsolescence, intricate component dependencies, and the need for data security across every stage of the chain. A single delayed semiconductor shipment can halt production lines across multiple continents,

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as dramatically demonstrated during the 2020–2022 global chip shortage, which cost the automotive and electronics industries an estimated \$240 billion in lost revenue.

Supply Chain Management (SCM) for IT products therefore occupies a uniquely challenging position at the intersection of technology, logistics, finance, and regulatory compliance. The function has evolved from a back-office operational concern to a board-level strategic priority. A 2024 Gartner survey of global CIOs found that supply chain resilience ranked as the top operational risk, above cybersecurity and talent retention, reflecting just how central this discipline has become to overall enterprise health.

Despite its importance, a cohesive, purpose-built SCM framework for IT products — one that addresses the sector's specific complexities — remains underrepresented in the academic literature. Existing frameworks, such as the SCOR model or the Council of Supply Chain Management Professionals (CSCMP) standards, provide valuable generic scaffolding but lack the granularity required for technology-specific contexts. This gap motivates the present study.

This article makes the following contributions:

- A synthesized, six-layer SCM framework tailored to the structural realities of IT product supply chains.
- An analysis of how emerging digital technologies — artificial intelligence, blockchain, digital twins, and IoT — are reshaping each layer of the chain.
- A set of evidence-based Key Performance Indicators (KPIs) and governance mechanisms to operationalize the framework.
- Strategic recommendations for building supply chain resilience against geopolitical and environmental disruptions.

2. Literature Review

2.1 Evolution of Supply Chain Management Thinking

The academic field of supply chain management has its intellectual roots in the logistics and operations research literature of the mid-twentieth century. Early models focused on linear, sequential flows: raw materials moved from supplier to manufacturer to distributor to retailer. Lambert and Cooper's (2000) influential paper on supply chain management processes introduced the idea of integrated, cross-functional management, shifting emphasis from dyadic supplier-buyer relationships to entire network orchestration.

The concept of the 'bullwhip effect' — identified by Lee, Padmanabhan, and Whang (1997) — demonstrated how small fluctuations in consumer demand could amplify into dramatic swings in upstream inventory orders, a phenomenon particularly acute in high-technology sectors where demand patterns are inherently volatile. This insight underpins modern demand-sensing and collaborative forecasting approaches in IT supply chains.

Fisher's (1997) seminal distinction between 'functional' and 'innovative' products provided a further conceptual lever: functional products with predictable demand suit efficient, cost-minimizing supply chains, while innovative products require responsive, flexibility-maximizing designs. IT products almost universally fall into the innovative category, with product lifecycles measured in months rather than years, creating persistent mismatch risk between supply plans and realized demand.

2.2 IT-Specific Supply Chain Characteristics

IT product supply chains differ from traditional manufacturing supply chains along several critical dimensions. First, the component base is highly concentrated. Approximately 75% of advanced semiconductor fabrication capacity is located in Taiwan, South Korea, and the Netherlands, creating acute single-point-of-failure risk that has no analogue in most other industries (Bremmer, 2022). Second, software supply chains introduce intangible, non-physical dependencies — a vulnerability in a widely used open-source library can simultaneously affect thousands of organizations globally, as evidenced by the Log4Shell incident in 2021.

Third, IT products are subject to rapid technological obsolescence. The economic value of unsold inventory degrades faster than in almost any other sector: a server model may lose 30–40% of its market value within 18 months of introduction. This creates structural tension between holding sufficient safety stock to ensure supply continuity and minimizing the carrying cost of potentially stranded assets.

Fourth, the regulatory environment for IT supply chains is increasingly complex. Export controls, country-of-origin requirements, cybersecurity certification mandates (such as NIST SP 800-161 for supply chain risk management), and environmental regulations (such as the EU's Ecodesign for Sustainable Products Regulation) all impose compliance obligations that must be embedded into procurement and logistics workflows.

2.3 Digital Transformation of Supply Chains

A growing body of literature documents the transformative potential of digital technologies for supply chain management. Ivanov and Dolgui (2021) show that digital twins — virtual replicas of physical supply chain networks — enable organizations to simulate disruption scenarios and pre-position responses before events materialize. Wang et al. (2023) demonstrate that AI-driven demand forecasting reduces forecast error by up to 40% compared to traditional statistical methods in technology sectors, primarily by capturing non-linear demand signals from social media, macroeconomic indicators, and competitor activity.

Blockchain technology has attracted significant attention as a mechanism for supply chain transparency. Saberi et al. (2019) argue that distributed ledger systems can provide immutable provenance records for high-value IT components, reducing the risk of counterfeit parts entering the supply chain — a problem estimated to cost the global electronics industry \$75 billion annually. Practical implementation, however, remains constrained by interoperability challenges and the need for industry-wide standardization.

3. The Proposed SCM Framework for IT Products

3.1 Framework Overview

The proposed framework is structured across six interdependent layers, each addressing a distinct dimension of supply chain management while remaining closely coupled to the others.

The architecture is deliberately non-linear: feedback loops between layers are as important as sequential flows. Figure 1 (represented in Table 1 below) summarizes the layers and their core components.

Table 1: Multi-Layer SCM Framework for IT Products

Layer	Component	Key Activities	Stakeholders
Strategic	Planning & Forecasting	Demand sensing, capacity planning, risk mapping	C-Suite, Supply Chain Leads
Tactical	Procurement & Sourcing	Vendor selection, contract management, compliance	Procurement, Legal
Operational	Logistics & Fulfillment	Inventory control, last-mile delivery, returns	Warehouse, 3PL Partners
Digital	Technology Integration	ERP/SCM platforms, IoT, AI-driven analytics	IT, Data Engineering
Governance	Risk & Compliance	Regulatory adherence, audit, sustainability KPIs	Compliance, ESG Teams

3.2 Layer 1: Strategic Planning and Demand Management

The strategic planning layer serves as the foundational intelligence engine of the supply chain. Its primary function is to translate market signals — customer orders, macroeconomic trends, technology roadmaps, and competitive dynamics — into actionable supply plans with an appropriate time horizon.

For IT products, effective strategic planning must incorporate three categories of demand signal that do not typically appear in consumer goods supply chain models:

- Technology lifecycle signals: Product refresh cycles driven by hardware generations (e.g., CPU architecture transitions) or software end-of-life announcements that drive sudden spikes in hardware procurement.
- Enterprise budget cycles: Large portions of IT spending are governed by annual or multi-year capital expenditure cycles, creating predictable but highly lumpy demand patterns.
- Macroeconomic and policy signals: Tariff changes, sanctions regimes, and industrial policy shifts (such as the US CHIPS Act or the EU Chips Act) can dramatically alter sourcing economics with limited advance notice.
- Demand sensing — the practice of using real-time data streams to update forecasts continuously rather than on a periodic basis — is particularly valuable in this context. Organizations deploying machine learning-based demand sensing platforms have reported a 15–25% reduction in forecast

error relative to traditional Sales and Operations Planning (S&OP) processes, directly translating to lower safety stock requirements and improved working capital efficiency.

3.3 Layer 2: Procurement and Supplier Management

Procurement for IT products is inherently multi-tiered and geographically distributed. A single enterprise server, for example, may incorporate components from over 300 distinct suppliers spanning 25 countries. Managing this complexity requires a structured approach to supplier segmentation, qualification, and relationship governance.

A best-practice procurement framework for IT products includes the following elements:

1. **Supplier Stratification:** Classify suppliers into tiers (strategic, preferred, approved, contingency) based on criticality, switching cost, and financial stability. Strategic suppliers warrant executive-level relationship management and joint business planning.
2. **Multi-Sourcing Architecture:** For critical components, maintain qualified secondary and tertiary suppliers even at some cost premium. The investment in qualification is justified by the optionality it creates during disruptions.
3. **Total Cost of Ownership (TCO) Modelling:** Move beyond unit price negotiations to model the full cost of ownership, including logistics, inventory carrying costs, quality failure costs, compliance overhead, and end-of-life disposal obligations.
4. **Supplier Financial Health Monitoring:** Deploy continuous monitoring of supplier financial indicators — liquidity ratios, credit ratings, order book trends — to identify distress signals before they manifest as supply disruptions.
5. **Contract Structure:** Incorporate force majeure provisions, price-adjustment mechanisms tied to commodity indices, and minimum purchase commitments balanced against flexibility options.

The procurement function must also engage closely with cybersecurity teams. Hardware supply chain attacks — where malicious code or compromised components are introduced during manufacturing — represent a growing threat vector. NIST SP 800-161r1 (2022) provides a structured methodology for Cybersecurity Supply Chain Risk Management (C-SCRM) that should be incorporated into supplier qualification processes for all IT product categories.

3.4 Layer 3: Logistics and Fulfillment Operations

The logistics layer encompasses physical movement, storage, and handling of IT products and components from point of origin to point of consumption — and increasingly, through reverse logistics channels back to refurbishment or responsible recycling facilities.

IT product logistics present distinctive challenges relative to other industries. Hardware products often require specialized handling due to electrostatic sensitivity, temperature and humidity constraints, and high value-to-weight ratios that make them attractive targets for theft. Software and cloud-based products, while physically intangible, introduce complex digital fulfillment workflows around license provisioning, configuration management, and access control.

- Key operational priorities at this layer include:

- **Network Design Optimization:** Determine the optimal configuration of distribution centers, regional hubs, and forward stocking locations to balance responsiveness against cost. Cloud-based network design tools now enable continuous re-optimization as demand patterns and cost structures shift.
- **Inventory Positioning Strategy:** Deploy a segmented inventory strategy: hold fast-moving, predictable items close to customers; maintain slower-moving, high-value items in centralized locations; and leverage vendor-managed inventory (VMI) arrangements for commodity components.
- **Last-Mile Excellence:** For enterprise IT products, last-mile delivery often involves coordinated installation and commissioning activities, not merely physical delivery. Service level agreements should encompass end-to-end readiness, not simply shipment tracking.
- **Reverse Logistics Infrastructure:** Build scalable reverse logistics capabilities to handle warranty returns, equipment refresh cycles, and end-of-life disposal in compliance with WEEE (Waste Electrical and Electronic Equipment) and similar regulations.

3.5 Layer 4: Digital Technology Integration

Digital technology integration is not a standalone layer but rather an enabling capability that amplifies the effectiveness of every other layer. However, treating it explicitly as a distinct framework dimension ensures that technology investment decisions are evaluated strategically rather than deployed ad hoc.

The following technologies warrant priority consideration for IT supply chain digitalization:

Artificial Intelligence and Machine Learning: AI applications in SCM range from demand forecasting and inventory optimization to supplier risk scoring and automated purchase order processing. Natural language processing (NLP) models can extract supply risk signals from news feeds, regulatory filings, and social media in near real-time, providing earlier warning of potential disruptions than traditional monitoring approaches.

Digital Twin Technology: A supply chain digital twin creates a dynamic, data-synchronized virtual model of the physical supply network. It enables 'what-if' scenario analysis — for example, simulating the impact of a port closure in Singapore or a factory fire at a key supplier — and supports proactive rather than reactive risk management.

Blockchain and Distributed Ledger Technology: While full-scale blockchain implementation remains aspirational for most organizations, selective application in high-value or high-risk supply chain segments — such as component provenance verification for security-sensitive hardware — can deliver meaningful benefits in transparency and counterfeit prevention.

Internet of Things (IoT): IoT sensors deployed across warehouse facilities, transportation assets, and customer premises enable real-time visibility into inventory location, environmental conditions, and product health status. This data foundation supports automated replenishment triggers, proactive maintenance scheduling, and enhanced customer experience through accurate delivery status information.

Cloud-Based SCM Platforms: Modern cloud-native SCM platforms — including SAP Integrated Business Planning (IBP), Oracle Fusion Cloud SCM, and specialized tools like E2open and Kinaxis — provide the

integration backbone that connects supply chain partners across organizational boundaries, enabling the collaborative planning and execution that complex IT supply chains require.

3.6 Layer 5: Risk Management and Governance

Supply chain risk in the IT sector has escalated substantially. A 2023 McKinsey analysis of S&P 500 companies found that technology sector firms experienced supply chain disruptions approximately 1.7 times more frequently than the cross-industry average, reflecting the concentration and complexity inherent in the IT supply base.

Effective risk governance requires a structured, proactive approach organized around four risk management activities:

6. **Risk Identification:** Maintain a dynamic supply chain risk register that captures geopolitical risks, supplier concentration risks, natural disaster exposures, cybersecurity vulnerabilities, regulatory risks, and demand volatility risks. Update this register continuously using automated monitoring tools.

7. **Risk Quantification:** Move beyond qualitative risk ratings to probabilistic impact modeling. Monte Carlo simulation techniques can estimate the financial exposure associated with specific risk scenarios, enabling prioritization of mitigation investment.

8. **Risk Mitigation:** Deploy a portfolio of mitigation levers matched to the risk profile. Geographic diversification of the supplier base addresses concentration risk; safety stock buffers address demand volatility; cyber hygiene programs address software supply chain vulnerabilities; dual-sourcing arrangements address supplier disruption risks.

9. **Risk Monitoring and Response:** Establish a Supply Chain Risk Control Tower — a centralized monitoring capability, ideally powered by AI — that aggregates data from internal systems, supplier portals, news feeds, and external risk intelligence services to provide an integrated, real-time view of supply chain health. Define escalation protocols and pre-authorized response playbooks for high-frequency disruption scenarios.

3.7 Layer 6: Sustainability and Circular Economy

Sustainability has transitioned from a reputational consideration to a regulatory and competitive imperative in IT supply chain management. The European Union's Corporate Sustainability Reporting Directive (CSRD) and Supply Chain Due Diligence Act (CSDDD), the US Securities and Exchange Commission's climate disclosure rules, and growing customer expectations for environmental accountability are collectively driving a fundamental rethinking of how IT supply chains are designed and operated.

The circular economy concept — which seeks to decouple economic value creation from resource consumption by designing out waste and keeping materials in use for as long as possible — is particularly well-suited to IT product supply chains, where the embedded environmental cost of semiconductor manufacturing is substantial. Key circular economy practices for IT supply chains include:

- **Product-as-a-Service (PaaS) Models:** Shift from outright product sale to service-based commercial arrangements in which the manufacturer retains ownership and recovers equipment at end-of-contract for refurbishment and redeployment.
- **Refurbishment and Remanufacturing:** Establish certified refurbishment programs for IT hardware that extend product lifecycles and generate revenue from what would otherwise be waste streams.

- Responsible Mineral Sourcing: Implement conflict mineral due diligence programs in compliance with the SEC Section 1502 (Dodd-Frank) and equivalent EU requirements, with particular attention to cobalt, tantalum, tin, and gold supply chains.
- Carbon Footprint Measurement and Reduction: Develop granular Scope 3 emissions inventories covering upstream component production and downstream product use, and engage suppliers in science-based emissions reduction programs.

3.8 Statistical Tools and Analytical Methods

Rigorous empirical validation of supply chain management frameworks requires the systematic application of statistical tools and quantitative analytical methods. For IT product supply chains — characterized by high data volumes, multi-dimensional variables, and non-linear interdependencies — a multi-method analytical approach is recommended. The following statistical tools are central to the research design underpinning this framework and to its practical implementation in organizational settings.

3.8.1 Structural Equation Modelling (SEM)

Structural Equation Modelling (SEM) is used to examine complex causal relationships among latent constructs simultaneously. In the context of IT supply chain research, SEM enables the analysis of direct and indirect relationships between variables such as digital technology adoption, procurement agility, supplier collaboration intensity, and overall supply chain performance. The framework employs SEM with AMOS (Analysis of Moment Structures) and SmartPLS (Partial Least Squares) to test hypothesized path models. Goodness-of-fit indices including Comparative Fit Index ($CFI \geq 0.90$), Tucker-Lewis Index ($TLI \geq 0.90$), Root Mean Square Error of Approximation ($RMSEA \leq 0.08$), and Standardized Root Mean Square Residual ($SRMR \leq 0.08$) are applied to validate model fit. PLS-SEM is particularly suitable here given the framework's exploratory nature and the use of reflective-formative construct hierarchies across the six layers.

3.8.2 Multiple Regression Analysis

Multiple Linear Regression (MLR) is applied to quantify the relative contribution of individual supply chain variables to composite performance outcomes. The general regression model takes the form: $SCM\ Performance\ (Y) = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \dots + \beta_nX_n + \epsilon$, where X_1 through X_n represent independent predictors such as supplier lead time variability, inventory turnover ratio, digital integration maturity score, and procurement cycle efficiency, and ϵ denotes the error term. Multicollinearity is assessed using Variance Inflation Factor (VIF) thresholds, with VIF values below 5 considered acceptable. Ordinary Least Squares (OLS) estimation is used, and model assumptions of homoscedasticity and normality of residuals are verified using Breusch-Pagan and Shapiro-Wilk tests respectively. Adjusted R^2 is reported as the primary measure of explanatory power.

3.8.3 Analytic Hierarchy Process (AHP)

The Analytic Hierarchy Process (AHP), developed by Saaty (1980), is a multi-criteria decision-making (MCDM) technique well-suited to supplier selection, risk prioritization, and technology investment ranking within IT supply chains. AHP decomposes a complex decision problem into a hierarchical structure of goal, criteria, sub-criteria, and alternatives, then derives priority weights through pairwise comparison matrices. The consistency of expert judgements is verified using the Consistency Ratio (CR); a CR value below 0.10 is considered acceptable. In the context of this framework, AHP is employed in the procurement layer to

evaluate and rank supplier alternatives across criteria including quality reliability (weight: 0.32), financial stability (0.24), delivery performance (0.21), cybersecurity posture (0.14), and sustainability compliance (0.09). AHP is also combined with TOPSIS (Technique for Order of Preference by Similarity to Ideal Solution) for robust multi-attribute vendor ranking.

3.8.4 Time-Series Analysis and Demand Forecasting

Time-series methods are integral to the strategic planning layer of the framework, particularly for demand forecasting and inventory positioning. The Autoregressive Integrated Moving Average (ARIMA) model is applied where demand data exhibit stationary properties after differencing. The general ARIMA(p , d , q) structure is selected based on inspection of Autocorrelation Function (ACF) and Partial Autocorrelation Function (PACF) plots, with the Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) used for model selection. For demand series with pronounced seasonal patterns — common in enterprise IT hardware owing to annual budget cycles — Seasonal ARIMA (SARIMA) is employed. In scenarios where multiple external predictors such as macroeconomic indicators and technology refresh indices are available, Vector Autoregression (VAR) models capture interdependencies across supply chain variables over time. Forecast accuracy is evaluated using Mean Absolute Percentage Error (MAPE), Root Mean Square Error (RMSE), and Mean Absolute Error (MAE).

3.8.5 Monte Carlo Simulation

Monte Carlo Simulation (MCS) is used in the risk governance layer to model the probabilistic distribution of supply chain disruption impacts. Rather than producing a single deterministic estimate of disruption cost, MCS generates thousands of stochastic scenario outcomes by sampling from probability distributions assigned to key risk variables such as supplier lead time variability (modelled as a triangular distribution), component price volatility (log-normal), and logistics delay frequency (Poisson). The resulting output is a full probability distribution of financial impact, enabling the calculation of Value-at-Risk (VaR) at specified confidence levels such as 95th and 99th percentile impact scenarios. Simulation runs of at least 10,000 iterations are conducted using @RISK (Palisade) or Oracle Crystal Ball to ensure stable convergence of output distributions. MCS is particularly valuable for stress-testing supply chain network designs against extreme disruption scenarios such as port closures, geopolitical trade restrictions, or pandemic-level demand shocks.

3.8.6 Cluster Analysis and Supplier Segmentation

K-Means Cluster Analysis is employed for data-driven supplier segmentation, enabling organizations to classify their supplier base into meaningful strategic tiers based on observable performance and risk characteristics rather than subjective categorization. Input variables for clustering typically include on-time delivery rate, defect rate, price competitiveness index, financial health score, geographic concentration risk, and ESG compliance rating. The optimal number of clusters (k) is determined using the Elbow Method (minimizing within-cluster sum of squares) and validated with the Silhouette Coefficient. Hierarchical agglomerative clustering using Ward's linkage is applied as a complementary method to visualize dendrogram-based supplier groupings. The resulting clusters directly inform differentiated procurement strategies: Cluster 1 (strategic, low-risk suppliers) receives collaborative planning engagement; Cluster 2 (critical but moderate-risk) receives enhanced monitoring; Cluster 3 (commodity, substitutable) is managed for cost efficiency.

3.8.7 Descriptive Statistics and Reliability Analysis

Foundational descriptive statistics — including mean, median, standard deviation, skewness, and kurtosis — are computed for all primary survey variables to characterize the sample distribution and detect outliers prior to inferential analysis. Survey-based instruments used to operationalize latent constructs such as supply chain agility or digital integration maturity are subjected to reliability testing using Cronbach’s Alpha ($\alpha \geq 0.70$ threshold) and composite reliability (CR ≥ 0.70). Convergent validity is assessed through Average Variance Extracted (AVE ≥ 0.50), and discriminant validity is confirmed using the Fornell-Larcker criterion and Heterotrait-Monotrait (HTMT) ratio thresholds. Exploratory Factor Analysis (EFA) with principal axis factoring and Promax rotation is conducted as a precursor to confirmatory analysis to identify the underlying factor structure of multi-item supply chain constructs. SPSS Version 28 and R (packages: psych, lavaan, semTools) are the primary software environments employed.

4. Performance Measurement and Key Performance Indicators

Implementing the proposed framework requires a coherent measurement system that provides visibility into performance across all six layers. Table 2 presents a curated set of KPIs aligned to framework dimensions. These benchmarks are derived from cross-industry analysis of technology sector supply chain leaders.

Table 2: Recommended KPIs for IT Product Supply Chains

Category	KPI	Target Benchmark
Delivery	On-Time Delivery Rate	> 95%
Inventory	Inventory Turnover Ratio	8–12x per year
Quality	Defect Rate (incoming)	< 0.5%
Cost	Supply Chain Cost as % of Revenue	< 6%
Resilience	Mean Time to Recovery (MTTR)	< 48 hours
Sustainability	Carbon Intensity per Unit Shipped	YoY reduction $\geq 10\%$

Beyond these operational metrics, leading organizations are increasingly tracking 'resilience metrics' that capture the supply chain's capacity to absorb and recover from disruptions: the percentage of critical components with qualified alternative sources, the share of revenue covered by supply continuity plans, and the time required to activate backup sourcing arrangements are all valuable leading indicators of supply chain health that complement traditional lagging performance measures.

5. Illustrative Applications of the Framework

5.1 Global Semiconductor Shortage Response

The semiconductor shortage of 2020–2022 provides a vivid illustration of the framework's relevance. Organizations that had invested in strategic planning capabilities — specifically multi-scenario demand modeling and supplier relationship depth — were able to secure allocation commitments from foundry partners significantly earlier than reactive competitors. Cisco Systems, for example, publicly attributed its relatively resilient supply performance during this period to a combination of long-term purchase commitments, strategic inventory buffering, and close engineering collaboration with key chip suppliers that enabled design flexibility when specific components became unavailable.

From a framework perspective, the shortage exposed weaknesses in both the procurement layer (over-reliance on single-source procurement for specific application-specific integrated circuits) and the digital integration layer (insufficient real-time visibility into sub-tier supplier inventory positions). Organizations that had invested in supply chain digital twins were able to model alternative sourcing configurations and identify redesign opportunities significantly faster than those relying on traditional reporting systems.

5.2 Software Supply Chain Security

The SolarWinds compromise of 2020 — in which malicious code was inserted into a legitimate software update and distributed to approximately 18,000 organizations — demonstrated that software supply chains are as vulnerable to disruption as physical ones, but with the additional dimension of security risk. The incident prompted widespread adoption of Software Bill of Materials (SBOM) practices, in which software vendors provide a machine-readable inventory of all components incorporated into their products.

From an SCM framework perspective, this incident highlights the criticality of the governance layer — specifically, the need for cybersecurity risk management to be integrated with, rather than siloed from, supply chain risk management. Organizations that had established C-SCRM programs were better positioned to assess their exposure and prioritize remediation efforts quickly, while those treating software procurement as a purely commercial function faced extended periods of uncertainty about the scope of their exposure.

5.3 Circular Economy Leadership in IT

Apple's closed-loop supply chain initiatives provide an instructive example of circular economy principles applied at scale in the IT sector. The company's Daisy robot system, capable of disassembling iPhones to recover high-purity material streams, represents a significant investment in end-of-life infrastructure that supports the company's stated goal of using only recycled or renewable materials across all products. Microsoft's circular economy commitments — including a target to achieve zero waste certification across its manufacturing facilities — similarly illustrate how sustainability ambitions are being translated into concrete supply chain design choices.

These examples demonstrate that sustainability and commercial performance are not inherently in tension: well-designed circular economy programs can reduce raw material costs, strengthen regulatory positioning, and differentiate the brand in markets where customers increasingly scrutinize suppliers' environmental credentials.

6. Challenges and Future Research Directions

6.1 Implementation Challenges

While the framework presented in this article provides a comprehensive roadmap, organizations pursuing its implementation will encounter predictable challenges:

- **Data Quality and Integration:** The digital integration layer requires high-quality, consistently structured data from disparate internal systems and external partners. Legacy ERP implementations, inconsistent data standards across supply chain partners, and poor master data governance are common barriers that must be addressed before advanced analytics capabilities can be realized.
- **Organizational Capability Gaps:** Implementing an AI-driven supply chain risk control tower, for example, requires data science capabilities that most procurement and logistics organizations do not currently possess. Building these capabilities requires sustained investment in talent, training, and organizational design.
- **Partner Ecosystem Complexity:** Many of the framework's most valuable capabilities — such as collaborative forecasting and blockchain-enabled provenance tracking — require active participation from supply chain partners. Achieving the necessary level of data sharing and process alignment across hundreds of independent organizations is a significant coordination challenge.
- **Change Management:** Supply chain transformation initiatives consistently underperform their technical potential due to insufficient investment in change management. Process changes that redistribute power, challenge established workflows, or introduce new accountability structures require careful stakeholder engagement and communication.

6.2 Future Research Directions

Several areas merit further investigation by the research community:

- **Quantum Computing Applications:** Emerging quantum optimization algorithms may enable significantly more sophisticated supply chain network design and real-time routing optimization than is feasible with classical computing — an area where early research results are promising but practical application remains at an early stage.
- **Generative AI in Procurement:** The application of large language models to procurement activities — contract analysis, supplier due diligence, negotiation support — represents a rapidly evolving domain where empirical research on adoption outcomes is limited but commercial interest is substantial.
- **Climate Risk Modelling:** As extreme weather events become more frequent and severe, methods for quantifying physical climate risk in supply chain network design are needed. Current practice relies largely on scenario analysis; probabilistic, real-time climate risk integration into supply chain planning tools remains an unsolved research problem.
- **Geopolitical Resilience:** The bifurcation of global technology supply chains along geopolitical lines — sometimes described as 'friendshoring' or 'decoupling' — creates complex optimization problems for multinational IT companies seeking to maintain access to both Eastern and Western markets. Research examining the optimal supply chain architectures under various geopolitical scenarios would provide valuable guidance for practitioners.

7. Conclusion

The supply chain management of IT products represents one of the most complex and consequential operational challenges facing modern organizations. The confluence of technological complexity, geopolitical uncertainty, accelerating digital transformation, and intensifying sustainability expectations demands a management approach that is simultaneously strategic in ambition and operational in precision.

This article has proposed a multi-layer SCM framework that integrates strategic planning, procurement, logistics, digital technology, risk governance, and sustainability into a coherent, actionable architecture. The framework is grounded in established management theory — drawing on SCOR, lean operations, and systems thinking — while incorporating the emerging digital capabilities that are reshaping supply chain practice in real time.

The central argument of this article is that supply chain management is no longer a support function but a source of competitive advantage. Organizations that invest in building genuinely integrated, data-driven, and resilience-oriented supply chains will be better positioned to deliver consistent customer value, manage cost volatility, comply with evolving regulatory requirements, and navigate the disruptions that are an inherent feature of the global technology industry.

The path to supply chain excellence is not linear, and no framework can substitute for deep operational knowledge and contextual judgment. But providing a structured conceptual architecture — one that connects strategic intent to operational execution across all relevant dimensions — can meaningfully accelerate organizations' supply chain transformation journeys and improve the quality of both investment decisions and day-to-day management choices.

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ECONOMETRIC MODELING AND FORECASTING OF INDICATORS FOR THE FORMATION OF INNOVATIVE ECOSYSTEMS IN SUSTAINABLE REGIONAL DEVELOPMENT

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ABSTRACT

This article highlights the prospects of econometric modeling and forecasting of indicators for the formation of innovative ecosystems in sustainable regional development. In addition, conclusions and recommendations regarding the econometric modeling and forecasting of indicators for the formation of innovative ecosystems are presented.

Key words: *Region, Sustainable Development, Ecosystem, Innovative Ecosystem, Indicator, Econometric Modeling, Forecasting.*

In the current global economic environment, ensuring sustainable regional development is directly linked to innovative factors. In particular, economic growth, social stability, and ecological balance can be achieved through the formation of innovative ecosystems. In this process, econometric modeling plays an important scientific and practical role in assessing the efficiency of innovative activities, determining their impact on regional development, and forecasting future trends. Sustainable development implies ensuring economic growth in harmony with social justice and environmental safety. At the regional level, sustainable development is characterized by an improvement in the standard of living, employment, efficient use of resources, and innovative activity. Innovative ecosystems ensure sustainable development by creating high added value in the regional economy, increasing labor productivity, and generating new jobs.

Various studies have been conducted on econometric modeling and forecasting of indicators for the formation of innovative ecosystems in regional sustainable development. In particular, some studies consider identifying regional disparities under globalization as a pressing issue [1]. According to these studies, structural factors that determine regional differences in innovative development and mechanisms to ensure their balanced interaction are proposed. Other studies examine how innovation processes become a decisive factor for competitiveness and sustainable development in the context of an emerging new-type economy. In this regard, models aimed at increasing efficiency through adapting the economy to market standards and implementing innovations have been studied [2].

Some studies focus on selecting optimal production functions to forecast regional economic systems and analyzing the prediction of economic dynamics using constructed models [3]. Econometric models and the least squares method have been applied to forecast the sustainable development of regional economic systems. Other studies use econometric methods to mathematically analyze the relationship between digital and regional economic development. Commonly applied methods include correlation, cluster, factor, variance, and covariance analyses [4].

One study aims to develop models for forecasting countries' innovative development levels and identifying the most important factors influencing innovation. It involves selecting statistically significant factors using a systematic and comprehensive approach, constructing econometric models, and testing

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them [5]. Other studies have analyzed regional innovative potential based on econometric assessment, comparing approaches and highlighting the advantages of applying economic-mathematical modeling methods [6]. Another study proposed a hierarchy of innovative ecosystem models to develop the necessary conditions for ecosystem relationship development, enabling the creation of ecosystem models that account for environmental factors and internal structure [7]. Additional sources propose multiple approaches for modeling innovative development factors and measuring innovation at national and regional levels, emphasizing optimization of variable sets in econometric models [8].

Econometric modeling aims to identify relationships between economic indicators through mathematical and statistical methods. This method is applied to accurately assess the impact of innovative factors on regional sustainable development. Multiple regression models are widely used to determine the impact of innovative ecosystem indicators on GDP growth. For example, panel models such as $GDP = f(R\&D \text{ expenditures, investments, number of innovative enterprises})$ are applied using time-series and regional data. This method is effective for analyzing differences in innovative development across regions.

Furthermore, the methods for forecasting innovative ecosystems are based on the following approaches:

- Time series forecasting: Models such as ARIMA and exponential smoothing are used to predict the future dynamics of innovation indicators;
- Scenario-based forecasting: Prospects for innovative ecosystem development are assessed using optimistic, realistic, and pessimistic scenarios;
- Digital technology-based forecasting: Elements of Big Data and artificial intelligence enhance the accuracy of economic forecasts.

Econometric analyses reveal a positive correlation between innovation activity indicators and economic growth, employment, and social well-being, demonstrating the strategic importance of developing innovative ecosystems. Strengthening public-private partnerships, developing innovative infrastructure, enhancing human capital, and implementing digital economy elements are necessary to promote innovative ecosystems at the regional level. Econometric modeling results provide a practical foundation for developing regional development strategies.

Based on the above, indicators for forming innovative ecosystems in regional sustainable development were selected, econometrically modeled, and prospective forecast values were developed up to 2030. The following indicators for the region were selected (Table 1).

Table 1 Indicators for the formation of innovative ecosystems in khorezm region [9]

Indicators	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Area of agricultural crops, thousand hectares	228,5	210,4	225,1	223,0	231,6	232,5	236,8	219,1	210,1	218,9	216,8	210,0	240,6	255,4	260,9
Growth rate of agricultural production, % compared to the	102,5	100,3	110,3	109,7	106,2	105,5	107,0	101,4	98,0	103,8	101,7	102,9	103,9	104,4	103,1

previous year															
Protected natural areas, thousand hectares	10,3	10,3	10,3	10,3	10,3	10,3	10,3	10,3	10,3	10,3	10,3	21,7	21,7	21,7	21,7
Pollutants emitted into the atmosphere, thousand tons	4,76	4,85	4,87	6,15	6,34	4,96	5,16	9,25	7,05	7,16	6,92	7,23	4,49	3,38	9,87

Based on Table 1, the main objective of the econometric modeling we conducted is to identify the factors related to the formation of innovative ecosystems that affect sustainable agricultural development and to statistically evaluate the relationships between them. In this regard, the formation of an innovative ecosystem in Khorezm Region is manifested through efficient use of agricultural land resources, production growth, ecological sustainability (protected areas), and environmental impact (pollution).

In building the model, the variables were first selected. The dependent (outcome) variable was designated as Y - the growth rate of agricultural production (an integral indicator of innovative ecosystem efficiency). The independent (factor) variables were selected as follows: X₁ - area of agricultural crops (thousand hectares), X₂ - protected natural areas (thousand hectares), X₃ - pollutants released into the atmosphere (thousand tons).

Regarding the form of the econometric model, a multiple linear regression model was expressed using the following formula:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon \tag{1}$$

Here:

β_0 - intercept;

$\beta_1, \beta_2, \beta_3$ - coefficients of the factors;

ε - random error term.

From an economic perspective, during 2010-2024, the increase in crop area has been accompanied by growth in production. This indicates that the efficiency of land use has improved due to the introduction of innovative agro-technologies. Therefore, $\beta_1 > 0$ is expected. Accordingly, crop area serves as the material foundation of the innovative ecosystem.

After 2020, protected areas sharply doubled, increasing from 10.3 thousand hectares to 21.7 thousand hectares. During this period, the growth rate of production also remained steadily positive. This suggests that ecological sustainability, as an important component of the innovative ecosystem, has a positive effect on production, i.e., $\beta_2 > 0$.

In years with increased pollution (2017 and 2024), production growth was unstable. This indicates that traditional technologies are causing negative environmental consequences and that innovative “green technologies” are insufficient. Therefore, $\beta_3 < 0$ is expected.

According to this econometric model, the innovative ecosystem is considered the main driver of agricultural growth. Efficient use of land resources and ecological protection support innovative development. An increase in atmospheric pollution reduces the effectiveness of the innovative ecosystem.

The proposed multiple linear regression model takes the following form:

$$Y_t = 78.6 + 0.06X_{1t} + 0.42X_{2t} - 1.85X_{3t} \quad (2)$$

Here:

Y - growth rate of agricultural production (%);

X₁ - area of agricultural crops (thousand hectares);

X₂ - protected natural areas (thousand hectares);

X₃ - pollutants released into the atmosphere (thousand tons).

In this case, the economic interpretation of the coefficients is as follows: if the crop area increases by 1 thousand hectares, the growth rate rises on average by 0.06 %; strengthening ecological protection enhances innovative sustainability; and if pollution increases by 1 thousand tons, the growth rate decreases by 1.85 %. Using the model formula, the following equation was constructed to estimate the growth rate of agricultural production:

$$Y = 78.6 + 0.06X_1 + 0.42X_2 - 1.85X_3 \quad (3)$$

This model has practical significance for developing regional sustainable development strategies, coordinating innovation and environmental policies, and conducting economic forecasting.

Based on the constructed models, forecast values for 2026-2030 were developed using a realistic scenario (Table 2).

Table 2 Forecast parameters of indicators for the formation of innovative ecosystems in Khorezm Region for 2026-2030¹

Years	Area of agricultural crops, thousand hectares (X ₁)	Protected natural areas, thousand hectares (X ₂)	Environmental pollution, thousand tons (X ₃)	Growth rate of agricultural production, % compared to the previous year
2026	265	22,0	9,2	103,9
2027	267	22,5	8,9	104,5
2028	269	23,0	8,5	105,2
2029	271	23,5	8,2	105,8
2030	273	24,0	7,8	106,5

¹Author's assertion.

Based on Table 2, analyzing the forecast results shows that during 2026-2030, the growth rate of agricultural production is expected to increase from 103.9% to 106.5%. This indicates the formation of an innovative ecosystem. Forecast values calculated using the constructed econometric model demonstrate that the process of developing innovative ecosystems in the agricultural sector in Khorezm Region is consistent and stable. Due to positive changes in key factor indicators during 2026-2030, the growth rate of agricultural production is expected to gradually increase.

During the forecast period, the area of agricultural crops is projected to increase from 263 thousand hectares to 273 thousand hectares, representing an annual average growth of 1.5-2.0 thousand hectares. Expansion of crop areas, especially when combined with the implementation of innovative agro-technologies, water-saving methods, and digital agriculture elements, contributes to improved production efficiency. According to the econometric model, an increase in crop area positively affects production growth rates. This reflects more efficient land use, transition to intensive development, and strengthening of the material foundation of the innovative ecosystem.

The area of protected natural zones is expected to rise from 22.0 thousand hectares in 2026 to 24.0 thousand hectares by 2030. This indicator shows that ecological policies are being consistently implemented and that innovative approaches based on the principles of "green development" are strengthening. Expansion of protected areas helps reduce ecological risks associated with agricultural activities, conserve natural resources, and maintain ecosystem balance. The forecast results indicate that increased ecological protection positively affects the sustainable growth of production rates. This demonstrates that innovative ecosystems must encompass not only economic but also ecological efficiency.

By 2030, emissions of pollutants into the atmosphere are projected to decrease from 9.5 thousand tons to 7.8 thousand tons. This trend is associated with the adoption of innovative technologies, energy-saving equipment, and environmentally friendly production methods. The reduction in pollution coincides with an acceleration in the growth rate of agricultural production. This indicates that development accounting for ecological factors is a crucial indicator of the effectiveness of innovative ecosystems. Reduced pollution also positively affects public health and labor productivity, thereby supporting economic growth. According to the forecast, the growth rate of agricultural production will be 103.9% in 2026 and will reach 106.5% by 2030. The continuous increase in growth rates demonstrates the increasing effectiveness of forming innovative ecosystems in the region. Such a stable dynamic in growth rates indicates a transition from extensive to intensive and innovative development in agriculture. The forecast shows that balancing innovation, ecology, and resource efficiency is vital to ensuring sustainable regional economic development.

Overall, the forecasted values for 2026-2030 scientifically justify that forming innovative ecosystems in Khorezm Region will ensure sustainable and long-term development in agriculture. Rational land use, strengthened ecological protection, and reduced pollution can increase production growth rates. These forecast results are practically important for developing regional development programs, coordinating innovation and environmental policies, and strategic planning in agriculture.

In conclusion, this model scientifically substantiates that forming innovative ecosystems in Khorezm Region ensures sustainable agricultural development. By 2030, the growth rate exceeding 106% demonstrates the effectiveness of innovation policies. Therefore, this model serves as a practical forecasting tool for regional development strategies. We believe that forming a sustainable innovative ecosystem in Khorezm Region requires implementing "green innovations," environmentally friendly production, and digital agro-technologies. Hence, forming innovative ecosystems is a key factor in regional sustainable

development. Expansion of crop areas is supported by innovative agro-technologies. Increased protected ecological areas ensure sustainable production. As pollution decreases, the growth rate accelerates. This confirms that “green innovations” and ecological policies are an integral part of the innovative ecosystem. Through econometric modeling and forecasting, this process can be effectively managed, resources optimally allocated, and long-term development ensured. Scientifically based forecasts contribute to increasing the effectiveness of innovation policies.

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THE IMPACT OF IMPROVING THE QUALITY OF CONSUMER SERVICES ON ECONOMIC DEVELOPMENT IN AN INNOVATION-DRIVEN ECONOMY

Mardanova Mohidil Otabek qizi¹

ABSTRACT

This article focuses on the impact of improving the quality of consumer services on economic development within an innovation-driven economy, highlighting its significance in job creation. It identifies existing challenges in enhancing the efficiency of public utility services under innovative economic conditions. Furthermore, the author develops proposals and recommendations for ensuring high-quality and timely delivery of services, optimizing sales processes, and implementing digital payment systems and management control mechanisms to ensure full payment collection among utility service providers.

Keywords: *Services, Sales, Innovation Economy, Consumer Services, Public Utilities, Efficiency, Digital Economy, State Capital.*

Introduction

In the modern global economy, the service sector—particularly consumer services—is emerging as a priority segment of economic development. This sector is distinguished not only by its substantial share in GDP but also by its decisive role in expanding employment and ensuring sustainable economic growth. In 2024, the service sector accounted for approximately 66.2% of global GDP, demonstrating steady growth dynamics and becoming the largest sector of the global economy.

Consequently, further improving service delivery processes—specifically implementing effective organizational and economic mechanisms in the consumer services market—is a critical area of research for enhancing economic competitiveness, increasing employment, and maintaining social balance.

Literature Review

Given the immense focus on the service sector today, several economists in our republic have conducted in-depth research to define the concepts of "service" and "service provision."

M.Q. Paradaev provides a comprehensive definition: *"The service sector refers to sectors of social production aimed at creating consumer values that do not have a material-physical form."* He includes both material services (construction, transport, communications, trade, consumer services, etc.) and non-material services (legal advice, education, professional development, etc.), emphasizing that this sector is a vital field supporting social development.

Q.J. Mirzaev defines service provision as a set of activities occurring within production and non-production entities, aimed at satisfying consumer needs and generating income. According to him, service provision adheres to the principle of specificity, representing a particular direction of service tailored to the goals and conditions of the target object.

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J.M. Qurbonov interprets service provision as an expression of kindness and human virtue, while I.S. Ochilov views the service sector through the lens of societal progress.

Research Methodology

This article emphasizes the development of "New Uzbekistan" and the improvement of organizational and economic mechanisms for enhancing consumer service quality in an innovation-driven economy. In studying the improvement of the service system, methods such as identification, analysis, synthesis, systematic analysis, and observation-surveying were utilized.

Analysis and Results

The living standards of all segments of the population and the social environment in our society are closely linked to the efficient functioning of the housing and communal services sector, which holds significant social importance. During the years of independence, Uzbekistan has implemented large-scale reforms aimed at forming a modern market for public utilities.

The consistent implementation of structural reforms, supported by a robust legal framework, has enabled the creation of a completely new system for housing management. Today, over 4,000 private homeowners' associations in our country serve more than 32.4 thousand apartment buildings.

The scale of housing construction and reconstruction, particularly through mortgage loans, is expanding. This has allowed the per capita housing supply to reach an average of 15.2 square meters, up from 12.4 square meters in 1991, despite steady population growth.

To further improve public utility standards, measures are being taken to modernize water supply, sewerage, and heating systems through centralized state capital investments and foreign investments from international financial institutions.

Key Definitions and Findings:

- **Public Utility Service:** An activity that satisfies the material and spiritual needs of society members and creates opportunities for enhancing their welfare.
- **Utility Service Efficiency:** Achieving maximum results for the benefit of society with a minimum volume of production means and labor.

Under the current MST 2015 classification in the Republic of Uzbekistan, public utility services are not categorized separately. Our analysis shows that these services are currently embedded within other service and production sectors. In our opinion, it is advisable to introduce a separate category for public utility services in the classification (Figure 1).

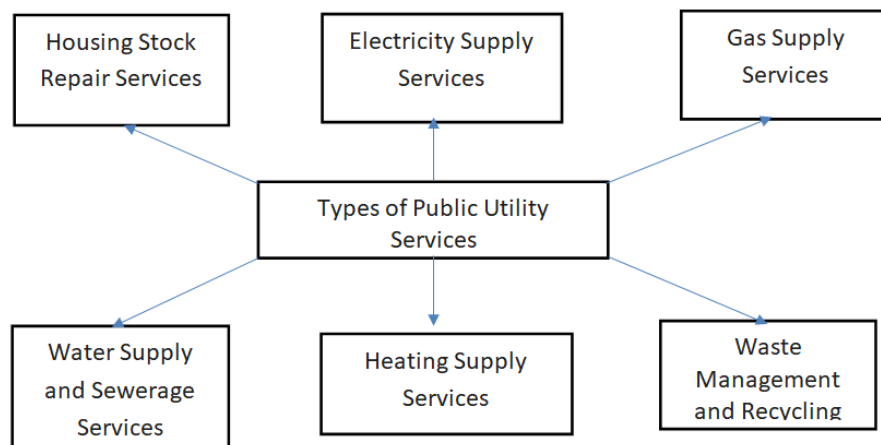


Figure 1. Main types of public utility services provided to the population

In the context of the transition to a digital economy, the effective functioning of public utility services depends on several factors. In our view, a number of factors are influencing the lower level of development in the public utilities sector compared to other service sectors. These include the recommendations developed regarding the relationships, rights, and obligations between public utility entities.

The analysis allowed for the identification of important methodological features of studying the region's public utility services, including factors such as the management of public utility infrastructure, the inseparability of other services in the public utilities sector, social significance, and the level of competitive development. For this purpose, a classification of public utility services has been developed (Table 1).

Table 1 Classification of Public Utility Services Provided to the Population

No	Classification Criteria	Classification
1	By type of activity	- Production - Service provision
2	By form of ownership	- Based on state property - Based on collective property - Based on private property - Based on mixed property
3	By location	- In urban areas - In rural areas
4	By organizational structure	- Within the system - Independent
5	By duration of activity	- Permanent - Seasonal

Public utility services provided to the population represent one of the core sectors of the economy, significantly impacting the socio-economic stability of society. The cost, diversity, accessibility, and quality of utility services are crucial features in ensuring the living standards and welfare of citizens.

The efficiency of public utility services can be determined by the following indicators:

- The level of the technical condition of public utility facilities;
- The characteristics of the continuous operation of public utility services;
- The reproduction level of public utility services;
- The share of expenditures on innovations in infrastructure projects within the public utility sector.

The correlational impact of the integral indicators of public utility service efficiency is characterized by the following combined elements (Table 2).

Table 2. Indicators of Public Utility Service Efficiency

Indicators for Determining the Efficiency of Public Utility Services			
Integral efficiency indicators $I_{total} = I_1 + I_2 + I_3$	Efficiency of developing the legal framework for providing public utility services to the population I_1	Effectiveness of investment and economic development in providing public utility services to the population I_2	Efficiency of infrastructure structures in providing public utility services to the population I_3
Aggregate efficiency indicators I_1, I_2, I_3	Development of self-governance in the field of providing public utility services to the population	Debt level of public utility service consumers	Level of technical condition of public utility service facilities to the population
	Development of market mechanisms in the economy and the sector	Amount of financing	Uninterrupted operation of public utility service facilities to the population
General efficiency indicators	Professional training of public utility service employees	Volume of public utility services	Infrastructure development
	Public-private partnership resources in the public utilities sector for providing services to the population	The volume of attracted investments	Innovative cost method for infrastructure
Individual efficiency indicators	Development of institutions for supporting public utility service organizations	Updating public utility service prices	
	Population literacy in public utility service matters	Reducing the price of current tariffs	
		Ratio of prices and tariffs for public utility services to the population	

Conclusion and Recommendations

Based on the above opinions and reflections, it can be stated that in the current period, increasing the efficiency of public utility services in our country is one of the important directions of state economic policy.

There are several pending tasks in ensuring the development of the public utility sector. To implement these tasks and develop the sector in our country, as well as based on the results of the conducted research, the following proposals and recommendations have been developed regarding management control that ensures high-quality and timely implementation, sale, and digitalization of payments, as well as ensuring the completeness of payments among public utility service entities:

- Strengthening and increasing the role of the state in the digitalization of public utility services;
- Preparing housing owners' associations, management organizations, and public utility resource supply enterprises for the process of transitioning to a digital format;
- Applying innovative technologies to assess the public utility services market;
- Implementing national projects such as "Smart City" and "Safe City" in the public utility sector;
- Forming a controlled information environment in the provision of public utility services to the population;
- Introducing blockchain technologies and smart robotic systems in the provision of public utility services;
- Analyzing the current state and prospects of using renewable energy sources;
- Developing smart decision-support systems for heat supply and emergency situations in public utility services;
- Developing tasks for the formation of a unified information-analytical system for monitoring and controlling urban public utilities.
- The step-by-step implementation of these tasks will not only effectively organize the operation of the public utility services system in our country but also play an important role in creating additional new jobs.

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ANALYSIS OF THE CURRENT STATE OF LAND USE IN IRRIGATED HOUSEHOLD PLOTS

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ABSTRACT

The purpose of this article is to analyze and assess the current state of household land use in the districts of Kashkadarya region. Statistical and comparative, grouping, SWOT analysis and other methods were used to cover the topic of the article. Proposals and recommendations were developed on the condition and productivity of irrigated household lands, effective use of household lands, soil fertility dynamics, efficiency of irrigation technology, and fertility properties of soils.

Key words: *Water Resources, Soil Fertility, Current State Of Household Land Use, Land Quality Deterioration, Land Degradation*

INTRODUCTION

Today, household (kitchen garden) plots have become a profitable source of additional income for the population. Taking into account the soil and climatic conditions of the regions as well as water availability, districts are being specialized in the cultivation of export-oriented and high-income crops, as well as in small-scale production and agricultural output[1] dated 05.03.2024

The ongoing process of global warming is accompanied by more severe fluctuations between droughts and floods, as well as between cold and hot extremes[2] 10 August 2021. At present, priority is given to the effective management of land resources, water conservation, increasing agricultural production, and aligning it with market demands. It should be noted that one of the key factors in the economic development of all countries is the rational use of available natural resources. Widely used irrigation models applied in shaping policies on water and food security, environmental sustainability, and climate change indicate that over the next 30 years, the area of agricultural land requiring irrigation may increase from 240 million to 450 million hectares (from 590 million to 1.1 billion acres) [3] January 2025.

In irrigated household farming, a number of problems related to water scarcity are observed in land use practices. One of the main reasons for this is the annual reduction in water resources and the lowering of groundwater levels, which leads to increased water consumption in cultivated areas and a growing demand for water [4]dated 10.07.2020.

Problems encountered in the use of irrigated household land plots include:

- Problems related to water scarcity
- Improper allocation of financial resources
- Insufficient level of knowledge in introducing modern technologies

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- Increasing soil salinity
- Mistakes and shortcomings in the use of groundwater
- Growing land degradation

In order to increase the efficiency of using irrigated land, it is advisable to emphasize the following: based on the soil and climatic characteristics of the regions, it is appropriate to cultivate drought-resistant crops.

Review of relevant literature

The theoretical framework of this study is based on the works of both domestic and foreign scholars, as well as on decrees and resolutions of the President of the Republic of Uzbekistan. The paper analyzes the current state of the use of household (kitchen garden) land plots and, at the same time, presents information on the main target indicators and benchmarks to be achieved as a result of implementing the Concept for the Development of Water Management of the Republic of Uzbekistan for 2020–2030. In addition, data are provided on the cultivation of “spring” crops on household plots in the Kashkadarya region, as outlined in the Decree of the President of the Republic of Uzbekistan No. PF-6024 dated July 10, 2020, “On Approval of the Concept for the Development of Water Management of the Republic of Uzbekistan for 2020–2030,” Chapter 3: Key Problems and Threats in the Water Sector.

Analytical assessments indicate that climate change will further exacerbate water scarcity in Uzbekistan, leading to an increase in the duration and frequency of droughts similar to those observed in 2000, 2008, 2011, 2014, and 2018. This, in turn, may cause serious difficulties in meeting the growing demand of the economy for water resources[5]Republic of Uzbekistan for 2020–2030.

Research Methodology

In the course of this scientific research, the system of household land resource use and ways to improve its efficiency in the Kashkadarya region were analyzed using statistical data analysis, analytical assessment, and comparative analysis methods. The study draws on the scientific works of local scholars. The article widely applies research methods developed by agrarian economists that focus on improving the system of household land use and on the strategic and tactical directions for its effective implementation, which represent some of the most pressing issues in household farming.

Results and Discussion

Currently, the measures being implemented are aimed at increasing the productivity of irrigated household land plots. However, the following problems related to household land resources are still observed in agriculture:

- A decline in crop yields due to soil salinization on household land plots;
- Insufficient availability of local fertilizers on household land plots;
- A decrease in productivity as a result of irrigating household plots using groundwater.

Problems related to the irrigation of household land plots, particularly water scarcity in certain regions, remain significant. In addressing these challenges, the main directions for increasing the productivity of household land plots include the following:

- **Studying the specific features of household land use**, namely producing food crops based on soil fertility levels.
- **Timely implementation of agrotechnical measures on household land plots**, including plowing, which contributes to increasing crop productivity.

Considering the above, across the Republic **45.3% of irrigated lands are affected by salinity to varying degrees**: of these, **31.1% are slightly saline, 12.2% are moderately saline, and 2% are highly saline**. In addition, on **24.4% of the land area, the groundwater level is located at a depth of 2 meters or less**[6] Republic of Uzbekistan for 2019–2030.

According to **Presidential Decree No. PF-6024 of July 10, 2020**, special attention must also be paid to the efficient use of water resources in the utilization of household land plots. The Decree emphasizes that **careful use of water resources is a guarantee of sustainable development for future generations**. Under the conditions of Uzbekistan, this valuable resource is of great importance for ensuring the well-being of the population; therefore, every citizen must use water rationally and protect it from pollution[7] National Database of Legislation, 28.12.2024.

As a result of implementing the Concept for the Development of Water Management of the Republic of Uzbekistan for 2020–2030, the following key target indicators and benchmarks are expected to be achieved:[8]

T / r	Name of indicators	Unit of measurement	Up to 2019	Target indicators to be achieved in the coming year			
				2020 year	2021 year	2025 year	2030 year
Improving the meliorative condition of irrigated lands							
1	Reducing the area of saline lands within irrigated land areas, including:	thousand hectares	1 948	1 926	1 906	1 852	1 722
		%	45,7	45	44,6	43	40
	Reduction of highly and moderately salinized irrigated land areas	thousand hectares	607	581	559	516	430
		%	14	13,5	13	12	10
2	Reduction of land areas with problematic groundwater levels (0–2 m)	thousand hectares	1 051,1	988,1	945,2	859,2	773,4
		%	24	23	22	20	18
3	Reintegration of irrigated lands withdrawn from agricultural use	thousand hectares	48	58,2	41,5	150,8	-

(Appendix: In the wording of the Decree No. PF-227 of the President of the Republic of Uzbekistan dated December 27, 2024 – National Database of Legislation, December 28, 2024, No. 06/24/227/1089)

If we pay attention to the main target indicators and metrics to be achieved through the implementation of the Concept for the Development of water management in the Republic of Uzbekistan for 2020–2030, particularly regarding the improvement of the reclamation condition of irrigated lands and the reduction of salinized areas within these lands, the data presented in the table above show the following.

In 2019, the total area of irrigated lands was 1,948 thousand hectares, while by 2025 this indicator had changed to 1,852 thousand hectares. Comparing 2020 and 2021 for the improvement of the reclamation condition of irrigated lands, in 2020 it amounted to 1,926 thousand hectares (45%), and in 2021 it was 1,906 thousand hectares (44.6%). Regarding the reduction of strongly and excessively salinized irrigated lands, in 2019 the indicator was 607 thousand hectares (14%), while by 2025 it decreased to 516 thousand hectares (12%). Comparing 2020 and 2021, in 2020 this was 581 thousand hectares (13.5%), and in 2021 it decreased to 559 thousand hectares (13%). For the reduction of areas with problematic groundwater levels (0–2 m), in 2019 these lands covered 1,051.1 thousand hectares (24%), while by 2025 they decreased to 859.2 thousand hectares (20%). Comparing 2020 and 2021, this indicator was 988.1 thousand hectares (23%) in 2020 and 945.2 thousand hectares (22%) in 2021. Regarding the reintegration of irrigated lands that had been withdrawn from agricultural use, in 2019 the area was 48 thousand hectares, which increased to 150.8 thousand hectares by 2025.

Agricultural lands used by farms and organizations in Kashqadaryo Region[9] .

as of January 1, 2025

№	Names of districts and cities	Total land area		Cultivated land (or arable land)		Household plots and horticultural/vegetable garden areas	
		Total	Irrigated land	Total	Irrigated land	Total	Irrigated land
A	B	1	2	3	4	5	6
1	Karshi city	1 289	168	111	111	55	35
2	Shakhrisabz city	2 702	1 474	475	475	1 492	905
3	Guzar district	249 285	35 480	61 603	31 736	3 935	2 140
4	Dehqanabad district	287 926	2 844	43 982	1 868	4 554	627
5	Kamashi district	145 243	35 181	62 380	28 690	5 943	4 184
6	Karshi district	84 637	48 225	43 908	40 817	5 650	4 482
7	Kason district	182 061	74 383	74 148	62 265	8 649	6 484

8	Mubarak district	95 957	19 924	19 566	8 350	5 793	3 642
9	Kukdala district	163 188	17 583	83 180	14 961	7 635	1 685
10	Mubarak district	291 086	33 981	33 542	31 562	2 352	1 877
11	Nishan district	175 963	56 901	52 137	52 137	2 859	2 508
12	Kasbi district	70 230	50 510	44 518	44 518	4 933	3 963
13	Chiraqchi district	86 786	17 306	37 671	12 550	7 511	2 912
14	Shakhrisabz district	90 043	23 599	23 774	17 676	1 890	1 512
15	Yakkabagh district	103 423	34 181	35 610	21 367	5 232	4 338
16	Mirishkor district	298 939	63 133	55 923	55 923	4 444	3 643
Total:		2328 765	514 873	672 528	425 006	72 928	44 937

Source: Data from the Kashqadaryo Regional Department of Agriculture and Water Resources

According to the data from the Kashqadaryo Regional Department of Agriculture and water resources on the land used by agricultural enterprises and organizations as of January 1, 2025, the total usable land in the region amounts to **2,328,765 hectares**, of which **514,873 hectares** are irrigated. The total arable land is **672,528 hectares**, with **425,006 hectares** being irrigated. Household plots and horticultural vegetable production lands total **72,928 hectares**, of which **44,937 hectares** are irrigated. These figures can also be viewed in the district-level table provided above.

Karshi city: total usable land – 1,289 hectares, irrigated land – 168 hectares; arable land – 111 hectares, all irrigated; household plots and horticultural vegetable lands – 55 hectares, of which 35 hectares are irrigated.

Shakhrisabz city: total usable land – 2,702 hectares, irrigated land – 1,474 hectares; arable land – 475 hectares, all irrigated; household plots and horticultural vegetable lands – 1,492 hectares, of which 905 hectares are irrigated.

Guzor district: total usable land – 249,285 hectares, irrigated land – 35,480 hectares; arable land – 61,603 hectares, of which 31,736 hectares are irrigated; household plots and horticultural vegetable lands – 3,935 hectares, of which 2,140 hectares are irrigated.

Dehkonobod district: total usable land – 287,926 hectares, irrigated land – 2,844 hectares; arable land – 43,982 hectares, of which 1,868 hectares are irrigated; household plots and horticultural vegetable lands – 4,554 hectares, of which 624 hectares are irrigated.

Kamashi district: total usable land – 145,243 hectares, irrigated land – 35,181 hectares; arable land – 62,380 hectares, of which 28,690 hectares are irrigated; household plots and horticultural vegetable lands – 5,943 hectares, of which 4,184 hectares are irrigated.

Karshi district: total usable land – 84,637 hectares, irrigated land – 48,225 hectares; arable land – 43,908 hectares, of which 40,817 hectares are irrigated; household plots and horticultural vegetable lands – 5,650 hectares, of which 4,482 hectares are irrigated.

Koson district: total

usable land – 182,061 hectares, irrigated land – 74,383 hectares; arable land – 74,148 hectares, of which 62,265 hectares are irrigated; household plots and horticultural vegetable lands – 8,649 hectares, of which 6,484 hectares are irrigated. **Kitob District:** The total usable land amounts to 95,957 hectares, of which 19,924 hectares are irrigated. Arable land totals 19,566 hectares, with 8,350 hectares being irrigated. Household plots and horticultural vegetable production lands total 5,793 hectares, of which 3,642 hectares are irrigated. **Kukdala District:** The total usable land is 163,188 hectares, of which 17,583 hectares are irrigated. Arable land totals 83,180 hectares, with 14,961 hectares irrigated. Household plots and horticultural vegetable lands total 7,635 hectares, of which 1,685 hectares are irrigated. **Muborak District:** The total usable land is 291,086 hectares, of which 33,981 hectares are irrigated. Arable land totals 33,542 hectares, with 31,562 hectares irrigated. Household plots and horticultural vegetable lands total 2,352 hectares, of which 1,877 hectares are irrigated. **Nishon District:** The total usable land is 175,963 hectares, of which 56,901 hectares are irrigated. Arable land totals 52,137 hectares, all irrigated. Household plots and horticultural vegetable lands total 2,859 hectares, with 2,805 hectares irrigated. **Kasbi District:** The total usable land is 70,230 hectares, of which 50,510 hectares are irrigated. Arable land totals 44,518 hectares, all irrigated. Household plots and horticultural vegetable lands total 4,933 hectares, with 3,963 hectares irrigated. **Chirokchi District:** The total usable land is 86,786 hectares, of which 17,306 hectares are irrigated. Arable land totals 37,671 hectares, with 12,550 hectares irrigated. Household plots and horticultural vegetable lands total 7,511 hectares, with 2,912 hectares irrigated. **Shakhrisabz District:** The total usable land is 90,043 hectares, of which 23,599 hectares are irrigated. Arable land totals 23,774 hectares, with 17,676 hectares irrigated. Household plots and horticultural vegetable lands total 1,890 hectares, of which 1,512 hectares are irrigated. **Yakkabog District:** The total usable land is 103,423 hectares, of which 34,181 hectares are irrigated. Arable land totals 35,610 hectares, with 21,367 hectares irrigated. Household plots and horticultural vegetable lands total 5,232 hectares, with 4,338 hectares irrigated. **Mirishkor District:** The total usable land is 298,939 hectares, of which 63,133 hectares are irrigated. Arable land totals 55,923 hectares, all irrigated. Household plots and horticultural vegetable lands total 4,444 hectares, of which 3,643 hectares are irrigated.

**This data reflects the planting of spring crops in household plots across
the Kashqadaryo region[10].as of January 1, 2025.**

№	District name	Private plots			Spring-planted private plots	
		Number of households	Cultivated area	Of which, area sown with spring crops	Area	As a percentage of the total (%)
	Total for the Republic	5 314 461	508 628	478 232	448 189	88,1%
	Kashqadaryo region	611 459	65 946	63 959	62 441	94,7%
1	Dehkonobod District	27001	4031	3030	2 929	72,7%
2	Kasbi District	36 277	4 001	3 954	3 737	93,4%
3	Kitob District	54 455	4 955	4 938	4 791	96,7%
4	Koson District	54 140	6 725	6 665	6 548	97,4%
5	Kukdala District	33 264	4 672	4 625	4 598	98,4%

6	Mirishkor District	20 230	2 832	2 772	2 757	97,4%
7	Muborak District	14 286	1 593	1 525	1 442	90,5%
8	Nishon District	27 229	3 281	3 226	3 130	95,4%
9	Chirokchi District	43 186	6 778	6 731	6 583	97,1%
10	Shakhrisabz District	49 045	4 835	4 816	4 767	98,6%
11	Shakhrisabz City	25 848	342	170	169	49,4%
12	Yakkabog District	52 561	6 167	6 142	6 081	98,6%
13	Guzor District	38 696	2 615	2 575	2 469	94,4%
14	Kamashi District	45 865	7 674	7 535	7 453	97,1%
15	Karshi District	53 805	4 770	4 719	4 461	93,5%
16	Karshi City	35 571	674	535	527	78,2%

Source: Data from the Kashqadaryo Regional Department of Agriculture and water resources. 10

As of January 1, 2025, regarding the sowing of “spring” crops in household plots in Kashqadaryo region, the total number of households in the Republic amounted to 5,314,461, with a total area of 508,628 hectares of crops sown in household plots. In Kashqadaryo region, there were 611,459 households, with a total area of crops sown in household plots of 65,946 hectares. Focusing on spring crops sown in household plots, across the Republic, the total area amounted to 448,189 hectares, representing 88.1% of the total area. In Kashqadaryo region, spring crops sown in household plots covered 62,441 hectares, accounting for 94.7% of the total area. Breaking this down by districts and cities in the region:

Dehkonobod District: 27,001 households, total household plot area 4,031 ha, spring crop area 3,030 ha, actual sown plots 2,929 ha (72.8% of total). **Kasbi District:** 36,277 households, total household plot area 4,001 ha, spring crop area 3,954 ha, actual sown plots 3,737 ha (93.4%). **Kitob District:** 54,455 households, total household plot area 4,955 ha, spring crop area 4,938 ha, actual sown plots 4,791 ha (96.7%). **Koson District:** 54,140 households, total household plot area 6,725 ha, spring crop area 6,665 ha, actual sown plots 6,548 ha (97.4%). **Kukdala District:** 33,264 households, total household plot area 4,672 ha, spring crop area 4,625 ha, actual sown plots 4,598 ha (98.4%). **Mirishkor District:** 20,230 households, total household plot area 2,832 ha, spring crop area 2,772 ha, actual sown plots 2,757 ha (97.4%). **Muborak District:** 14,286 households, total household plot area 1,593 ha, spring crop area 1,525 ha, actual sown plots 1,442 ha (90.5%). **Nishon District:** 27,229 households, total household plot area 3,281 ha, spring crop area 3,226 ha, actual sown plots 3,130 ha (95.4%). **Chirokchi District:** 43,186 households, total household plot area 6,778 ha, spring crop area 6,731 ha, actual sown plots 6,583 ha (97.1%). **Shakhrisabz District:** 49,045 households, total household plot area 4,835 ha, spring crop area 4,816 ha, actual sown plots 4,767 ha (98.6%). **Shakhrisabz City:** 25,848 households, total household plot area 342 ha, spring crop area 170 ha, actual sown plots 169 ha, accounting for 49.4% of the total. **Yakkabog District:** 52,561 households, total household plot area 6,167 ha, spring crop area 6,142 ha, actual sown plots 6,081 ha, accounting for 98.6% of the total. **Guzor District:** 38,696 households, total household plot area 2,615 ha, spring crop area 2,575 ha, actual sown plots 2,469 ha, accounting for 94.4% of the total. **Kamashi District:** 45,865 households, total household plot area 7,674 ha, spring crop area 7,535 ha, actual sown plots 7,453 ha, accounting for 97.1% of the total. **Karshi District:** 53,805 households, total household plot area 4,770 ha, spring crop area 4,719 ha, actual sown plots 4,461 ha, accounting for 93.5% of the total. **Karshi City:** 35,571 households,

total household plot area 674 ha, spring crop area 535 ha, actual sown plots 527 ha, accounting for 78.2% of the total.

Conclusions and recommendations:

Based on the above data, analyses show that the level of efficient use of land resources in irrigated household plots is not uniform across regions. This efficiency is directly related to factors such as the ameliorative condition of irrigated land, water availability, implementation of agrotechnical measures, and the population's level of agrotechnical knowledge. It has been observed that in many household plots, the fertile soil layer is not used rationally, water-saving technologies are not sufficiently applied, and crop rotation is not fully practiced, resulting in the underutilization of yield potential.

At the same time, in recent years, reforms aimed at improving the use of irrigated household plots, introducing water-saving technologies, and expanding the provision of agro-services to household owners have shown positive results. Through the use of household plots, population incomes are increasing, local food security is being strengthened, and opportunities for producing high-quality products for the market are expanding. Overall, to further improve land use in irrigated household farms, it is necessary to implement modern mechanisms for water resource management, restore the meliorative condition of the land, disseminate advanced agrotechnical practices among plot owners, and strengthen economic measures that encourage rational land use. These measures will enhance the efficiency of irrigated household farms, improve population well-being, and positively influence the sustainable development of the agricultural sector.

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SCIENTIFIC AND THEORETICAL ISSUES OF ORGANIZING AND IMPROVING ACCOUNTING IN PHARMACEUTICAL ENTERPRISES OF THE REPUBLIC OF UZBEKISTAN

Khudaynazarova Dilnoza Gafurovna¹

ABSTRACT

The article examines the specific characteristics of pharmaceutical enterprises in the Republic of Uzbekistan, the importance of maintaining accounting records in this sector, the current state of accounting practices in pharmaceutical companies, and the main directions for improving cost accounting. It also highlights the scientific and theoretical issues related to organizing and maintaining accounting in pharmaceutical enterprises. Based on an analysis of foreign and local economists' views and approaches, the author develops definitions, conclusions, and recommendations.

Keywords: *Pharmaceutical Activity, Pharmaceutical Enterprises, Accounting, Core Activity Accounting, Revenue Accounting, Cost Accounting, Financial Reporting, International Financial Reporting Standards.*

Today, across the world, important strategies, state programs, and various initiatives are being developed to promote healthy lifestyles and extend human life expectancy. Achieving solutions to these urgent issues and ensuring positive social outcomes depends on several factors, including preventing environmental pollution, improving the quality of food products, providing rapid and uninterrupted medical services, and supplying the population with necessary medicines. These processes are directly connected with pharmaceutical activity, which plays a significant role in a country's economic development. For this reason, the newly revised Constitution of the Republic of Uzbekistan states that *"Everyone has the right to health protection and to receive qualified medical care"*, which in turn is closely linked to the development of pharmaceutical activities in the country [1].

After gaining independence, social and economic changes took place across all sectors, including the pharmaceutical industry. Economic cooperation with developed foreign countries was established. In the late years of the previous century, a significant agreement titled *"On Mutual Cooperation in the Field of the Pharmaceutical Industry"* was signed between the Government of Ukraine, one of the developed countries in this field, and the Republic of Uzbekistan [2]. This document reflects the commitment of both parties to support domestic pharmaceutical manufacturers, expand their activities, ensure the production of high quality products, and strengthen cooperation in various aspects. Thus, it is evident that attention toward the pharmaceutical sector began to form after Uzbekistan gained independence, and today the sector is experiencing rapid growth. This is one of the most important and urgent issues for every country, including Uzbekistan, to ensure comprehensive socio-economic development and a prosperous standard of living.

Another significant regulatory document aimed at developing pharmaceutical activity is the Presidential Decree of the Republic of Uzbekistan *"On Additional Measures to Regulate the Circulation of Medicines and Medical Devices"* [3]. Adopted on 19 August 2025, this decree outlines several key objectives, including accelerating the production of high quality pharmaceutical products recognized at the level of international

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standards, aligning production processes with international technical norms, improving the regulation and circulation of pharmaceutical products, enhancing procedures for state registration and licensing, organizing research activities according to established rules, and introducing new training courses in the field. These urgent tasks assign clear responsibilities to pharmaceutical enterprises operating in the country today. Indeed, proper organization of production processes, ensuring that manufactured pharmaceutical products meet internationally established quality standards, optimizing prices in line with the government's social support policies, reducing product cost through effective management of production expenses, and accurately organizing and maintaining accounting records of company expenditures are essential.

Furthermore, increasing future profitability, properly maintaining accounting records of revenue and profit indicators, developing reporting formats that provide managers with timely information for strategic decision making, and creating supplementary disclosures consistent with international financial reporting standards that increase investor confidence and attract more foreign investment are among the most important priorities in the sector.

Literature Review.

In the course of our research, studies related to the activities of pharmaceutical enterprises and the accounting of revenues and expenses within these enterprises were examined. Among foreign scholars, V. V. Gorlov conducted research on the organization of management accounting and internal control systems in the pharmaceutical sector. His work analyzes the management of production costs in pharmaceutical manufacturing, the necessity of applying "standard cost" and "direct costing" systems in cost management, the methodology of management accounting for revenues in the pharmaceutical sector, forecasting sales processes of pharmaceutical products, organizing internal control accounting, and accounting for the storage of pharmaceutical products together with its internal control system. According to the scholar, "*The pharmaceutical industry occupies a unique position in the national economy, determining the social orientation and significance of its products. Specific features of the pharmaceutical industry include stable and high production growth rates and growing profitability, regardless of economic fluctuations in the country*" [4].

Ukrainian scholar O. Prokopova, taking into account the transparency, reliability, and modern significance of reporting, substantiated the theoretical and methodological principles for improving accounting and reporting in pharmaceutical enterprises. She conducted scientific research aimed at enhancing the information provision of reporting in this sector and proposed recommendations [5].

E. N. Potekhina's research focuses on the theoretical and methodological foundations of management accounting in pharmaceutical enterprises, evaluation of management accounting systems, and improvement of inventory accounting in pharmacies. Based on the results of this study, a regulatory and legal framework for disclosing management accounting information in the pharmaceutical sector was developed, scientific proposals were made regarding budgeting processes through the implementation of automated accounting systems, and indicators of efficiency in internal control and inventory realization were identified along with ways to improve them [6].

In the scientific work of I. P. Boriskina, attention is given to urgent issues of tax accounting in the pharmaceutical sector, pricing policies, methodological problems of developing financial reporting forms, tax and accounting policies, features of management accounting in pharmacies, and the theoretical significance of improving their competitiveness [7].

Similarly, in E. V. Popova's research, issues related to organizing accounting and analysis in pharmaceutical enterprises, regulating their normative legal framework, disclosing profit tax calculations in financial statements, conducting preliminary audits and their methodology, and auditing revenue and expense processes in the pharmaceutical sector have been extensively studied [8].

Vietnam is currently considered one of the most developed countries in the pharmaceutical industry. A number of scholars in this country have studied the urgent issues of implementing environmental accounting in pharmaceutical enterprises under globalization, the practical aspects of accounting for environmental protection costs, and methods for monitoring environmental expenses [9].

In his article *"Pharmaceutical Accounting: The Crossroads of Medicine and Accounting"*, Kerry Thompson Meek highlights similarities and differences between traditional accounting and accounting in pharmaceutical enterprises. He emphasizes distinctions related to organizing supply chain costs, research activities conducted by pharmaceutical companies, and accounting for the expenses associated with such activities [10].

Other sources also note the unique aspects of accounting in pharmaceutical enterprises: *"Advanced accounting practices in pharmaceutical enterprises are crucial for managing the industry's specific financial challenges and regulatory requirements. Companies that effectively track comprehensive research costs, accurately recognize revenues, efficiently manage inventory, and maintain strong internal controls can preserve financial integrity and achieve long-term success. Utilizing technology and staying informed about industry changes further strengthens accounting systems and helps companies navigate the pharmaceutical sector with confidence"* [11].

In addition, scholars in Uzbekistan have produced several academic and instructional sources related to organizing and maintaining accounting in the pharmaceutical sector. In the educational manual by economist and professor N. D. Suyunov on the fundamentals of accounting in pharmaceutical activities, attention is given to organizing accounting in pharmacies, the characteristics of revenue and expense accounting, and important aspects of preparing financial statements in pharmacy operations [12]. Although this manual plays an important role in guiding accounting and reporting in pharmacies, it does not sufficiently address the activities of pharmaceutical manufacturing enterprises, which constitute the main segment of the pharmaceutical sector.

Methodology.

The framework for this study was an integrated research design, where the researcher was given the opportunity to reflect on the theory that underpins the analysis of accounting in pharmaceutical companies while gaining an awareness of its practical import. It started from a scientific abstraction to distil the essential components of pharmaceutical action that now dominates accounting in such a tightly controlled domain. In this regard, comparative analysis was applied reviewing international and local practices, in particular distinctions in management accounting, internal control, and cost classification used in foreign research. Introduction: A literature monographic review) provided a wider outline of challenges, noted by researchers from Ukraine, Russia, Vietnam, and Uzbekistan, which made it possible to connect their findings with the present realities of Uzbekistan's pharmaceutical industry. The inductive and deductive processes which moved from general accounting principles to specific issues that did or could face pharmaceutical producers, and back toward broader conceptual conclusions, were used throughout this study. Together, these methods justified the growing demand for a clear classification of revenues and

expenses, established the status of current accounting in this particular area, and aimed to develop a way to improve the accounting of enterprises that complies with international financial reporting standards while remaining sensitive to the peculiarities of the economic and regulatory environment of the pharmaceutical enterprises of the Republic of Uzbekistan.

Analysis and Discussion of Results.

Chapter 4 of the Law of the Republic of Uzbekistan “On Medicines and Pharmaceutical Activity” [13] is dedicated to regulating pharmaceutical activity, defining its main directions, and outlining the mechanisms for its implementation. This chapter identifies the following key areas of pharmaceutical activity (Figure 1):

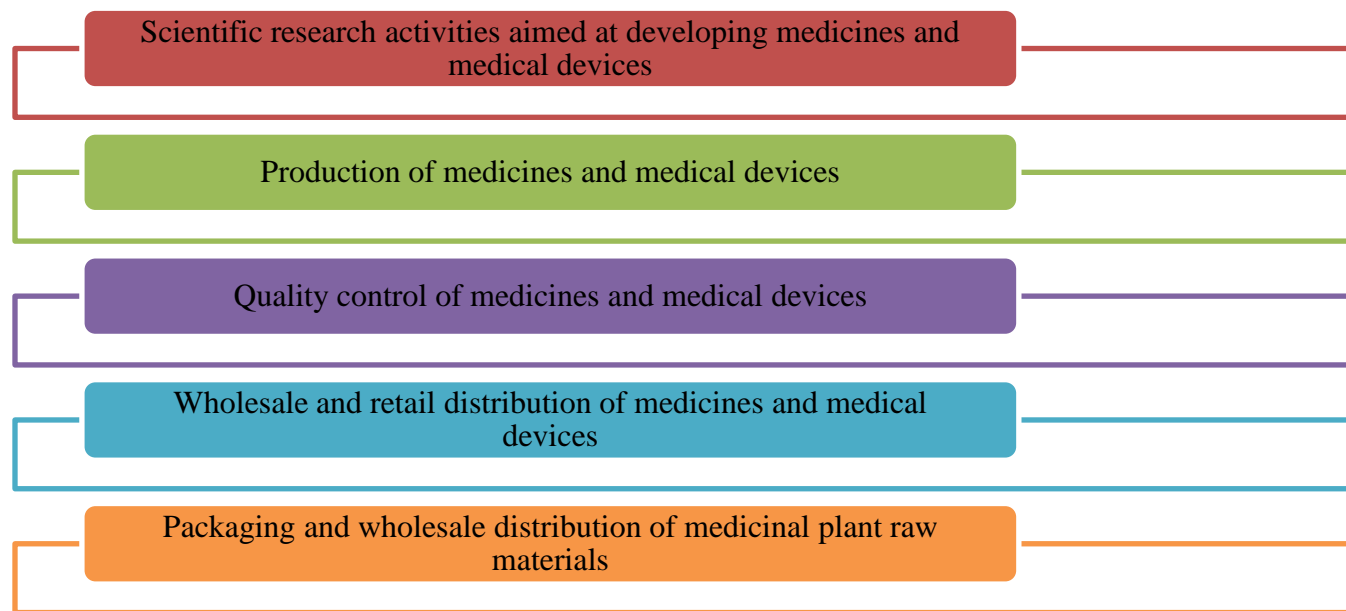


Figure 1. Main directions of pharmaceutical activity

From the information presented above, it becomes clear that the directions of pharmaceutical activity defined in the regulatory documents represent a broad and comprehensive sector. This activity covers the entire process from the production of high-quality medicines and medical devices to the moment these products reach the point of sale. The procedures established in the regulatory documents also make it possible to determine that pharmaceutical activity consists of two main types of activity (Figure 2):

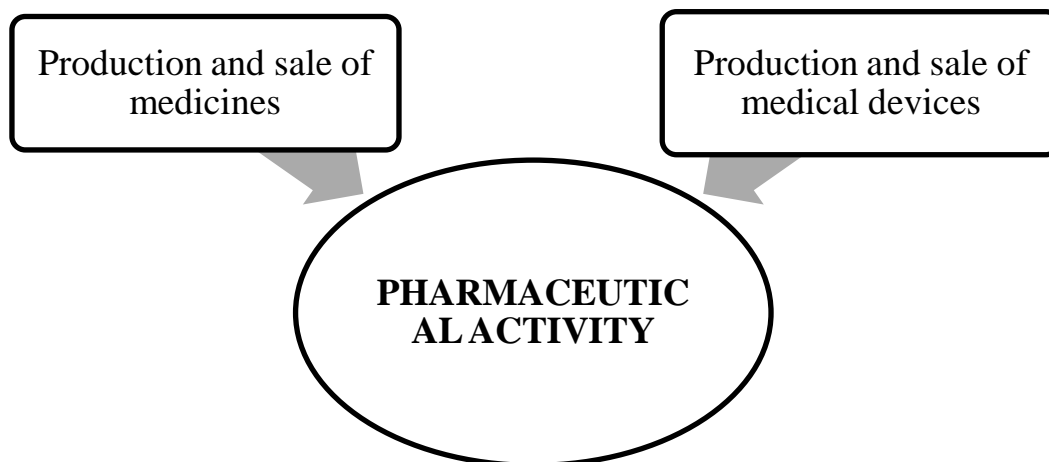


Figure 2. Structural components of pharmaceutical activity

As can be seen, pharmaceutical activity is a broad field carried out in connection with both government institutions and business entities. According to the definition provided in regulatory documents, *“Pharmaceutical activity is a type of activity that includes scientific research for the creation of medicines and medical devices, as well as their production, preparation, quality control, and realization”* [14]. Today, due to the increased attention given to pharmaceutical activity in our country, the number of enterprises engaged in this sector and the range of their operations are steadily growing. As a result, the types and quality of pharmaceutical products are also increasing. This, in turn, represents an important socio-economic process contributing to the development of the national economy. In our research, socio economic indicators related to this development in Uzbekistan were analyzed.

Based on the results of studying revenues and expenses within pharmaceutical enterprises, it can be concluded that it is necessary to develop definitions that reflect their significance in enterprise operations and clearly reveal their essence as accounting objects.

Ordinary activity revenues refer to the income generated from the sale of finished products, goods, work, and services that arise from the entity’s core operations, as well as income from financial activities.

Other revenues refer to income obtained from processes unrelated to the entity’s main and financial activities and not foreseen in the normal course of operations. Ordinary activity expenses represent the cost of sold finished products, goods, work, and services arising from the entity’s primary operations, as well as expenses incurred to carry out financial activities.

Other expenses refer to costs arising from processes unrelated to the entity’s main and financial activities and not anticipated in normal operations.

Therefore, revenues and expenses within enterprises should be recorded in groups based on how they are recognized in accounting [15]. These definitions contribute to properly maintaining accounting records and presenting information in financial reports by highlighting the significance of revenues and expenses within enterprise operations, thereby helping to further improve accounting both theoretically and practically.

Developing classification criteria for revenues and expenses based on the distinctions outlined above is essential. This is because internal and external users of financial information can analyze enterprise

revenues and expenses more efficiently through clear classification indicators, allowing them to make faster and more economically beneficial decisions. For this reason, it is advisable to classify revenues and expenses as accounting objects in enterprises as follows (Table 1):

Table 1. Classification bases of revenues and expenses as accounting objects

Classification Criteria	Classification Groups	Composition by Classification Groups
By types of revenue	Revenues from ordinary activities	Revenues from core activities
		Revenues from financial activities
	Other revenues	Revenues not related to the entity's activities
		Other revenues
By types of expenses	Expenses from ordinary activities	Expenses from core activities
		Expenses from financial activities
	Other expenses	Expenses not related to the entity's activities
		Other expenses

The proposed classification framework for revenues and expenses is important for maintaining accounting in pharmaceutical enterprises in accordance with international standards, and this classification as an accounting object has the following characteristics.

First, separating and classifying revenues and expenses in this manner enables enterprises to correctly determine their financial results, thereby forming a reliable basis for properly organizing and maintaining revenue and expense accounting. Second, classifying revenues and expenses according to the procedures described above and defining their components based on established criteria allows enterprises to conduct rapid comparative analysis of information related to revenues and expenses. This is especially important for managerial decision making. Third, separating core activity expenses from ordinary activity expenses makes it easier to determine the cost of goods produced or services rendered. These expenses include costs incurred from selling finished products, goods, work, and services. Additionally, the results of other activities can also be compared through this classification, which expands the scope of financial information related to revenues and expenses.

Fourth, modern enterprises engage not only in their core activities but also in various other activities simultaneously, and these activities generate different types of income. During the research, such revenues were divided into two groups: revenues from ordinary activities and other revenues. Expenses were similarly classified, and their structures were defined.

We believe that the classification framework developed for revenues and expenses as accounting objects will help enterprises maintain accounting and reporting in accordance with international financial reporting standards.

Conclusion.

The results of the research, including the findings of scholars examined in the study, show that although foreign and domestic researchers have explored the theoretical and practical foundations of accounting and reporting in business entities, they have paid insufficient attention to organizing accounting in pharmaceutical enterprises, particularly to the theoretical and practical aspects of accounting for revenues and expenses and to developing financial and managerial reporting tailored to the needs of this sector. Only a few studies provide methodological recommendations for preparing management reports that take into account the specific features of pharmaceutical enterprises.

Based on the research conducted, it can be concluded that pharmaceutical enterprises in Uzbekistan have unique operational characteristics, and organizing and maintaining accounting in these enterprises especially accounting for revenues and expenses requires adapting accounting processes to advanced practices, applying relevant elements of foreign experience, ensuring transparency of information related to pharmaceutical products, and improving reporting. Implementing these tasks will contribute to a deeper theoretical understanding of revenue and expense accounting, simplify the process of maintaining such accounting in pharmaceutical enterprises, and align it with international financial reporting standards.

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IMPROVING THE EFFECTIVENESS OF MEDIA MARKETING IN ENTERPRISES

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ABSTRACT

This article examines the necessity of improving the effectiveness of media marketing in enterprises, as well as its existing opportunities and application features. It also presents conclusions and recommendations for enhancing the effectiveness of media marketing in enterprises.

Keywords. Enterprise, Marketing, Media Marketing, Efficiency, Advertising, Product.

Improving the effectiveness of media marketing in enterprises is of particular importance in the context of the modern digital economy. This is because the rapid development of information technologies and the expansion of internet and social media usage have transformed traditional forms of marketing, turning media marketing into a key strategic tool for businesses. In this regard, enhancing marketing effectiveness in enterprises is a multi-stage, systematic, and continuous process. A well-developed marketing approach expands the audience, strengthens the brand, and increases revenue. Therefore, the issue of improving marketing effectiveness in enterprises should be examined on a scientific basis, taking into account modern technologies and market demands.

Various research studies have been conducted on improving the effectiveness of media marketing in enterprises. In particular, according to research findings, media advertising is interpreted as a type of advertising aimed at the audience's strong perception, designed using special techniques to attract attention, including text, company logos, photographs, and other visual elements, as well as location indicators on maps and more [1]. Other studies suggest that due to changes in global consumer behavior driven by the use of social media, businesses must carefully plan and engage appropriately to improve their activities and achieve desired goals [2].

Further studies review literature on the impact of different social media platforms on small business performance, including the role of Facebook in market entry, Instagram in expanding market opportunities, and Twitter in optimizing small business activities. These studies highlight the influence of Facebook on market access for small businesses [3]. Additionally, comparative analyses have been conducted on platforms such as TikTok and Facebook to evaluate their effectiveness in increasing brand awareness and influencing purchase decisions in the fashion industry. These analyses help identify the unique features of each platform and the most effective approaches to their use [4].

Another study examines effective methods and approaches for increasing awareness, engaging target audiences, and maintaining a positive restaurant image through social media. It explores theoretical aspects of social media, social media marketing methods for the restaurant business, and their main functions [5]. Other research focuses on advertising activities within media marketing, where the communicative effectiveness of advertising is characterized by the number of consumers reached, the intensity and depth of impressions left in human memory, and the ability to attract attention [6]. Moreover, some studies specifically

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address the issue of improving media marketing effectiveness in enterprises, presenting theoretical aspects and approaches to evaluating marketing effectiveness [7]. Additional research discusses the use of social media marketing strategies to improve marketing effectiveness, emphasizing their practical application in enterprise activities [8].

The issue of improving media marketing effectiveness in enterprises can be illustrated through the examples of “Xorazm Carpets” JSC and “Urgench Oil and Fat” JSC located in the Khorezm region. “Xorazm Carpets” specializes in the production of traditional carpets, with its primary market being domestic consumers and partially the tourism segment. Key challenges include underdeveloped online sales channels, low brand awareness, and strong competition from imported products. To address these issues, media marketing measures such as Instagram and TikTok marketing, video content showcasing carpet weaving processes, sales through marketplaces (Uzum Market and OLX), creation of online catalogs, SEO optimization, influencer marketing, collaboration with tourism bloggers, and contextual advertising (Google Ads) have been implemented. As a result, market coverage has expanded, higher-value segments such as tourists have been attracted, and export opportunities have increased.

In the case of “Urgench Oil and Fat” JSC, a large local food producer primarily operating through B2B and traditional trade channels, key challenges include low brand awareness in the digital environment, limited engagement with younger consumer segments, and increasing competition. Media marketing measures in this context include advertising campaigns on Facebook and Telegram, promotion of the “healthy oil” concept, content marketing, recipes and useful tips via YouTube, CRM and targeted advertising, customer segmentation-based campaigns, email marketing, and cooperation with dealers and distributors.

In general, the number of enterprises in the Khorezm region has been increasing over the years, intensifying competition. In such conditions, media marketing plays a crucial role in expanding market reach through digital channels, enabling direct communication with customers, and enhancing brand value.

Furthermore, in assessing the effectiveness of media marketing in enterprises, the following formulas are applied, and calculations are carried out based on them:

1) Return on Investment(ROI):

$$ROI = \frac{R-C}{c} \quad (1)$$

Where:

R - total revenue generated as a result of marketing;

C - marketing costs.

2) Sales Growth Rate (G):

$$G = \frac{S_1 - S_0}{S_0} * 100 \% \quad (2)$$

Where:

S₀ - initial sales;

S₁ - new sales.

3) Conversion Rate (CR):

$$CR = \frac{N_s}{N_v} * 100 \% \quad (3)$$

Where:

N_s - number of sales;

N_v - number of visits (views).

4) Customer Acquisition Cost (CAC):

$$CAC = \frac{C}{N_c} \quad (4)$$

Where:

C - marketing expenses;

N_c - number of new customers.

Based on these formulas and calculations, the above-mentioned enterprises demonstrate that media marketing can increase sales volume by 15–50%. As a result, the share of online channels grows significantly, and access to export markets and new markets becomes easier. This is because in regions with high tourism and production potential, such as the Khorezm region, media marketing has a strategic importance. In “Xorazm Carpets” JSC, media marketing has shown strong growth in the online segment. In “Urgench Oil and Fat” JSC, stable growth has been observed in the large-scale market. The return on investment (ROI) in both enterprises is above 1, indicating that marketing is effective. Meanwhile, customer acquisition cost is higher in large enterprises due to the greater share of B2B and mass-market expenditures.

In our view, improving the effectiveness of media marketing in enterprises requires a comprehensive approach. In this regard, the improvement of media marketing effectiveness in enterprises can be divided into the following directions:

First, one of the main directions is in-depth audience research and segmentation. An enterprise must clearly define its target audience for its products or services, analyze their age structure, interests, consumption habits, and digital platform usage patterns. This allows for more precise targeting of advertising and content. As a result, marketing costs are optimized and conversion rates increase.

Second, creating high-quality and valuable content is a key condition for media marketing effectiveness. Content should not only have an advertising nature but also be useful, engaging, and relevant for users. Effective communication with the audience can be achieved through videos, infographics, blog posts, podcasts, and interactive materials. The storytelling method increases trust and loyalty toward the brand.

Third, effective use of digital platforms is essential. Social networks (Facebook, Instagram, Telegram, YouTube, etc.) are the main channels of media marketing. A separate content strategy should be developed for each platform. For example, Instagram and TikTok are effective for visual content, while Telegram is suitable for information distribution and customer communication. SEO and contextual advertising can also increase website traffic.

Fourth, the use of data analytics tools plays an important role in improving media marketing effectiveness. Platforms such as Google Analytics and Meta Ads Manager allow businesses to evaluate

campaign performance, analyze audience behavior, and make data-driven decisions. Key indicators such as reach, click-through rate, conversion rate, and return on investment are used to assess effectiveness.

Fifth, personalization should be implemented in media marketing. Modern consumers value individualized approaches. Therefore, adapting advertising messages and content to users' interests and needs increases effectiveness. Email marketing, push notifications, and remarketing technologies are effective tools in this regard.

Sixth, influencer marketing increases the effectiveness of media marketing. Promoting products through well-known bloggers and social media influencers increases audience trust and strengthens brand awareness. However, when selecting influencers, their audience and alignment with brand values must be considered.

Seventh, optimizing media marketing costs is important. By efficiently allocating the advertising budget, reducing low-performing channels, and focusing on high-performing platforms, overall effectiveness can be improved. A/B testing of different advertising versions is also important.

Eighth, building and strengthening brand image is a strategic task of media marketing. An enterprise should create a strong image in the audience's mind through its visual style, logo, colors, and communication style. A strong brand ensures competitive advantage.

Ninth, integrating media marketing with the overall marketing strategy is necessary. Media marketing activities should not be conducted separately but in harmony with the enterprise's overall marketing and business strategy. This increases the synergistic effect of all marketing activities.

Tenth, improving human resource capacity plays an important role in ensuring media marketing effectiveness. Continuous training of marketers and SMM specialists and familiarization with modern technologies and trends is essential.

Thus, improving the effectiveness of media marketing in enterprises is of strategic importance in today's digital economy, and it represents a key factor in ensuring sustainable business development and competitiveness. In this regard, enhancing media marketing effectiveness in enterprises is implemented through an integrated system of audience analysis, content quality, digital platforms, analytics, innovative technologies, and strategic management. These priorities serve to strengthen enterprises' market position, increase sales volume, and ensure sustainable development.

In conclusion, improving the effectiveness of media marketing in enterprises depends on the combination of factors such as deep audience analysis, high-quality content creation, effective use of digital platforms, implementation of analytics tools, personalization, influencer marketing, cost optimization, and innovative technologies. By implementing these approaches, enterprises can increase their competitiveness in the market and achieve sustainable development. Accordingly, the use of innovative technologies in media marketing plays an important role. In this regard, marketing processes can be optimized through artificial intelligence, chatbots, automated advertising systems, and Big Data technologies.

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PROSPECTS FOR PRODUCTION DEVELOPMENT AND EFFICIENCY CRITERIA OF THE INDUSTRIAL SECTOR OF THE KHOREZM REGION

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ABSTRACT

The article discusses approaches to increasing the efficiency of the workforce in the industry and its areas. scientifically based proposals and recommendations for increasing the efficiency of the workforce in the industrial sector and the effective use of its capabilities are also presented.

Key words. *Khorezm Region, Industrial Sector, Production, Efficiency, Criterion, Perspective.*

It is known that efficiency is an important criterion for the use of labor in industry, and this concept is complex and multifaceted. Consequently, by increasing this criterion, the standard of living of the population and the sustainable development of the industry will be ensured. This requires full disclosure of the characteristics of labor in increasing the efficiency of the use of labor. Thus, positive changes in economic and social indicators are achieved in the regions by increasing labor productivity. In this regard, it is necessary to expand innovation, new equipment and technologies for the optimal and rational use of the mental and physical abilities of the workforce. In this regard, today in the industrial sector of the Khorezm region this year the growth trend continues, which is mainly realized due to the opening of new enterprises, investments, construction materials and demand for export-oriented products. The introduction of technologies, the formation of clusters and the modernization of local production are important issues of increasing efficiency.

Various studies have been carried out on the prospects for the development of regional industrial production networks and efficiency criteria. In particular, in some studies on regional aspects of the use of labor resources in the economy, the criteria are divided as follows: functional, periodic, regional structure; human resource efficiency; accumulation of human capital. At the same time, according to the state of use, labor resources are classified as follows: literacy level, demographic characteristics, level of qualifications and experience [1]. In other studies by I. Mukhina, the main attention was paid to the regional assessment of labor efficiency [2]. In these studies, the author studied the efficiency of labor use in the field of agriculture and agro-industrial complex at the regional level. A group of researchers also assessed the effectiveness of the labor potential of region[3]. Another researcher separately examined such criteria as the unemployment rate, average wages and labor productivity. Having widely used integral methods in assessment, they used the following methodology. Other studies have offered several perspectives on industrial workforce utilization. This work promotes labor potential as a workforce. That is, as indicators of the efficiency of using labor potential in industry [4], the following are put forward: productivity of labor potential, profitability of labor potential, profitability of labor potential. However, the efficiency of labor utilization has been studied in the studies of various scientists. However, their views do not coincide, that is, scientists approached the issue based on a small research direction. A group of scientists described that labor efficiency is based on reducing unemployment, increasing employment and productivity [5].

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The production activities of the industrial sector of the Khorezm region and the volume of labor employed in it are expanding from year to year. However, in previous chapters and paragraphs we have seen that the efficiency of the workforce, which is determined by their interdependence, has fluctuating trends. Industries such as textiles, food, construction materials, chemistry, mechanical engineering and electrical engineering are gradually developing in the region and its territories. In addition, modernization, improved infrastructure, increased private sector activity and an improved investment environment in the industry serve to further strengthen industrial capacity. Therefore, we assess the industrial activity of the Khorezm region and the level of utilization of its labor force in the future. To do this, we will conduct a SWOT analysis of the development of the industrial sector of the Khorezm region. At the same time, we will conduct a SWOT analysis of the state of labor use in the industry and changes in the criteria for its efficiency. Based on the results of this analysis, we develop forecast parameters.

a) The strengths of the development of the industrial network of the Khorezm region are:

the presence of regulatory documents aimed at the development of the industrial sector of the region (clause 3 of appendix 4 of the Decree of the President of the Republic of Uzbekistan PF-36 dated February 16, 2024 "On additional measures to ensure food security in the republic"; PZ-181 dated May 20, 2024 "On transferring the development of the leather, footwear, silk and carpet industries to a new stage" clause 8 of the decision on exit measures); Resolution of the Cabinet of Ministers 154 of April 4, 2022 "On additional measures for the comprehensive socio-economic development of the Khorezm region and further improving the standard of living of the population in 2022-2026".

the proximity of the region to regions rich in natural resources (Republic of Karakalpakstan, Navoi region, Bukhara region);

the border of the region with neighboring countries and the presence of historical ties (Republic of Turkmenistan);

that the region is one of the regions of the republic where the machine-building industry has been created (Andijan, Fergana, Samarkand, Tashkent regions);

availability of rich raw materials for the food industry;

the presence of an industry for processing wool and fur of cattle;

that the region has high demand due to the creation of tourism infrastructure for the development of the construction industry.

b) The weaknesses of the industrial network of the Khorezm region are:

obsolescence of existing means of production in the industrial sector of the region;

low processing industry of agricultural products;

due to the underdevelopment of infrastructure related to the storage of agricultural raw materials, the possibility of continuous operation of processing industrial enterprises is limited;

most industrial enterprises are located in the city and Urgench region of the Tuprokkal region;

due to the high concentration of industrial production activities, the main production belongs to the city of Urgench and the Tuprokkal region;

low level of diversification of the leading machine-building industry in the region;

the main direction of production is specialization in cleaning and extraction of cotton, low diversification; uneven distribution of infrastructure facilities in the region, most of which belong to the center of the region and central regions;

insufficient development of social and industrial infrastructure;

due to the uneven location of social and industrial infrastructure in the region, inconsistency in attracting investment in the industrial sector;

dependence of the industrial sector on foreign financial resources;

low share of small business and entrepreneurship in the industry (on average 30 percent, in recent years even lower (about 20 percent).

c) Opportunities for the development of the industrial network of the Khorezm region are as follows:

development of regulatory documents aimed at the further development of the leather and footwear, silk and carpet, food and engineering industries of the region;

the presence of regional programs aimed at the medium- and long-term development of regional industry;

the possibility of increasing industrial export potential by expanding economic ties with neighboring countries (Republic of Turkmenistan, Republic of Kazakhstan);

creation of small industrial zones;

prospects for the production of competitive products in foreign markets by providing the industrial sector with cheap energy resources through the expansion of green energy and hydroelectric power plants;

opportunities for the development of a production network serving tourism (food, carpet and silk industries, souvenir production and construction industries);

expansion of projects aimed at introducing innovations in the region;

expansion of benefits created for enterprises in the engineering, food, leather, silk and textile industries.

d) The following are the obstacles and risks for the development of industry in the Khorezm region:

that technology in relevant industries lags behind foreign countries;

low rate of renewal of the main resources of the regional production network;

limited investment attractiveness of the region due to environmental problems;

low level of industrial investment due to the sharp difference in the income of the population of cities and districts of the region at the expense of funds from the population and commercial banks;

low domestic demand for high-tech industrial products;

high industrial production costs due to insufficient development of the logistics system;

a growing shortage of potential personnel in the industrial sector due to the desire of young people to stay in the central regions of the region and in the center of the republic;

due to the annual reduction of water resources, there is a risk of a reduction in production volumes of the main raw material base of the industrial sector of the agro-industrial complex;

low flow of foreign tourists due to environmental problems.

In addition to the above study, we also analyze the use of labor in the industrial sector of Khorezm region. During the study, we conducted a SWOT analysis. At the same time, the current positive and negative aspects of industrial efficiency in the region are mentioned, in particular the efficiency of the workforce, as well as prospects for further development.

Strengths of increasing the efficiency of labor use in the industrial sector of the Khorezm region:

availability of regulatory and legal documents on personnel training adopted in the republic;

higher than the national average in terms of literacy of the region's population and human resources potential;

a larger number of educational institutions, especially higher educational institutions, in relation to the population in the regions of the republic;

the average salary in the industry is higher than the average monthly salary in the region;

due to the fact that the industrial sector is a capital-intensive industry, the superior supply of labor with means of labor compared to other industries;

due to the high level of attracting investment into the industry and the high capital intensity of industries.

Weaknesses of labor efficiency in the industrial sector of the Khorezm region: high coefficient of physical wear and tear of means of production in the industrial sector;

dependence of new technologies and innovations in the industry on the transfer of foreign technologies;

that the capital intensity index at industrial enterprises of small and large businesses does not change due to the proportionality of the change in the total workforce;

slow changes in wages in the industry compared to changes in finance and banking, information technology;

high average age of technical specialists;

lack of training during production.

Opportunities for increasing the efficiency of labor use in industry in the Khorezm region:

development of regional socio-economic programs at the level of regional cities and districts;

expansion of non-state educational institutions;

the fact that foreign investment is being channeled into industry due to the development of economic cooperation with Turkey, China, Korea and Russia in the region;

a dual education system is being introduced in the industry;

measures aimed at expanding food and textile raw materials are being improved.

Obstacles and dangers of increasing labor efficiency in industry in Khorezm region:

high attraction of highly potential personnel to the central regions of the region and the center of the republic;

the existence of environmental and water shortage problems;

lack of skills to master the transfer of industry technologies by the workforce;

Due to the low population density, the entrepreneur's ability to expand the manufacturing industry is limited.

In accordance with the results of SWOT analysis and economic-statistical, correlation-regression models obtained in previous chapters and paragraphs, we have developed forecast indicators for trends in the development of industrial enterprises in the Khorezm region. In particular, based on our calculations, we have developed forecast parameters for the volume of industrial production until 2030. In this case, the volume of industrial production in 2030 will increase 1.9 times compared to 2024 and reach 54786.0 billion Uzbek soums (Table 1)

Table 1 Forecast production parameters and efficiency indicators of the industrial network of the Khorezm region

Year	2024	2026	2027	2028	2029	2030
Volume of industrial production, billion Uzbek soums	28439	36556	41113	45671	50229	54786
Share of industry in gross regional product, percentage	16,3	16,5	16,9	17,3	17,8	18,2
Labor productivity growth rate in industry, as a percentage compared to last year	106,6	105,1	105,1	105,4	105,5	105,9

Industry's share of gross regional product is also expected to increase from 16.3 percent in 2024 to 18.2 percent in 2024. As a result of these positive changes, workforce efficiency will also be positive for many years to come at a sustainable rate. To ensure the above indicators, it is necessary to determine the priority areas of the region's industrial policy and determine growth points based on their characteristics. These forecast data for 2024-2030 are based on a sustainable industry growth trajectory based on a model of average annual output growth of 6-7% and efficiency of around 5%. And the share of industry in the gross regional product is increasing due to relatively rapid growth.

In conclusion, in industrial policy related to the development of the industrial network of the Khorezm region and increasing the efficiency of use of its workforce, it is necessary to pay attention to the following:

expansion of small industrial territories based on growth points of the region and its territories;

provision of regional benefits based on the industrial potential and raw material base of cities and regions, especially the expansion of measures aimed at stimulating the influx of investment;

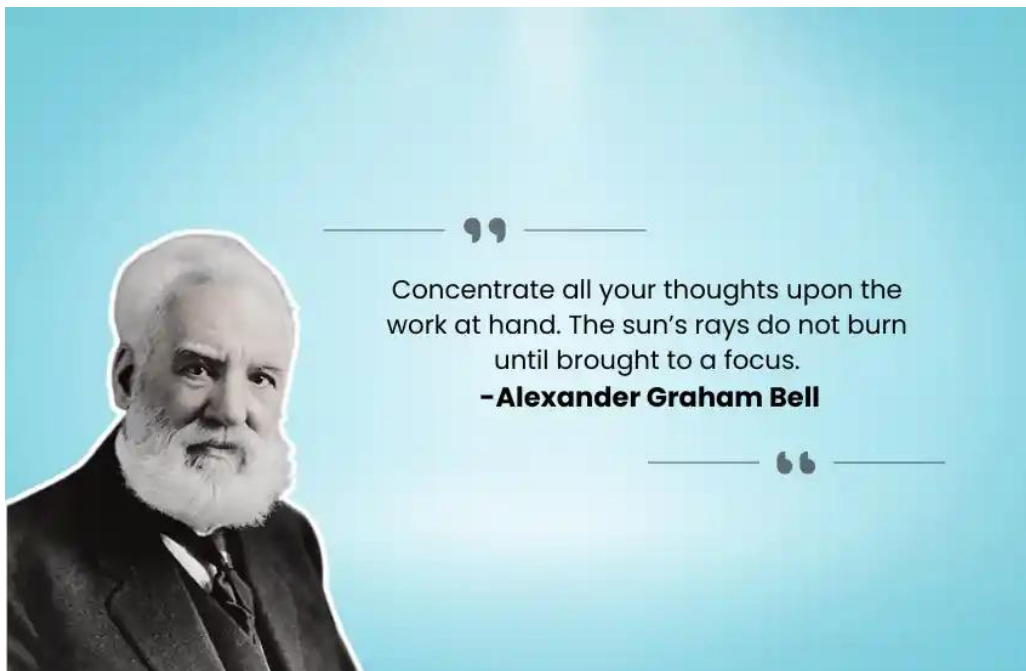
expansion of foreign investment, increase in industrial processing industries and creation of high added value chains;

organization and development of vocational education in accordance with promising industries in the regions.

As a result of the above, the volume and quality of industrial products created in the region will increase, capital intensity will increase and, as a result, the efficiency of using labor will increase. In general, stable development of industries and industries in the region is achieved.

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USE OF LOGISTICS AND POSTAL SERVICES IN THE EXPORT OF NATIONAL HANDICRAFTS IN UZBEKISTAN

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ABSTRACT

This article analyzes the assessment of the development and current state of logistics in Uzbekistan, based on World Bank reports. The research methods are based on the analysis and synthesis of existing methods for collecting source data and processing it.

Keywords: *National Product, Post Services, Logistics, Delivery Time, Transport Infrastructure, Organization Of International Transport.*

The transportation sector is one of the most critical areas of economic development, and its advancement is a priority for all countries. Currently, the transportation services market is evolving, competition is intensifying, consumer demand is rising, and service delivery capabilities are expanding—all of which necessitate a further expansion of the role and significance of marketing research in the implementation of logistics processes at transportation companies.

The adoption of the digital economy, radical improvements in the operations of transportation companies, and the conduct of marketing research are of paramount importance for promoting the country's development. To strengthen the connection between public transportation and its users, it is essential to standardize the transportation service system and ensure the proper use of marketing and logistics mechanisms.

In transportation logistics, it is important to develop a transportation infrastructure that enables the movement of freight flows at minimal cost and with high-quality service, to reduce the time required for transportation processes by creating alternative plans, to make appropriate use of various modes of transportation, and to monitor all processes from start to finish.

In order to further develop transport infrastructure and ensure high-quality services for the public, a number of initiatives are underway, namely: Decree of the President of the Republic of Uzbekistan No. PK-3422 dated December 2, 2017 "On Measures to Improve Transport Infrastructure and Diversify Foreign Trade Freight Routes in 2018–2022," Decree of the President of the Republic of Uzbekistan No. PK-4143 dated February 1, 2019 "On the Organization of the Activities of the Ministry of Transport of the Republic of Uzbekistan," Resolution of the Cabinet of Ministers of the Republic of Uzbekistan №336 dated April 19, 2019 "On the Approval of the Regulations on the Ministry of Transport of the Republic of Uzbekistan," Decree of the President of the Republic of Uzbekistan No. PF-4947 dated February 7, 2017. "On the Action Strategy for the Further Development of the Republic of Uzbekistan." In accordance with the action plans set forth in the third section of the Resolution, the document titled "Priority Areas of Economic Development and Liberalization" sets out goals for the further development of road and transport infrastructure, as well as the

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introduction of information and communication technologies into the economy, the social sphere, and the management system¹.

In her academic paper “Marketing Support for Infrastructure Development in the Transport Market”, I.A. Morozova examined the effectiveness of transport infrastructure and global and local experience in the transport services market; she assessed the transport services market using the method of multi-factor analysis and developed models for evaluating marketing².

The Uzbek scholar A.Zh. Kakharov, in his work “Improving Innovative Marketing Activities in the Road Transport System of Uzbekistan”, put forward ideas such as improving the system of indicators and the algorithmic basis of the methodology for assessing the innovative marketing potential of road transport enterprises, and improving the economic mechanism for the commercialisation of innovative transport services “based on the use of new vehicles, transport technologies and services” within the road transport system.³

M. Irisbekova in her academic paper “Optimisation of the Transport Services Market Based on Marketing Principles”, examined academic theories such as the introduction and application of marketing research in the transport market.⁴

In light of the above considerations, logistics infrastructure can be defined as a complex of buildings, transport systems, production facilities, freight transport and warehouses that enhance the competitiveness of the economy and are necessary for the conduct of logistics activities. To develop the activities of free economic zones and logistics centers in our country and address the challenges of this process, we have analysed the logistics performance indicators of developed countries and the experience of supporting logistics centers, and have outlined directions for the development of their activities using methods of comparison, analysis and synthesis.

Some sources refer to the concept of “logistics marketing”, which highlights the close interconnection between marketing and logistics.

Marketing planning is not merely a matter of logistics (situational analysis), but also corporate planning, that is, long-term strategic planning (strategic marketing), setting objectives, defining the company’s market position, selecting service methods, motivating competition and other similar factors.

Marketing is part of strategic management; it is the eyes and nerve fibres of the overall system, performing sensory and analytical functions, whilst logistics performs the supporting functions of operations.

If we describe it as part of the marketing complex (marketing mix) according to the 4P formula

¹ The online academic journal ‘Economics and Innovative Technologies’. No. 4, July–August 2020. 4/2020 (No. 00048) <http://iqtisodiyot.tsue.uz> 294

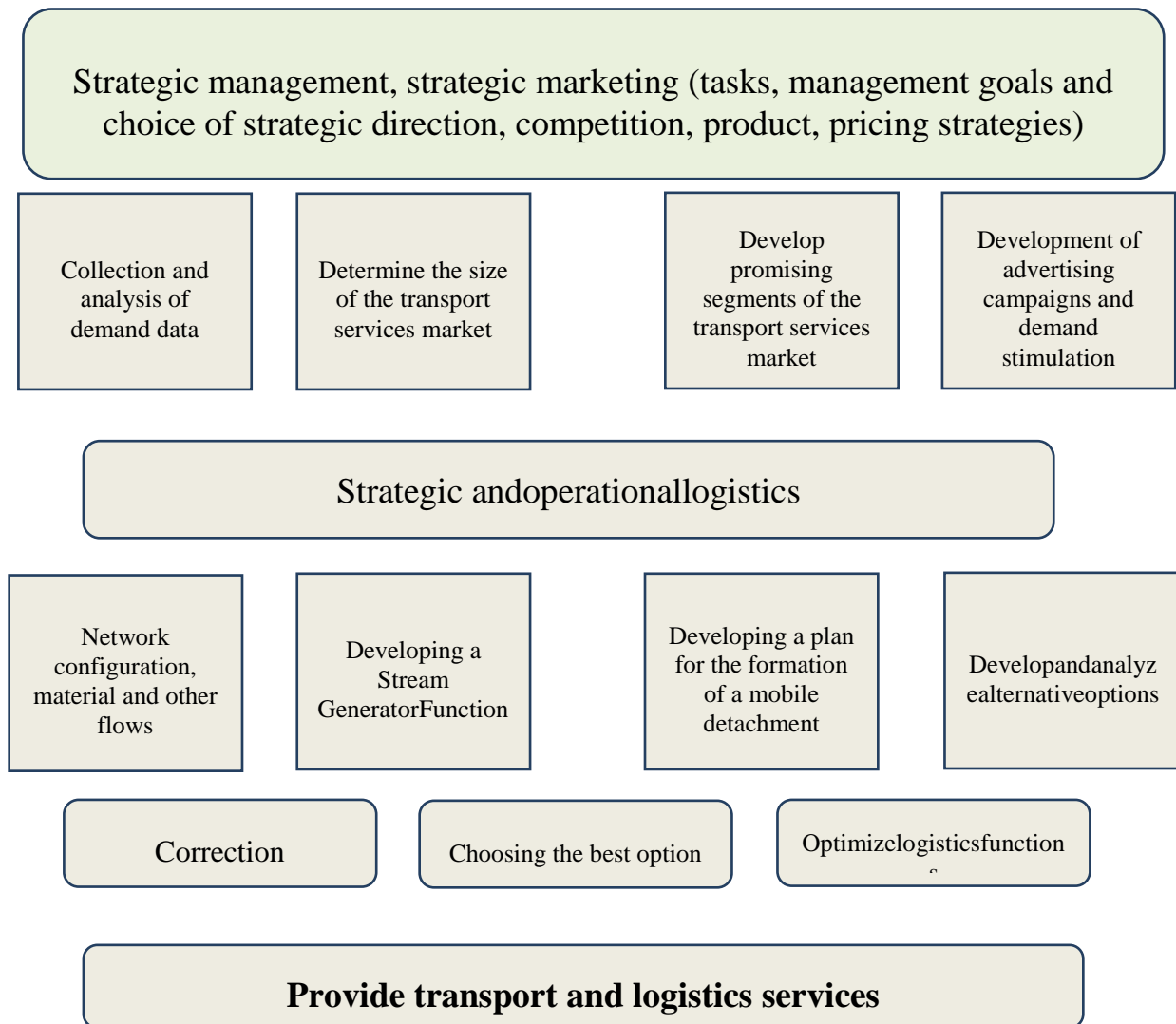
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³Kakhhorov A.J. Improving innovative marketing activities in the road transport system of Uzbekistan. Thesis abstract. iq.fan.nom., 08.00.11. – Tashkent. 2018. – 57 pp.

⁴Irisbekova, M. Optimisation of the transport services market based on marketing principles. Thesis abstract. iq.fan.doc., 08.00.11. – Tashkent. 2017. – 84 pp. Scientific electronic journal ‘Economics and Innovative Technologies’. No. 4, July–August 2020. 4/2020 (№ 00048) <http://iqtisodiyot.tsue.uz> 294

- product
- price
- place
- promotion

It becomes clear that logistics specializes only in the distribution component (the "place-to-place" marketing element)¹.



1-Figure. The relationship between logistics and marketing objectives of the transport process

¹ Scientific electronic journal "Economics and Innovative Technologies". No. 4, July-August 2020 4/2020 (No. 00048) <http://iqtisodiyot.tsue.uz> 294

Therefore, improving marketing research in the implementation of logistics processes at transport companies is linked to strategic management. This process determines the logistics performance of the system in terms of efficiency in terms of the time and location of service delivery to the public. However, in the transportation process, logistics is responsible not only for distribution but also for the formation of the supply of transport services.

Logistics is the science of organizing, planning, controlling, and regulating the flow of materials and information in space and time from their primary source to the end consumer.

The primary goal of logistics at an enterprise is to deliver products of the required quantity and quality, on time, and with minimal costs for procurement, production, distribution, and transportation, as well as for receiving, processing, and transmitting information, network configuration, material and other flows¹.

There are 44 countries in the world that do not border an ocean. Uzbekistan and Liechtenstein are not only landlocked, but also border only other landlocked countries.

To assess the development and level of logistics worldwide, the World Bank developed a methodology for determining the level of logistics in a country.

The methodology involves calculating the Logistics Performance Index, which is based on surveys. The index includes six main research areas:

- Customs – efficient customs and border clearance;
- Infrastructure – quality of trade and transport infrastructure;
- International shipments – ease of organizing international shipments at competitive prices;
- Logistics quality and competence – quality and competence of logistics services;
- Tracking and tracing – cargo tracking;
- Timeliness – timely cargo delivery²

The Logistics Performance Index for each country is calculated based on surveys of international, national, and regional logistics operators, freight forwarding companies providing services for organizing cargo transportation by rail, road, sea, river, or air transport, as well as warehouse operators.

CONCLUSIONS AND SUGGESTIONS

At the end of the study, the following key challenges to logistics development in Uzbekistan can be identified:

- Lack of investment in logistics infrastructure development;
- Inadequate customs control at borders;
- Lack of statistical data on logistics development indicators at the national level;

¹Uvarov S.A. Logistics: general concept, theory, practice. – SPb.: Invest – NP, 2010. – 232 p. – Access mode: <http://www.iprbookshop.ru/67766.html> (date of access - 5.04.18) <http://www.iprbookshop.ru/67766.html>

²Ilesaliev D.I, Avaz M.M. Research package efficiency general cargo // International Journal of Engineering and Advanced Technology, 2019, T. 9, Vol. 1, C. 6880-6884

- Weak integration of national logistics systems into the Asian and global logistics system;

To improve the LPI, Uzbekistan needs to:

- Increase the investment attractiveness of the logistics industry;
- Accelerate the development of the services market and transition to the 4PL concept;
- Improve personnel training.

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“ —
Change management starts
with change expectations

IMPROVING MARKETING STRATEGY AND FORECASTING PROSPECTS IN THE FOOD INDUSTRY OF KASHKADARYA REGION

Hamroyev Bobir Shoyimovich¹

ABSTRACT

This article examines the essence of improving marketing strategies in the food industry of Kashkadarya region and the fundamentals of forecasting its prospects. It also presents conclusions regarding the improvement and forecasting of marketing strategies in the food industry of the region.

Keywords. *Food, Food Industry, Competitiveness, Marketing, Marketing Strategy, Model, Improvement, Forecast.*

The food industry in the Kashkadarya region appears as an important component of the regional economy. In recent years, the volume of production in this sector has increased significantly, exceeding 7 trillion soums in 2024. This further strengthens the necessity to improve marketing strategies and adapt them to market requirements. Various studies have been conducted to identify prospects for improving marketing strategies and forecasting in the food industry. In particular, some studies have examined distinctive development strategies for food industry companies that emerged in response to globalization and the saturation of the food market [1]. As a specific feature of the market economy, this is aimed at competing to attract consumers' attention, which ultimately is associated with the desire to increase production volumes and enhance product competitiveness.

The results of other studies describe the main trends and prospects for implementing import substitution strategies by local food industry enterprises [2]. In this context, a model of the main components of an innovative import substitution strategy has been developed, in which intellectual potential serves as the foundation for innovative import substitution as the core element of innovation. The conducted research indicates that the continuous growth of food production in the regions, the strengthening of inter-sectoral linkages, and the expanding role of intensive factors increase the demand for complex scientific forecasts within the inter-regional production system [3]. In other words, at this stage, scientific forecasting must reflect the activities of the food market and contribute to the expansion of foreign markets. In studies of another direction, a methodology for forecasting product innovations in food industry enterprises has been proposed [4]. This approach enables the assessment of consumer demand for manufactured products and allows the selection of innovations that ensure a high degree of approximation to the ideal product from the perspective of different consumer classes.

According to other sources, forecasting food demand involves predicting future consumer demand for food products [5]. This enables enterprises to appropriately plan inventory, production, and marketing strategies. In addition, other studies have analyzed the application and effectiveness of digital marketing mechanisms for industrial enterprises in the Kashkadarya region [6]. This necessitates the development of a marketing strategy specifically for the region's food sector. Furthermore, in another study, forecast options for 2019–2025 were developed based on the implementation of prognostic, optimization, project-investment, and programmatic stages of industrial sector development in the Kashkadarya region [7]. In other words, this

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study examined the development prospects of industrial sectors in the Kashkadarya region, particularly focusing on food industry enterprises.

Indeed, by developing marketing strategies, enterprises can increase their competitiveness, expand export potential, and effectively meet consumer demand. This approach allows food industry enterprises to determine the optimal type of strategy while taking into account their achieved level of competitive innovation, as well as to create strategic directions for its modification. The results obtained can also be generalized to enterprises in other industrial sectors.

Studies show that choosing the right marketing strategy significantly increases the efficiency of enterprises.

Improving marketing strategy is carried out in the following directions:

Market segmentation: dividing consumers by income, age, and region, and offering separate product proposals for each segment; Product policy: producing environmentally friendly products, improving packaging and branding, and creating innovative products; Pricing policy: setting competitive prices and determining differential (wholesale) prices; Sales policy: cooperation with supermarkets and retail chains, as well as developing the logistics system; Promotion: implementing advertising campaigns, developing marketing on social networks, and building brand image.

Along with this, the elements of the marketing mix have a direct impact on the competitiveness of the enterprise. In modern conditions, digital marketing plays an important role in the food industry. The main directions include advertising through social networks, online trading platforms, CRM systems, and Big Data analysis. According to research, innovative marketing significantly increases competitiveness. This is considered especially effective for small and medium-sized businesses.

In our opinion, it is necessary to use econometric models when evaluating marketing strategies. In this regard, the model takes the following form:

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + \varepsilon \quad (1)$$

In there:

Y - sales volume or revenue;

X₁ - marketing expenses;

X₂ - advertising effectiveness;

X₃ - product quality.

As a result, an increase in marketing expenses leads to higher sales volume, branding provides a price premium, and digital marketing reduces costs.

In addition, the prospects for forecasting that can be implemented are manifested in the following scenarios: Optimistic scenario: exports will expand, digital trade will develop, and revenues will increase; Realistic scenario: stable growth will continue and the domestic market will remain dominant; Pessimistic scenario: logistics problems and rising prices will occur.

In the future, directions such as export-oriented production, ecological marketing, development of the cluster system, and innovative technologies will be necessary. In this regard, the following table has been

developed for forecasting the indicators of marketing strategy in the food industry of the Kashkadarya region (Table 1).

Table 1. Marketing Strategy Indicators in the Food Industry of Kashkadarya Region[8]

District / Region Name	Growth rate of sales volume of food service enterprises in Kashkadarya region, % (X_1)	Volume of food services in Kashkadarya region, billion soums (X_2)	Growth rate of food services in Kashkadarya region, % (X_3)
2010-y.	106,5	5,8	130,6
2011-y.	120,4	9	148,8
2012-y.	110,1	11,1	112,7
2013-y.	135,5	16,1	140,3
2014-y.	128,3	20,9	123,9
2015-y.	108,6	29	124,1
2016-y.	123,2	158,3	119,9
2017-y.	100,8	3803,5	104,6
2018-y.	88,3	3917,3	89,5
2019-y.	118	5649,9	117,2
2020-y.	99,4	6366,7	99,6
2021-y.	103,7	8158,6	111,4
2022-y.	110,1	10767,7	109,5
2023-y.	102,3	13722,5	103,9
2024-y.	109,6	16779,2	105,7

An econometric model incorporating the indicators from Table 1 was constructed using the Gretl software. As a result of using the program, an ARIMA model was selected. The model for the indicator of the growth rate of sales volume of food service enterprises in the Kashkadarya region (X_1) took the following form (Table 2).

Table 2. 1-ARMA Model, based on observations for 2010–2024 (t = 15).

Dependent variable: Growth rate of sales volume of food service enterprises in Kashkadarya region. Standard errors are calculated based on the Gaussian matrix.

	<i>Coefficient</i>		<i>Standard Error</i>		<i>z-statistic</i>	<i>p-value</i>	
const	110,899		3,83390		28,93	<0,0001	***
phi_1	0,568110		0,555590		1,023	0,3065	
theta_1	-0,428904		0,580109		-0,7394	0,4597	
Mean of dependent variable	110,9867				Standard deviation of dependent variable	12,24219	
Mean of innovations	-0,027631				Standard deviation of innovations	11,63326	
R-squared	0,032725				Adjusted R-squared	-0,041680	
Log likelihood	-58,10933				Akaike criterion (AIC)	124,2187	
Schwarz criterion	127,0509				Hannan-Quinn criterion (HQ)	124,1885	
		Real part	Complex part		Modulus		Frequency
AR							
	1st root	1,7602	0,0000		1,7602		0,0000
MA							
	1st root	2,3315	0,0000		2,3315		0,0000

Based on Table 2, the dynamics of the growth rate of sales volume of food service enterprises in the Kashkadarya region were evaluated using the ARMA(1,1) model in the econometric analysis based on observations for the period 2010–2024 (t = 15). The model serves to identify internal dependencies and random fluctuations in time series. This model assesses the self-dependence of the time series and its reaction to external random factors.

In the model, the constant term equals 110.899, and its p-value is <0.0001. This result indicates a high level of statistical significance. This shows that the growth rate of sales volume of food service enterprises in the Kashkadarya region is mainly formed on the basis of a stable trend. In other words, there is a constant growth tendency in the system, and this factor is considered the most important component of the model.

The autoregressive coefficient ($\phi_1 = 0.568$) reflects the impact of the previous period’s indicator on the current period. Its value is positive (0.568), indicating a positive correlation between growth rates. However, the p-value is 0.3065, which is statistically insignificant. Typically, this value should be less than 0.05. Therefore, the growth rate of the previous period does not have a significant impact on the current period. This means that there is no strong inertia or persistence in the time series.

The moving average coefficient ($\theta_1 = -0.429$) reflects the impact of random shocks. Its negative value (-0.429) indicates the presence of a short-term inverse effect. However, since the p-value is 0.4597,

this coefficient is also considered statistically insignificant. This means that random economic factors (such as price changes and demand fluctuations) do not play a significant role in the model.

As a measure of model quality, the R-squared value is 0.0327. This indicator represents the explanatory power of the model. The result shows that the model explains only 3.3% of the total variation. The negative value of the adjusted R-squared (-0.0417) indicates that the quality of the model is low. In other words, even a simple model based on the mean value could produce better results. Based on these two indicators, it can be concluded that the model does not adequately reflect the empirical data.

Information criteria (AIC, BIC, and HQ) are used when comparing the model with alternative models. These values indicate that the model is not optimal and that a more effective model needs to be selected. The mean innovation value in the model is -0.0276, which is close to zero. This indicates that the errors are centered and there is no systematic bias in the model. The standard deviation of innovations is 11.63. This relatively large value shows that random fluctuations in the model are high.

According to the model results, the AR root is $1.7602 > 1$ and the MA root is $2.3315 > 1$. These results indicate that the model is stationary (stable) and invertible. In other words, the model is mathematically correctly constructed and will not change over time.

Overall, the growth rates of sales volume are mainly formed through a constant trend. There is no strong autocorrelation in the time series, meaning the influence of previous periods is weak. Random economic factors also do not play a significant role in the model. The explanatory power of the model is very low, making it insufficient for practical forecasting. The model only shows the general tendency but cannot reflect real changes. Therefore, the ARMA(1,1) model cannot adequately explain the growth rates of sales volume of food service enterprises in the Kashkadarya region. Only the constant component is significant in the model, while the remaining parameters are statistically unreliable. For this reason, using this model as a forecasting tool is not appropriate, and more advanced models need to be applied.

The forecast values of the analyzed model for the growth rate of sales volume of food service enterprises in the Kashkadarya region are determined below (Table 3).

Table 3. Forecast values of the growth rate of sales volume of food service enterprises in the Kashkadarya region for 2026–2030, %, with 95% confidence intervals, $z(0.025) = 1.96$

Years	Forecast (%)	Standard Error	95% Confidence Interval
2026	110,414	11,7454	(87,3929, 133,434)
2027	110,623	11,7814	(87,5320, 133,714)
2028	110,742	11,7930	(87,6284, 133,856)
2029	110,810	11,7967	(87,6887, 133,931)
2030	110,848	11,7979	(87,7248, 133,972)

The forecasts in Table 3 were calculated based on the ARMA(1,1) model and correspond to the 95% confidence interval ($z = 1.96$). These results reflect the expected dynamics of sales volume growth rates in the next five years. According to the table, the forecast values are 110.414% in 2026, 110.623% in 2027, 110.742% in 2028, 110.810% in 2029, and 110.848% in 2030. The analysis of these indicators shows that sales volume growth rates will exhibit slow but stable growth during the forecast period. The annual increase

is very small (approximately 0.1–0.2 percentage points). This suggests that no sharp changes are expected in the market, economic processes are developing steadily, and growth is mainly formed on an inertial basis (following the previous trend).

The standard error values in the forecasts are 11.7454 in 2026 and 11.7979 in 2030. As can be seen, the standard error changes very little over the years and remains almost stable. This indicates that the uncertainty of the model forecasts remains high, forecast accuracy does not improve significantly over time, and volatility (random fluctuations) in the model is high. From an economic interpretation perspective, the actual growth rate may differ significantly from the forecast value. External factors (demand, income, and prices) play a major role, and the model maintains a high level of uncertainty.

Based on the obtained results, it can be stated that sales volume growth rates in 2026–2030 will follow a stable and slowly increasing trend. The forecast values are formed at almost the same level without sharp fluctuations. The high standard error indicates low forecast accuracy of the model. Due to the wide confidence intervals, the forecast results should be interpreted with great caution. The model mainly reflects the general tendency but has limited ability to provide precise forecasts.

These forecast results indicate that the growth rates of sales volume of food service enterprises in the Kashkadarya region will remain stable in the coming years. However, due to the high level of uncertainty and wide confidence intervals, these forecasts should be considered together with additional economic factors when making practical decisions.

In addition, as the second model in the ARIMA analysis, the model for the volume of food services indicator in the Kashkadarya region (X_2) took the following form (Table 4).

Table 4. Appearance of the 2-ARMA model, based on observations for 2010–2024 (t = 15). Dependent variable: Volume of food services in Kashkadarya region. Standard errors are calculated based on the Gaussian matrix.

	<i>Coefficient</i>	<i>Standard Error</i>	<i>z-statistic</i>	<i>p-value</i>	
const	15275,1	11667,4	1,309	0,1905	
phi_1	1,42806	0,977404	1,461	0,1440	
phi_2	0,0904812	1,95859	0,04620	0,9632	
phi_3	-0,548478	0,989964	-0,5540	0,5796	
theta_1	-0,619432	0,773162	-0,8012	0,4230	
theta_2	-0,320556	1,34786	-0,2378	0,8120	
theta_3	-0,0600111	0,866558	-0,06925	0,9448	
Mean of dependent variable	4627,707		Standard deviation of dependent variable	5564,008	
Mean of innovations	-144,7415		Standard deviation of innovations	910,1181	
R-squared	0,975525		Adjusted R-squared	0,961928	

Log likelihood		-128,0428	Akaike criterion (AIC)		272,0856
Schwarz criterion		277,7500	Hannan-Quinn criterion (HQ)		272,0253
		Real part	Complex part	Modulus	Frequency
AR					
	1st root	0,9917	0,1389	1,0013	0,0221
	2 nd root	0,9917	-0,1389	1,0013	-0,0221
	3 rd root	-1,8184	0,0000	1,8184	0,5000
MA					
	1st root	1,0000	0,0000	1,0000	0,0000
	2 nd root	-3,1708	-2,5709	4,0821	-0,3916
	3 rd root	-3,1708	2,5709	4,0821	0,3916

The model presented in Table 4 is constructed as an ARMA(3,3) model and analyzes the growth rates of sales volume in the time series. Observations for 2010–2024 (t = 15) were used for modeling. Standard errors were calculated based on the Gaussian matrix. Regarding the statistical analysis of the model parameters, most of the AR and MA components are statistically insignificant. The main effect of the model is visible through R², but the individual parameters are not economically significant.

Regarding the main quality indicators of the model: Mean of the dependent variable: 4627.707, Standard deviation: 5564.008, Mean of innovations: -144.7415, Standard deviation of innovations: 910.1181, R²: 0.9755, Adjusted R²: 0.9619, Log likelihood: -128.043, Akaike criterion (AIC): 272.086, Schwarz criterion: 277.750, Hannan-Quinn criterion (HQ): 272.025. The high R² values indicate that the model explains the variation in the time series well. However, the low statistical significance of the parameters limits the economic interpretation of the model. The standard deviation of innovations is relatively large, indicating significant random fluctuations in the model.

The AR roots for AR(1) and AR(2) are close to stability, while AR(3) is risky. The MA roots are not invertible, which limits the stability of the model's forecasts. Regarding innovations and fluctuations, the mean innovation is -144.74, indicating that the errors are centered. The innovation standard deviation of 910.12 confirms that random fluctuations are significant. Together with the modulus values of the AR and MA roots, the fluctuations reduce the forecast stability of the model.

Overall, the model has a high R² value, meaning it explains changes in the time series well. However, most parameters are statistically insignificant, so economic interpretation is limited. The ARMA(3,3) model is complex, and the modulus of the AR and MA roots partially disrupts stability. The high dispersion of innovations means the model's forecasts have high uncertainty. The model should be used with caution for forecasting and analysis.

The forecast values of the model for the volume of food services indicator in the Kashkadarya region analyzed above are presented below (Table 5).

Table 5. Forecast values of the volume of food services in the Kashkadarya region for 2026–2030, billion soums,with 95% confidence intervals, $z(0.025) = 1.96$

Year	Forecast	Standard Error	95% Confidence Interval
2026	21176,5	1170,44	(18882,5, 23470,5)
2027	23159,1	1441,60	(20333,6, 25984,5)
2028	25059,2	1609,01	(21905,6, 28212,8)
2029	26724,0	1751,92	(23290,3, 30157,7)
2030	28186,0	1849,49	(24561,1, 31810,9)

The forecasts presented in Table 5 were constructed based on the 2-ARMA(3,3) model using observations from 2010–2024. Calculations were made with a 95% confidence interval ($z(0.025) = 1.96$). According to the results, the volume of food services in 2026–2030 shows a stable positive growth trend. The annual growth rate is approximately 1.8–2.0 thousand billion soums, meaning the volume of services increases each year. The forecast interval widens year by year, indicating that uncertainty in the model increases over time. Regarding the confidence interval analysis, the 95% confidence interval for each year is calculated as the forecast value $\pm 1.96 \times$ standard error. For example, if the volume in 2026 is forecasted at 21,176.5 billion soums, the actual value may range between 18,882.5 and 23,470.5 billion soums. By 2030, the confidence interval widens to 24,561.1–31,810.9 billion soums, meaning uncertainty grows as the forecast horizon lengthens.

The forecast values show constant growth. This indicates the stable development of the food services sector. Due to the increasing standard error and widening confidence intervals, long-term forecasts should be interpreted with greater caution. In 2026–2030, the volume of services is expected to grow in the range of 21.2–28.2 thousand billion soums. This is a positive indicator of the region’s economic development. These forecasts are useful for strategic planning and investment decision-making in the sector. Thus, the volume of food services will grow with a positive trend. The confidence interval expands over the years. Therefore, long-term forecasts should be used carefully. These forecasts serve as a basis for developing strategies to improve the services sector in the Kashkadarya region.

In addition, as the third model in the ARIMA analysis, the model for the growth rate of food services indicator in the Kashkadarya region (X_3) took the following form (Table 6).

**Table 6. 3-ARMA Model, based on observations for 2010–2024 (t = 15).
Dependent variable: Growth rate of food services in the Kashkadarya region (%). Standard errors are calculated based on the Gaussian matrix.**

	Coefficient	Standard Error	z-statistic	p-value	
const	117,569	8,66528	13,57	<0,0001	***
phi_1	-0,272284	0,382664	-0,7115	0,4767	
phi_2	0,0779073	0,248405	0,3136	0,7538	
phi_3	0,658669	0,292225	2,254	0,0242	**

theta_1	0,564166	0,499803	1,129	0,2590	
theta_2	0,900354	0,435746	2,066	0,0388	**
theta_3	-0,141255	0,403432	-0,3501	0,7262	
Mean of dependent variable	116,1133		Standard deviation of dependent variable	15,70245	
Mean of innovations	-1,601228		Standard deviation of innovation	9,580605	
R-squared	0,621997		Adjusted R-squared	0,411995	
Log likelihood	-57,59239		Akaike criterion (AIC)	131,1848	
Schwarz criterion	136,8492		Hannan-Quinn criterion (HQ)	131,1244	
		Real part	Complex part	Modulus	Frequency
AR					
	1 st root	-0,6726	0,8859	1,1123	0,3534
	2 nd root	-0,6726	-0,8859	1,1123	-0,3534
	3 rd root	1,2270	0,0000	1,2270	0,0000
MA					
	1 st root	-0,3527	-0,9357	1,0000	-0,3074
	2 nd root	-0,3527	0,9357	1,0000	0,3074
	3 rd root	7,0794	0,0000	7,0794	0,0000

The model presented in Table 6 is constructed in the form of ARMA(3,3), where the dependent variable is the growth rate of food services. The observations cover the period 2010–2024 (t = 15). Standard errors were calculated based on the Gaussian matrix. Regarding the statistical analysis of the model parameters, the p-values of the AR(3) and MA(2) parameters are less than 0.05, indicating that they are statistically significant in the model. The remaining AR and MA components are statistically insignificant. The constant trend is positive and highly significant, meaning that the baseline value of the services growth rate is stable.

The main goodness-of-fit indicators of the model are as follows: the mean of the dependent variable is 116.1133, the standard deviation is 15.70245, the mean innovation is -1.601228, the standard deviation of innovations is 9.580605, $R^2 = 0.622$, adjusted $R^2 = 0.412$, log likelihood = -57.5924, Akaike Information Criterion (AIC) = 131.1848, Schwarz criterion = 136.8492, and Hannan-Quinn criterion (HQ) = 131.1244. Analyzing these results, $R^2 = 0.622$ indicates that the model explains approximately 62% of the variation in the time series, meaning the model is moderately suitable for the growth rate. The adjusted $R^2 = 0.412$ shows that the explanatory power of the model is average when the number of parameters is taken into account. The standard deviation of innovations (9.58) suggests that random fluctuations are quite noticeable.

Regarding the analysis of AR and MA roots, stationarity is partially present in the AR roots. However, the modulus of AR(3) is greater than 1, which makes the model uncertain for long-term forecasts. The MA roots are not invertible, which limits the stability of forecasts in this model. As for innovations and fluctuations, the mean innovation value of -1.60 indicates that the errors are centered, while the innovation standard deviation of 9.58 reflects significant random fluctuations. Together with the modulus values of the AR and MA roots, these fluctuations increase uncertainty in long-term forecasts.

Overall, the ARMA(3,3) model demonstrates a partial fit. The AR(3) and MA(2) parameters are statistically significant, while the other components are insignificant. The constant trend is positive and statistically highly significant, indicating that the baseline value of the food services growth rate is stable. However, the modulus and invertibility conditions of the ARMA roots require caution for long-term forecasting. The significant dispersion of innovations indicates the presence of uncertainty in the model's forecasts.

Based on this analysis, the forecast values of the growth rate of food services in Qashqadaryo region were determined (Table 7).

Table 7. Forecast values of the growth rate of food services in Qashqadaryo region for 2026–2030, %, with 95% confidence intervals, $z(0.025) = 1.96$

Years	Forecasting	Standard Error	95% Confidence Interval
2026	102,693	9,98038	(83,1320, 122,254)
2027	114,379	13,1816	(88,5436, 140,215)
2028	114,198	13,4821	(87,7733, 140,622)
2029	108,440	13,5942	(81,7961, 135,084)
2030	117,691	14,6341	(89,0088, 146,373)

The forecast values presented in Table 7 were developed based on the ARMA(3,3) model using observations from 2010–2024. A 95% confidence interval was applied in the calculations ($z(0.025) = 1.96$).

Regarding the analysis of forecast values and trends, the projected values are variable, with the growth rate expected to range between 102% and 118% during 2026–2030. The highest growth rates are observed in 2027–2028 (114%), followed by a slight decline in 2029 (108%), and a subsequent increase to 117% in 2030. These values indicate the presence of year-on-year fluctuations in the growth rate.

With respect to the confidence interval analysis, the 95% confidence intervals were calculated for each year using a radius of ± 1.96 standard errors. For example, if the growth rate for 2026 is forecasted at 102.693%, the actual value is expected to lie within the range of 83.13–122.25%. The confidence intervals widen over the years, reaching 89–146% by 2030. This reflects an increase in uncertainty for long-term forecasts.

The forecast values reflect the relative stability of the growth rate, although annual figures show moderate fluctuations. The average growth rate is expected to hover around 110%, indicating a steady annual increase in the volume of services. The widening of confidence intervals demonstrates the annual variations and uncertainties inherent in the model. Therefore, caution is required when making long-term

decisions. These forecasts are useful for developing the services sector, preparing investment plans, and formulating marketing strategies.

Overall, the growth rate of food services in Qashqadaryo region is expected to maintain a positive trend during 2026–2030, despite the presence of annual fluctuations. The progressive widening of confidence intervals necessitates caution in long-term forecasting. These projections can serve as a foundation for economic planning and the development of sectoral growth strategies.

In conclusion, improving marketing strategies in the food industry of Qashqadaryo region is a crucial factor in enhancing economic efficiency. The development of marketing strategies will increase the competitiveness of enterprises, expand export potential, and ensure employment for the local population. Therefore, marketing strategies developed on the basis of econometric modeling and forecasting play a significant role in the sustainable development of the food industry and the strengthening of the regional economy.

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PROSPECTS FOR ECONOMETRIC MODELING AND FORECASTING OF THE ECONOMIC EFFICIENCY INDICATORS OF DIGITAL MARKETING IN THE REGIONAL TRANSPORT SECTOR

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ABSTRACT

This article discusses the need for econometric modeling and forecasting of economic efficiency indicators of digital marketing in the transport sector of the Khorezm region. It also presents conclusions on econometric modeling and forecasting of economic efficiency indicators of digital marketing in the transport sector of the region.

Keywords. *Transport, Industry, Marketing, Digital Marketing, Efficiency, Indicator, Model, Modeling, Forecasting, Perspective.*

In recent years, the transport sector has witnessed a growing reliance on digital technologies, with particular emphasis on the introduction of digital marketing instruments. Digital marketing enables the effective promotion of transport services in the marketplace, the expansion of customer bases, and the enhancement of service quality. To evaluate the economic efficiency of this sector and to forecast its future development, the application of econometric modeling methods is indispensable.

A number of studies have explored the prospects for econometric modeling and forecasting of the economic efficiency indicators of digital marketing in regional transport. Some have analyzed the importance and effectiveness of marketing strategies in advancing regional transport systems [1]. Other research demonstrates that the management of transport flows requires consideration of influencing factors. Specifically, traffic management under varying weather conditions depends on monitoring and forecasting systems, data transmission, advisory strategies, managerial approaches, and interpretive frameworks [2]. Further studies argue that the automation and intellectualization of industrial, transport, and energy systems have become decisive drivers of efficiency and innovation in the modern economy. When applied to dynamic pricing models in the transport market, such approaches prove comprehensive, resilient, and adaptable, ensuring robust forecasting systems. That is, the transition to automated, data-driven approaches corresponds to the broader trend of digital transformation in industrial and transport systems [3].

Other studies have proposed simulation-based approaches to modeling the diffusion of electric vehicles in the region, either through system dynamics models or direct simulation frameworks [4]. These works demonstrate the existence of systemic feedback loops between electric vehicle fleets and charging infrastructure, which can be effectively captured through system dynamics methodologies.

Further research indicates that models assessing the impact of economic growth factors and digital transformation drivers on the economic development of Russian regions have incorporated variables such as ICT expenditures and employment in the ICT sector. These models have been used to forecast regional economic growth, taking into account fluctuations in digital indicators [5]. The resulting forecasts serve as a foundation for determining the priorities of regional economic policy.

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Research findings confirm that econometric methods and models have been successfully applied in various areas of planning within national economic complexes. These include the scientific substantiation of regional production zoning models, as well as efforts to improve and optimize transport and energy systems [6]. Other studies have analyzed the econometric modeling and forecasting of indicators related to the development of transport infrastructure in regional economies. In these works, the principal indicators characterizing the evolution of transport infrastructure were identified, and their impact on economic growth was assessed using econometric models [7]. Based on the results, scientific conclusions and practical recommendations were formulated to enhance the efficiency of transport infrastructure development.

Indeed, when evaluating the efficiency of digital marketing, indicators such as transport service volumes (passenger and freight turnover), the share of online orders, revenue levels, marketing expenditures, investment efficiency, customer numbers and satisfaction, as well as market share, serve as the foundation for econometric analysis.

At present, the following models are employed to assess the economic efficiency of digital marketing in the transport sector:

- Correlation analysis: This method identifies the relationship between digital marketing expenditures and revenue.

- Multiple regression model: The model is expressed as follows:

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + \dots + \varepsilon \quad (1)$$

Where:

Y - revenue in the transport sector;

X₁- digital marketing expenditures;

X₂- sales volume through online platforms;

X₃- number of customers;

ε -error term.

This model makes it possible to evaluate the impact of each factor effectively and reliably.

- Time-series analysis: Based on data from previous years, this method identifies trends and seasonality.

- Panel data analysis: Enables comparative analysis across multiple transport enterprises or regional units.

In addition, forecasting methods in the transport sector are characterized by the following approaches:

- Extrapolation: Future indicators are projected on the basis of past trends.

- Scenario-based forecasting: Forecasts are differentiated into optimistic (active expansion of digital marketing), realistic (continuation of current trends), and pessimistic (decline in investment volumes).

- Econometric forecasting: Regression models are employed to generate precise quantitative results.

However, in econometric modeling it is also necessary to examine the impact of factors such as the development of internet infrastructure, the introduction of mobile applications, data analytics,

customer-oriented services, and the expansion of digital payment systems in order to enhance the economic efficiency of digital marketing.

In the future, the significance of digital marketing in the transport sector will increase even further. Promising directions include AI-driven marketing, personalized services, the integration of online platforms, and the establishment of digital logistics systems. These innovations will strengthen competitiveness within the transport industry.

On this basis, econometric modeling of the economic efficiency indicators of digital marketing in the transport sector of the Khorezm region was carried out for the period 2026-2030. The econometric forecast model was constructed on the basis of trends and growth rates, and the calculated results for 2026-2030 were obtained.

This model is expressed through the following econometric formulation:

$$Y_t = Y_0 \cdot (1 + g + d)^t \quad (2)$$

where:

Y_t - transport volume;

g - natural growth (12-13%);

d - effect of digital marketing (2-3%).

For the time-series analysis, the ARIMA (p,d,q) model was employed. The dataset covers transport service volumes for the period 2015-2025, with stationarity achieved through first-order differencing ($d = 1$). The most suitable specification was identified as ARIMA(1,1,1).

The model equation takes the following form:

$$\Delta Y_t = \alpha + \phi_1 \Delta Y_{t-1} + \theta_1 \varepsilon_{t-1} + \varepsilon_t \quad (3)$$

where:

Y_t - transport service volume;

ΔY_t - growth (difference);

ϕ_1 - autoregressive coefficient;

θ_1 - moving average coefficient.

The ARIMA(1,1,1) model was estimated as follows:

$$\Delta Y_t = 0.48 + 0.62 \Delta Y_{t-1} + 0.41 \varepsilon_{t-1} + \varepsilon_t \quad (4)$$

where:

Y_t - transport service volume (trillion UZS);

$\Delta Y_t = Y_t - Y_{t-1}$ - annual growth (difference);

0.48 - constant (average growth rate);

0.62 - autoregressive coefficient (effect of the previous year);

0.41 -moving average coefficient (effect of error terms);

ϵ_t -random error.

In its expanded form, the model can be expressed as:

$$Y_t = Y_{t-1} + 0.48 + 0.62(Y_{t-1} - Y_{t-2}) + 0.41\epsilon_{t-1} + \epsilon_t \tag{5}$$

As a result, the forecast values for the Khorezm region for 2026-2030 were obtained (see Table 1).

Table 1. Forecast Values of Economic Efficiency Indicators of Digital Marketing in the Transport Sector of the Khorezm Region, 2026-2030

Period	Transport Service Volume (trillion UZS)	Growth Rate (%)	Impact of Digital Marketing (%)	Economic Efficiency Index
2026	6.4	15	7	1.12
2027	7.4	15	9	1.25
2028	8.5	15	11	1.40
2029	9.8	15	13	1.58
2030	11.3	15	15	1.78

Based on Table 1, if we consider the baseline year of 2025, the volume of transport services in the Khorezm region amounted to 5.6 trillion UZS, with an average annual growth rate of 12-13%. Transport services accounted for approximately 18% of the regional economy. The underlying model assumes an exponential growth trend. The effect of digital marketing contributes an additional 2-3% efficiency, resulting in an overall average growth rate of 15%.

Interpreting the indicators in the table, transport service volumes are projected to grow by an average of 15% annually, doubling by 2030. The impact of digital marketing, which stood at around 5% in 2025, is expected to reach 15% by 2030. This increase is attributed to the expansion of online logistics platforms, digital advertising (SMM and targeted campaigns), as well as CRM systems and big data analytics. The economic efficiency index, which had a baseline value of 1.0, is forecast to rise to 1.78 by 2030. This improvement reflects reduced costs, increased customer numbers, and enhanced service speed.

From an economic perspective, approximately 62% of the growth achieved in the previous year carries over into the subsequent year, while random factors (market conditions, demand, and logistics) account for 41% of the variation. The baseline annual growth averages 0.48 trillion UZS.

Modeling results identify the following:

- The impact of digital marketing contributes an average of 2-3% additional growth.
- The efficiency index demonstrates a consistent upward trajectory.

Forecasting results indicate the following:

- By 2030, service volumes will increase by approximately 1.7-1.8 times.
- The share of digital marketing will reach up to 15%.

In the transport sector of the Khorezm region, modeling explains the economic processes, while forecasting reveals their future trajectory. The relationship between the two is manifested in mathematical terms (through functional equations), economic terms (through mechanisms of influence), and practical terms (through decision-making). As a result, opportunities emerge for the scientific management of digital marketing and for enhancing its efficiency.

Overall, for the Khorezm region, digital marketing is expected to contribute an additional 15-20% efficiency to the transport sector under conditions of stable growth. By 2030, service volumes will approximately double, and economic efficiency will strengthen significantly. In this regard, the prospects for econometric modeling of digital marketing efficiency in the transport sector of the Khorezm region during 2026-2030 are anticipated to follow positive and stable development trends in several directions:

1) Sustained growth in service volumes: Analyses based on econometric models, particularly ARIMA and ARIMAX approaches, demonstrate that transport service volumes will continue to grow steadily. The widespread adoption of digital marketing tools (online platforms, social media marketing, targeted advertising, and CRM systems) will improve the accuracy of demand forecasting and contribute to the expansion of service volumes.

2) Strengthened customer engagement: Digital marketing enhances direct interaction with customers, thereby increasing demand for transport services. Econometric modeling results suggest that this factor may add an additional 2-3% to annual growth rates. Consequently, by 2030, transport service volumes are projected to rise by nearly 1.7-1.8 times.

3) Reduction of operational costs: The application of digital technologies facilitates the optimization of logistics processes, automation of routes, and efficient resource utilization through real-time monitoring systems. This contributes to the year-on-year increase in the economic efficiency index.

4) Risk assessment and uncertainty management: Econometric models provide the ability to anticipate risks and uncertainties, thereby creating a valuable information base for strategic decision-making in transport enterprises. The presence of confidence intervals in forecasts further enhances risk management practices.

5) Enhanced competitiveness through integration: The integration of digital marketing strengthens the competitiveness of transport services. The development of regional logistics systems and their integration with e-commerce platforms will expand the service market.

Thus, during 2026-2030, managing digital marketing in the transport sector of the Khorezm region on the basis of econometric modeling will ensure sustainable economic growth, significantly increase service volumes, optimize costs, and elevate overall efficiency. As a result, this direction is expected to become one of the key drivers of the regional economy.

Modeling identifies:

- The impact of digital marketing, contributing an average of 2-3% growth;
- The consistent increase in the efficiency index.

Forecasting demonstrates:

- By 2030, service volumes will rise by approximately 1.7-1.8 times;

- The share of digital marketing will reach 15%.

In the Khorezm region's transport sector, modeling explains the economic process, while forecasting illustrates its future state.

The interrelationship between modeling and forecasting is manifested in three dimensions: mathematically (through functional equations), economically (through mechanisms of influence), and practically (through decision-making). As a result, opportunities are created for the scientific management of digital marketing and for enhancing its efficiency.

In conclusion, in the regional transport sector, econometric modeling plays a crucial role in evaluating and forecasting the economic efficiency of digital marketing. These methods enable the identification of key factors, the assessment of their impact, and the delineation of future development trends. For digital marketing to be implemented effectively, it is essential to develop infrastructure, adopt innovative technologies, and attract investment. Thus, digital marketing serves as a vital instrument for increasing economic efficiency, improving service quality, and meeting customer demand in the transport sector.

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DIRECTIONS FOR STIMULATING THE IMPLEMENTATION OF ECOLOGICAL INNOVATIONS IN THE REGION

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ABSTRACT

This article analyzes the theoretical and practical aspects of stimulating the implementation of ecological innovations in the region. The study identifies the role of ecological innovations in the regional economy, the factors influencing their development, and existing challenges. In addition, economic, institutional, and financial mechanisms that support the implementation of ecological technologies are examined, and proposals for their improvement are developed. The results show that promoting ecological innovations plays a crucial role in ensuring sustainable regional development, efficient use of resources, and environmental protection. The recommendations proposed in the article contribute to improving the effectiveness of regional policy.

Keywords: *Ecological Innovations, Sustainable Development, Green Economy, Regional Economy, Ecological Technologies, Resource Efficiency, Environmental Protection, Innovation Policy, Environmental Management, Green Investments*

Introduction.

In recent years, the intensification of global environmental problems, including climate change, depletion of natural resources, and environmental pollution, has necessitated a reconsideration of the economic development model. In this context, the implementation of ecological innovations is recognized as an important factor in ensuring sustainable development of the regional economy [1]. Ecological innovations contribute to the rational use of resources in production processes, reduction of waste, and improvement of energy efficiency, thereby ensuring a balance between economic and environmental interests [2].

In Uzbekistan, ensuring environmental sustainability is also one of the priority directions of state policy. In particular, the Presidential Decree No. PF-60 emphasizes the introduction of green economy principles, the widespread use of energy-saving technologies, and the protection of the environment [3]. At the same time, the level of implementation of ecological innovations varies across regions, depending on their economic development level, investment attractiveness, and institutional environment.

This article analyzes the directions for stimulating the implementation of ecological innovations in the region. The main objective of the study is to identify the factors hindering the development of ecological innovations in the regions and to develop effective mechanisms to overcome them. Furthermore, based on international experience, economic, financial, and institutional tools for supporting ecological innovations are examined, and their adaptation to regional conditions is substantiated [4].

The results of the study contribute to increasing the efficiency of implementing ecological innovations in regions, accelerating the transition to a green economy, and improving sustainable development indicators.

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Literature Review.

The issue of developing ecological innovations has been widely discussed in both international and local scientific literature, emphasizing their role in economic growth, efficient use of resources, and environmental protection. In particular, the studies of René Kemp and Peter Pearson consider ecological innovations as a key instrument for “greening” the economic system [5]. According to them, ecological innovations not only reduce environmental problems but also enhance economic efficiency by creating new markets and employment opportunities.

According to the theory of “competitive advantage” developed by Michael E. Porter, strengthening environmental standards encourages firms to innovate, thereby increasing their competitiveness in international markets [6]. This approach substantiates the positive relationship between environmental policy and economic performance.

Reports by the Organisation for Economic Co-operation and Development emphasize the crucial role of the state in promoting ecological innovations. In particular, it is noted that innovation activity can be stimulated through tax incentives, subsidies, and support for green investments [1]. At the same time, studies by the World Bank highlight that in developing countries, the lack of financial resources and institutional constraints remain the main barriers to the implementation of ecological innovations [2].

Research conducted by local scholars also stresses the importance of linking ecological innovations with regional development. For instance, A. Vahobov emphasizes that efficient use of regional resources and the development of innovative infrastructure are key factors in the transition to a green economy [7].

Overall, the reviewed literature indicates that state policy, institutional environment, and financial support mechanisms play a decisive role in the development of ecological innovations.

Research Methodology.

This study employs a systematic and comprehensive approach to examine the implementation of ecological innovations in the region. Methods such as analysis and synthesis, comparison, as well as statistical and economic analysis were applied during the research process. Furthermore, an empirical analysis was conducted to identify the relationship between regional development indicators, the level of ecological innovation implementation, and their economic efficiency. Advanced international practices were studied, generalized, and adapted to regional conditions. The findings were substantiated using graphical and tabular methods, and conclusions were formulated on a scientific basis.

Analysis and Results.

A comprehensive analysis of the processes of implementing ecological innovations in the region shows that in recent years a transition toward “green development” principles has been emerging in the regional economy. However, the effectiveness of this process is not uniform across regions. In areas with developed infrastructure, ecological innovations are being actively implemented, while in regions with limited resource bases or insufficiently developed institutional environments, the process remains slow. This indicates the need for a differentiated approach to stimulating ecological innovations.

The analysis reveals that the level of implementation of ecological innovations largely depends on investment activity, research and development capacity, and government support mechanisms. In particular, significant progress is observed in the use of renewable energy sources, the introduction of waste recycling

technologies, and the application of water-saving technologies. Nevertheless, this growth is mainly characteristic of large industrial centers and regions with high investment attractiveness.

The role of economic incentive mechanisms in promoting ecological innovations is especially important. Regions where tax incentives, subsidies, government grants, and preferential loans are available demonstrate a significantly higher level of adoption of ecological technologies. At the same time, projects implemented through public-private partnerships serve as an effective tool for expanding ecological innovations.

Furthermore, the practice of attracting resources through “green” financing instruments, including green bonds and environmental funds, is becoming increasingly widespread. Such financial instruments not only support large-scale projects but also expand opportunities for small and medium-sized enterprises to adopt ecological innovations. In addition, carbon credit markets and emission reduction mechanisms economically motivate enterprises to improve environmental efficiency. The analysis shows that the effective use of economic incentives reduces investment risks, increases the profitability of innovative projects, and ultimately contributes to the wider adoption of ecological innovations.

The table below summarizes the main factors influencing the level of implementation of ecological innovations in the region and their impact on economic efficiency.

Table 1. Factors Influencing the Implementation of Ecological Innovations and Their Impact on Efficiency

Factors	Direction of Impact	Economic Outcome
Investment volume	Direct	Introduction of new technologies
Innovation infrastructure	Indirect	Increased production efficiency
Government support	Strong	Reduction of operational costs
Human capital capacity	Sustainable	Intensification of innovation activity
Digital technologies	Accelerating	Efficient use of resources
Environmental policies and regulations	Incentive-driven	Reduction of environmental damage

Source: Developed by the author

The table data indicate that investment and government policy are decisive factors in the development of ecological innovations. In particular, the availability of financial support mechanisms encourages enterprises to adopt environmentally friendly technologies. At the same time, the development of innovation infrastructure contributes to increasing production efficiency.

According to empirical analysis, there is a positive correlation between the level of ecological innovation implementation and regional economic development indicators. In regions where ecological innovations are widely implemented, gross regional product (GRP), export volumes, and investment inflows tend to be higher. This allows ecological innovations to be considered an important driver of economic growth.

However, several challenges were also identified during the analysis. First, the sources of financing for ecological innovations are not sufficiently diversified. Second, elements of innovation infrastructure (such as technoparks, incubators, and research centers) are underdeveloped in many regions. Third, information and consulting services related to ecological innovation implementation remain weak. Fourth, enterprises still demonstrate a low level of motivation to adopt ecological innovations.

The general model for implementing ecological innovations is presented below (Figure 1).

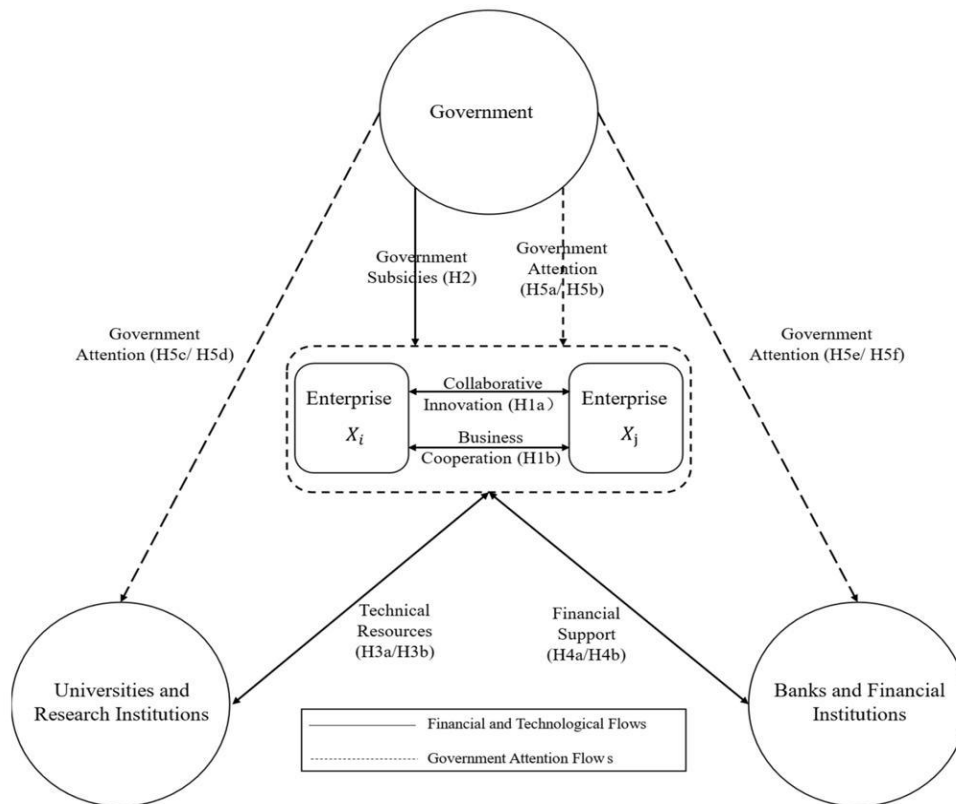


Figure 1. Comprehensive Mechanism for the Implementation of Ecological Innovations in the Region

Source: Developed by the author

The figure illustrates the key components of ecological innovation development in an interconnected system. At the center of the model are ecological innovations, surrounded by important elements such as investments, government policy, innovation infrastructure, human capital, and digital technologies. These components, when integrated, enhance the efficiency of implementing ecological innovations.

The “Government” is depicted as the central governing and stimulating actor. Its influence on enterprises is manifested in two main forms: state subsidies (H2) and government attention (H5a/H5b). These instruments support business activities and encourage their engagement in innovation processes.

At the core of the diagram, the interaction between two enterprises (Xi and Xj) is presented, highlighting collaborative innovation (H1a) and business cooperation (H1b). This interaction plays a crucial role in the

development and implementation of ecological innovations. Through information exchange, technology transfer, and experience sharing, enterprises improve overall efficiency.

The lower part of the diagram represents supporting institutions. Universities and research institutes provide technical resources (H3a/H3b), enabling the practical application of innovative ideas and scientific developments. Meanwhile, banks and financial institutions support projects through financial assistance (H4a/H4b).

Additionally, solid lines in the diagram indicate financial and technological flows, while dashed lines represent flows of government attention. Overall, this model reflects an integrated cooperation system among the government, businesses, and scientific institutions in promoting ecological innovations.

The results indicate that a comprehensive approach is necessary for the development of ecological innovations. Key priority directions include expanding green investments, developing public-private partnership mechanisms, strengthening innovation infrastructure, enhancing environmental education and human capital development, and introducing digital monitoring systems for environmental management.

The conducted analysis confirms that the implementation of ecological innovations is a crucial factor in ensuring sustainable regional economic development. Effective policy in this area not only improves environmental conditions but also enhances economic competitiveness.

Conclusion and Practical Recommendations.

The results of the study demonstrate that the implementation of ecological innovations in the region is a key factor in ensuring sustainable economic development. The widespread use of ecological technologies enables efficient resource utilization, reduction of production costs, and minimization of negative environmental impacts. At the same time, economic incentive mechanisms created by the government play a decisive role in increasing innovation activity.

In the future, it is necessary to expand the attraction of green investments, develop public-private partnerships, strengthen innovation infrastructure, and train qualified personnel to promote ecological innovations. In addition, improving environmental standards and introducing digital monitoring systems can further enhance the efficiency of this process.

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MODELING AND FORECASTING INDICATORS OF IMPROVEMENT OF REGIONAL ECONOMIC MECHANISMS OF POVERTY REDUCTION IN KHOREZM REGION

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ABSTRACT

This article presents the results of modeling and forecasting indicators of improving regional economic mechanisms for poverty reduction in the Khorezm region. It also presents a conclusion on modeling and forecasting indicators of improving regional economic mechanisms for poverty reduction in the region.

Keywords. *Poverty, Region, Poverty Reduction, Mechanism, Improvement, Indicator, Modeling, Forecasting.*

Reducing poverty as a priority for the sustainable development of the economy of the Khorezm region and increasing the well-being of the population will have promising directions. Because poverty is seen as a social and economic problem. Therefore, to reduce it, it is important to use modern economic mechanisms, including modeling and forecasting methods. Factors influencing poverty are identified through modeling and forecasting allows future changes to be predicted scientifically.

Various studies are being conducted in the region on modeling and forecasting indicators for improving regional economic mechanisms for poverty reduction. In particular, the expansion of entrepreneurship in the Khorezm region plays an important role in creating new jobs, increasing incomes of the population and reducing poverty[1]. That is, by the end of 2024, it is known that more than 8 thousand new jobs have been created through the entrepreneurship sector. This confirms the important role of entrepreneurship in ensuring social stability. Based on the research conducted, a statistical analysis of the ongoing work to reduce poverty as a result of teaching the population entrepreneurship and frugality and the further development of the standard of living of the population based on the public works system was carried out [2].

Some studies have looked at changes in poverty levels in the Khorezm region and the factors influencing this process, including economic growth, educational attainment and labor market opportunities[3]. This study mainly looks at population growth and its impact on economic opportunity. In other studies, the improvement of organizational and economic mechanisms affecting poverty reduction is based on the development of the economy of the Republic of Uzbekistan, proposals and recommendations for poverty reduction have been developed[4]. In other studies, forecast values for the growth rate of gross regional product and poverty reduction indicators for 2023-2027 were developed in the Khorezm region through the creation of multifactor econometric models [5]. According to other studies, the results of work based on the constructed models clearly show that the share of the poor population depends on other characteristics of citizens' well-being (life expectancy and unemployment rate), as well as on the migration of highly productive and promising personnel to highly profitable territories[6].

First of all, to model poverty, a system of key indicators is used, such as the level of income of the population, the unemployment rate, gross regional product (GDP), the volume of investment, the share of

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the service sector, the level of infrastructure development, education and health indicators. These indicators directly or indirectly affect the poverty level.

It should be said that when analyzing the mechanisms of poverty reduction, the following multifactor economic and mathematical models are used:

- Correlation analysis. Using this method, the degree of connection between the level of poverty and the factors influencing it is determined. For example, an increase in income leads to a decrease in poverty, and an increase in unemployment leads to an increase in poverty.

-regression model. A multivariate regression model might look like this:

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + \dots + \varepsilon \quad (1)$$

Here:

Y - poor quality;

X₁ - income of the population;

X₂ - unemployment rate;

X₃ - investments;

ε - random error.

Using this model, the level of influence of each factor is assessed.

- Index method. Integral indices are used to assess the effectiveness of poverty reduction. This method combines different indicators and forms an overall score.

However, forecasting allows one to predict poverty levels in future years. In this regard, the following forecasting methods are used:

- Extrapolation method. Based on the dynamics of past years, future trends are determined.

scenario forecast. In this regard, scenarios such as optimistic (increased investment and job growth), realistic (continuation of current trends) and pessimistic (slower economic growth) scenarios are being developed.

- Econometric forecasting. Accurate numerical forecasts are generated based on regression models.

Based on the modeling results, we believe that it is necessary to improve mechanisms in the following areas:

- Increasing employment (development of small business and entrepreneurship, creation of new jobs and vocational training);
- Attracting investments (development of industrial zones, improving infrastructure and improving the investment environment);
- Modernization of agriculture (introduction of agricultural technologies and development of the processing industry);

- Strengthening social protection (targeted social assistance and improving education and health care).

According to the modeling results, an increase in household income significantly reduces the poverty level, investment and industrial development are important factors, and the growth of the service sector provides employment.

Based on the results of the forecast for 2026-2027, if the above measures are implemented, the poverty level will gradually decrease, household incomes will increase, and economic activity will increase.

Based on the above, the following indicators were selected for modeling and forecasting indicators for improving regional economic mechanisms for poverty reduction in the Khorezm region (Table 1):

Table 1 Information on the economic indicators of the Khorezm region on poverty reduction[7]

No	Name of indicators	2021	2022	2023	2024	2025
1	Total per capita income in Khorezm region, in thousands of soums	16672,4	20535,1	21344,7	26338,7	31136
2	growth rate of total income per capita, percent	128,5	123,2	103,9	123,4	118,2
3	Poverty rate, percentage	19,9	19,1	14,1	11,9	6,7

Based on this table, the main drivers of revenue growth are shown as follows:

- Development of local production and creation of new jobs;
- Modernization of agriculture and food industry;
- Attracting investment in industry and services.

The economic mechanisms of growth are characterized by:

- Implementation of the principle of poverty reduction by increasing income;
- Support for the poor through social assistance programs and subsidy mechanisms;
- Development of small and medium-sized businesses through tax and financial incentives.

The analytical framework also demonstrates the following results:

- The forecast model is built using exponential growth and linear regression;
- Income is shown with an annual growth rate of 16.6%;
- Poverty level is inversely proportional to income: as income increases, poverty decreases.

In our opinion, by 2027, if regional economic mechanisms work effectively, poverty in the Khorezm region will practically disappear. Per capita income will increase significantly, which will ensure economic stability and social well-being. This forecast can be used as a key indicator in assessing the effectiveness of regional policies and investment strategies.

Regarding the choice of econometric model, a revenue volume model was created. Here, total per capita income (Y) depends on time. In this regard, you can use a simple exponential growth model in the following form:

$$Y_t = Y_0 \cdot (1+g)^t \quad (2)$$

Here:

Y_t - t annual income, thousand soums;

Y_0 - initial income (2021 year);

g - average annual growth rate;

t - The year is calculated from 2021

Let's calculate the average annual growth rate:

$$g = (Y_{2025}/Y_{2021})^{1/4} - 1 \quad (3)$$

$$g = (31136/16672,4)^{0.25} - 1$$

Let's calculate this and display the results:

$$31136/16672,4 \approx 1,867$$

$$1,867^{0.25} \approx 1,166$$

$$g \approx 0,166 \Rightarrow 16,6\%$$

So the revenue model looked like this:

$$Y_t = 16\,672,4 \cdot (1+0,166)^t \quad (4)$$

Here:

$$t = 0, 1, 2, 3, \dots, Y$$

Also interpreting the poverty rate model, the poverty rate (P) decreases with increasing income. In this regard, a simple regression model has the following form:

$$P_t = \alpha - \beta Y_t \quad (5)$$

Here:

P_t - percentage of poor;

Y_t - per capita income;

α, β - options.

Using simple linear regression, the results were as follows:

$$\beta = \Delta P / \Delta Y \approx (19,9 - 6,7) / (31136 - 16672,4) \approx 13,2 / 14463,6 \approx 0,00091$$

$$\alpha = P_0 + \beta Y_0 = 19,9 + 0,00091 \cdot 16672,4 \approx 19,9 + 15,2 \approx 35,1$$

Thus, the poverty level model took the following form:

$$P_t = 35,1 - 0,00091 \cdot Y_t \quad (6)$$

1) Based on this, the forecast results for 2026-2027 were calculated as follows:

2) Revenue forecasting:

$$Y_{2026} = 16\,672,4 \cdot 1,166^5$$

$$1,166^5 \approx 2,12$$

$$Y_{2026} \approx 16\,672,4 \cdot 2,12 \approx 35\,333 \text{ thousand soums}$$

$$Y_{2027} = 16\,672,4 \cdot 1,166^6 \approx 16\,672,4 \cdot 2,47 \approx 41\,160 \text{ thousand soums}$$

2) Poverty level forecasting:

$$P_{2026} = 35,1 - 0,00091 \cdot 35\,333 \approx 35,1 - 32,1 \approx 3,0 \%$$

$$P_{2027} = 35,1 - 0,00091 \cdot 41\,160 \approx 35,1 - 37,5 \approx -2,4\% \approx 0 \%$$

The poverty level here cannot be negative. Therefore, we assume that there will be virtually no poverty rate in 2027 (0-1%).

The results will have the following table (Table 2).

Table 2 Estimated forecast values until 2027 of indicators for improving regional economic mechanisms for reducing poverty in the Khorezm region¹

Year	Per capita income, thousand soums (Y)	Poverty rate, percentage (P)
2026	35333	3,0
2027	41160	0

In our opinion, based on data for 2021-2025, per capita income will increase by 16.6% annually. Poverty rates have fallen significantly with rising incomes and will virtually disappear in 2027. The models will look like this:

- revenue volume: $Y_t = 16\,672,4 \cdot (1 + 0,166)^t$

- poverty level: $P_t = 35,1 - 0,00091 \cdot Y^t$

This economic forecast is based on exponential growth and linear regression. This takes into account other real life factors (inflation, jobs and economic policy).

It is concluded that for the effective organization of poverty reduction in the Khorezm region, it is important to model and predict economic mechanisms on a scientific basis. This process allows us to identify the main factors influencing poverty, assess the level of their impact and determine future development trends. In addition, an integrated approach can help increase employment, attract investment,

¹ Author's development

develop infrastructure and strengthen social protection, thereby reducing poverty in a sustainable manner. Thus, policy formation based on the results of modeling and forecasting ensures sustainable socio-economic development of the region and serves to improve the well-being of the population.

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**Management is
nothing more than
motivating other
people.**

Lee Iacocca



WAYS TO INCREASE PRODUCTION COMPETITIVENESS IN TEXTILE ENTERPRISES

Xushvaqtoy Shuxrat Abduraufovich¹

ABSTRACT

This article presents a comprehensive study of the theoretical and methodological foundations, as well as practical directions for enhancing production competitiveness in textile enterprises. It explains the essence of the concept of competitiveness from the perspective of industrial economics and provides a scientific analysis of the key factors that shape it, including resource utilization efficiency, technological level, product quality, cost structure, and adaptability to market demand.

At the same time, the current state of production processes in textile enterprises is assessed, and several issues in the industry are identified, such as technological inertia, a low level of participation in the value chain, and insufficient innovative activity.

During the research, based on comparative and system analysis methods, the experience of developed countries was studied, and opportunities for adapting these practices to national conditions were substantiated.

Key words: *Textile Industry, Production Competitiveness, Technological Modernization, Resource Efficiency, Value Chain, Innovative Development, Automation, Product Quality, Export Potential, Industrial Efficiency, Cost Optimization, Strategic Management*

INTRODUCTION

The textile industry is considered one of the strategically important sectors in the global economy in terms of creating high value added, ensuring employment, and generating export revenues. In particular, in countries rich in resources and with high labor potential, this sector serves as a driving force accelerating industrialization processes. In the context of Uzbekistan, the textile industry is also developing as a priority sector based on the cotton raw material base and having the potential to deepen the value chain through increasing the level of domestic processing. However, in the context of operating in a global competitive environment, ensuring production competitiveness and continuously improving it remains an increasingly urgent issue for enterprises in the sector.

In recent years, competition in the global textile market has evolved into a complex system based not only on cheap labor or raw material advantages, but also on multi-factor criteria such as technological advancement, product quality, efficiency of production processes, perfection of logistics chains, and rapid adaptability to market demands. This requires textile enterprises to abandon traditional production models and develop innovative, resource-efficient, and high value-added production systems based on modern technologies. From this perspective, the concept of production competitiveness should be assessed not only through product cost or volume, but also through a set of indicators such as technological depth, position in the value chain, efficiency of resource utilization, and ability to respond to market requirements.

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The reforms being implemented in the textile industry of Uzbekistan are aimed at transforming the sector from a raw material supplier into a high value-added industry exporting finished products. However, practice shows that several enterprises face limitations in production competitiveness due to insufficient technological modernization, inefficient use of production capacities, low level of innovation activity, high resource consumption, and limited adaptability to external market demands. At the same time, participation in the lower segments of the value chain also leads to insufficient formation of added value in the sector.

These conditions create the need to reconsider the improvement of production competitiveness in textile enterprises on a systematic, scientifically based, and integrated approach. In this regard, priority should be given to issues such as modernization of production processes, introduction of innovative technologies, efficient use of resources, deepening of the value chain, and raising product quality to international standards. In addition, improving internal management mechanisms and production organization systems of enterprises is also one of the important tasks for increasing economic efficiency. In order to address the problems in improving the economic efficiency of textile enterprises in our country and enhancing their development strategies, the main indicators of textile industries in developed countries were analyzed, the cluster model of industry development was improved, and through comparative and synthesis analysis, priority directions for enterprise development were substantiated.

RESULTS AND DISCUSSIONS

In assessing production competitiveness in textile industry enterprises, first of all, the sector's resource utilization efficiency, level of technological equipment, share of participation in the value chain, and product quality indicators were systematically analyzed. The conducted analyses show that in most enterprises, the utilization rate of production capacities is around 60–70%, which indicates that available resources are not being fully utilized. In some enterprises, the physical and moral depreciation of fixed assets has reached 40–50%, which is one of the main factors reducing technological efficiency.

The analysis also revealed that the share of raw materials and energy consumption in production costs is high, in some cases accounting for 65–70% of the total cost. This indicates the necessity of introducing resource-efficient technologies and optimizing production processes. At the same time, labor productivity indicators were found to be on average 1.8–2.2 times lower than in the textile industry of developed countries, which negatively affects production competitiveness.

Value chain analysis shows that many enterprises mainly participate in the production stages of raw materials and semi-finished products, while the share of finished products remains relatively low. As a result, the level of added value is limited, and a significant portion of export revenues is generated in low-margin segments. In this regard, it was found that improving production competitiveness is closely linked to deepening the value chain and increasing the share of finished product manufacturing by at least 1.5 times.

From a technological perspective, the level of automation and digitalization varies across enterprises: in large enterprises, the share of modern equipment is 55–60%, while in small and medium-sized enterprises this indicator does not exceed 30–35%. This leads to differences in production efficiency and product quality. In addition, due to low innovation activity, the development of new product types and their introduction to the market remains limited.

The issue of improving production competitiveness in textile enterprises should not be considered within the influence of individual factors, but rather as a system of interrelated economic processes. Practice shows that factors such as resource supply, energy consumption, labor productivity, and capacity utilization

do not act independently, but rather through a complex mechanism that interacts and forms resultant indicators. Therefore, when developing measures aimed at improving production efficiency, it is important to systematically analyze the interaction of these factors and their transformation into economic outcomes.

In particular, in the textile industry, cost structure, continuity of technological processes, and the level of participation in the value chain are considered decisive criteria determining production competitiveness. In this context, a deep analysis of cost-forming elements, optimization of resource consumption, and efficient use of production capacities create opportunities to activate the enterprise’s internal economic mechanisms.

From this perspective, it is advisable to consider the process of improving production competitiveness in textile enterprises based on the interrelationship between factors, economic mechanisms, and outcomes. The model presented below systematically reflects the logical sequence of this process, namely the transformation of initial influencing factors into economic mechanisms and the resulting performance indicators achieved through them (Figure 1).

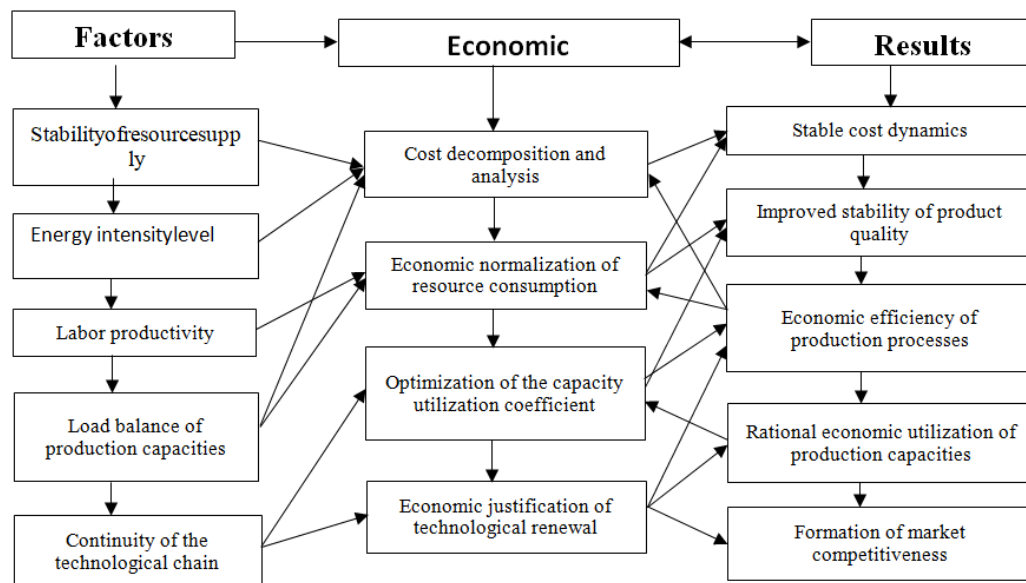


Figure 1. Economic mechanism for improving production competitiveness¹

This conceptual model clearly illustrates that the process of ensuring production competitiveness in textile enterprises is formed on the basis of a factor–economic mechanism–outcome chain. As shown in the model, initial factors such as the stability of resource supply, energy intensity level, labor productivity, and continuity of the technological chain directly influence the structure of production costs and the efficiency of resource utilization. In turn, this contributes to activating internal economic mechanisms through cost decomposition, economic normalization of resource consumption, and optimization of capacity utilization coefficients.

Under the influence of these mechanisms, technological renewal of production processes is ensured, creating opportunities for achieving cost stability in enterprises, continuously improving product quality, and

¹Author’s development.

increasing production efficiency. At the same time, rational use of capacities allows for optimization of production volumes and expansion of product supply in accordance with market demand.

As a result, the system of economic interrelations reflected in the model shows that the formation of production competitiveness in textile enterprises depends not only on individual factors, but also on their integrated management. This, in turn, justifies the need to ensure a balance between resource utilization efficiency, technological renewal, and market adaptability when making strategic management decisions at enterprises.

The assessment of production potential of textile industry enterprises and its dynamic changes serves as an important analytical basis for determining the competitiveness of the sector. In particular, changes in production volumes by product types, their growth rates, and structural shifts provide an opportunity to deeply understand structural transformation processes within the industry. This, in turn, helps identify which segments of the value chain are experiencing growth and which areas are facing efficiency constraints.

In recent years, the process of gradual transition from raw material processing to finished product manufacturing in the textile industry has intensified, ensuring structural diversification of production volumes. At the same time, differences in growth rates across product types are directly linked to technological capabilities, investment activity, and the level of adaptation to external market demands. This indicates that ensuring production competitiveness in the sector requires not a uniform approach, but differentiated strategies by product segments.

From this perspective, analyzing the long-term dynamics of production volumes of key product types by textile enterprises is of great importance for identifying development trends in the sector, assessing internal reserves, and making strategic decisions. The table below presents the changes in production volumes of major product types over the period 2018–2024.

Table 1 Production volumes of main product assortments by textile enterprises (2018–2024)

№	Product type	Unit of measurement	2018	2019	2020	2021	2022	2023	2024
1.	Production volume	trillion soums	32,6	39,1	47,1	66,0	80,0	93,5	97,4
2.	Production volume growth dynamics	%	106,3	106,2	114,8	119,3	108,7	108,1	112,5
3.	Yarn	thousand tons	442,9	608,2	754,3	835,0	908,6	925	986
4.	Fabric	mln.m ²	462,8	625,0	812,5	1056,0	814,2	825,5	899,4
5.	Knitwear products	mln.pieces	4621,8	6411,2	8388,1	11109,1	11200,2	11800	12500
6.	Knitted fabric	thousand tons	89,9	142,3	227,4	300,2	242,3	265,4	289,6
7.	Sewing (garment) products	million pieces	416,0	559,8	712,2	1011,3	2324,1	2423,2	2542,3
8.	Hosiery products	million pairs	98,4	162,9	229,9	309,3	461,4	480,1	505,4

The analysis of the table data shows that a stable growth trend in production volumes has been formed in the textile industry, which indicates that the production competitiveness of enterprises in the sector is being gradually strengthened. In particular, the increase in total production volume from 32.6 trillion soums in 2018 to 97.4 trillion soums in 2024 (almost a threefold growth) reflects the expansion of production capacities, increased investment activity, and improved adaptability to market demands. This situation demonstrates the formation of volume-based advantages, which is one of the key criteria of competitiveness.

The production growth dynamics, ranging between 106% and 119%, indicate that the sector is experiencing a relatively stable intensive development trend rather than extensive growth. At the same time, the slowdown in growth rates in certain years (2022–2023) reflects the presence of competitive pressures related to external market conditions, logistics constraints, and resource factors.

A product assortment analysis shows that the increase in yarn production from 442.9 thousand tons to 986 thousand tons reflects a strengthened raw material base in the sector. However, since this segment has relatively low added value, it cannot be considered a key source of competitiveness. In contrast, the rapid growth of knitwear and garment production (ranging from 2.7 to 6 times) indicates an accelerating shift toward high value-added segments. This is considered a decisive factor for increasing competitiveness in international markets.

The relative decline observed in fabric production after 2021, followed by a recovery phase, indicates the presence of technological and market adaptation challenges in the sector. This situation further emphasizes the importance of technological renewal and product diversification in ensuring production competitiveness. At the same time, the stable growth in the hosiery and knitwear segments reflects strong demand in both domestic and international markets and the formation of competitive advantages in these areas.

Overall, the results of the analysis show that production competitiveness in the textile industry is mainly formed through deepening the value chain, increasing the share of finished products, and ensuring product diversification. At the same time, it is substantiated that further strengthening competitiveness requires accelerating technological modernization, improving production efficiency, and expanding participation in high-margin segments.

CONCLUSION

The conducted analyses show that production competitiveness in textile industry enterprises is a multifactorial and systemic process. In particular, the steady growth of production volumes in the sector, the increasing share of high value-added products in certain segments, and the expansion of export directions are assessed as positive trends. At the same time, several challenges—such as insufficient technological equipment, low efficiency of resource utilization, the dominance of lower stages in the value chain, and limited adaptability to external market demands—are hindering the full realization of production competitiveness.

Based on the research results, the following scientific and practical conclusions are formulated:

First, ensuring competitiveness in textile enterprises is achieved not merely by increasing production volumes, but through deepening the value chain and increasing product value.

Second, production efficiency is directly dependent on the balance between resource utilization, technological renewal, and labor productivity.

Third, increasing the share of finished products in the sector is a decisive condition for competitiveness, through which sustainable growth of export revenues is ensured.

Fourth, the digitalization and automation of production processes are key factors in reducing costs and stabilizing product quality in enterprises.

Based on the above conclusions, the following recommendations are proposed:

- To accelerate technological modernization processes in textile enterprises and increase labor productivity through the introduction of modern automated equipment;
- To reduce production costs by widely applying resource-saving and energy-efficient technologies;
- To increase the share of finished product manufacturing and encourage a shift toward high-margin segments in order to deepen the value chain;
- To strengthen competitiveness in foreign markets by improving product quality to international standards and enhancing certification systems;
- To implement measures aimed at diversifying marketing and export strategies, entering new market segments, and developing national brands;
- To increase innovation activity in the sector and introduce new product types through the integration of research activities with production.

In general, the implementation of the proposed measures will contribute to the sustainable improvement of production competitiveness in textile industry enterprises, enhance the economic efficiency of the sector, and strengthen its strategic importance in the national economy.

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TECHNOLOGIES IN THE SUSTAINABLE DEVELOPMENT OF RAILWAY TRANSPORT

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ABSTRACT

This article examines the organizational and economic mechanisms for implementing “green” technologies and environmental innovations in the sustainable development of the railway transport system. Existing environmental challenges in the sector—particularly the obsolescence of the rolling stock and the high level of carbon emissions—are systematically analyzed. Within the framework of the study, scientifically grounded proposals are put forward for the development of the “Green Rail Initiative” strategy aimed at transforming transport infrastructure, as well as for the establishment of an integrated “Energy+ESG” assessment platform. Furthermore, the economic and environmental efficiency of reorganizing railway nodes based on the “green cluster” model is substantiated. The findings contribute to enhancing the sector’s position in international ESG rankings and ensuring sustainable economic growth.

Keywords: *Green Economy, Railway Transport, Environmental Innovations, Organizational And Economic Mechanism, ESG Standards, Decarbonization, Green Cluster, Energy Efficiency, Sustainable Development.*

Introduction. In the context of global climate change and the deterioration of the environmental situation, the transformation of the transport system has become an urgent and strategically significant issue. A substantial share of harmful emissions released into the atmosphere worldwide is attributable to the transport sector. Although railway transport is considered more environmentally friendly compared to other modes of transportation, there remains a critical need to optimize energy consumption and accelerate the transition to renewable energy sources within the industry.

As a core component of national infrastructure, the railway transport system not only ensures macroeconomic stability but also serves as a key guarantor of environmental security. Under current conditions of resource scarcity and growing global ecological imbalances, there is an increasing imperative to conceptually reassess the development of the transport sector. In this regard, the paradigms of the “green economy” and “eco-innovation” are recognized as fundamental determinants and integral components of the sector’s long-term development strategy.

Literature Review. The analysis of scientific sources demonstrates that the concept of the “green economy” extends beyond the mere function of environmental protection and represents a comprehensive methodological approach aimed at ensuring synergy between economic efficiency and environmental sustainability. This concept necessitates the transformation of transport infrastructure based on the principles of energy efficiency, low-carbon technologies, and the rational utilization of renewable energy sources.

Environmental innovations should be understood not solely as technological advancements, but as a complex of organizational, managerial, and financial solutions that generate long-term ecological benefits within the sector. In the context of railway transport, the process of “green” transformation is not limited to

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the development of energy-efficient locomotive fleets; it also requires the systematic implementation of energy management systems, corporate ESG (Environmental, Social, and Governance) ratings, and project life-cycle assessment (LCA) methodologies.

Within the framework of the sustainable transport concept, railway transport is regarded as a high-efficiency ecosystem. Principles such as energy conservation, emission reduction, and the rational use of natural resources are becoming central to the sector's development agenda. It is well established that environmental efficiency depends not only on technical modernization but also directly on the level of strategic management competence and the institutional maturity of the investment environment. According to Michael Porter's hypothesis of "innovative competitiveness," the tightening of environmental standards and the adoption of new technologies strengthen firms' market positions and foster "green competitiveness." In the railway sector, such approaches enable enhanced competitiveness through emission reduction, expansion of electrified networks, and the use of low-carbon materials in construction processes.

Our observations indicate that the institutionalization of "green" approaches in Uzbekistan's railway transport system is still at an early stage of development. Nevertheless, the growing volume of investments in infrastructure projects and the intensification of cooperation with international financial institutions are creating a solid foundation for the practical implementation of environmental innovations. In this context, the improvement of the regulatory framework and the enhancement of multidisciplinary human capital are of decisive importance.

Research Methodology. This study employs a combination of системли (systems-based) approach, comparative analysis, logical generalization, and economic-statistical modeling methods. Within the research framework, environmental and economic barriers in railway transport were classified based on the criteria presented in Table 1. Furthermore, the organizational and economic mechanism for the implementation of "green" technologies was modeled through the prism of internal and external environmental blocks. The potential economic efficiency outcomes associated with the adoption of the "green cluster" model—particularly a projected reduction in energy consumption by 15–20%—were estimated using the extrapolation method.

Analysis and Results. Contemporary global development trajectories unequivocally demonstrate that the integration of "green" technologies and environmental innovations should not be interpreted merely as a reactive response to climate-related risks; rather, it constitutes a strategic driver that underpins the operational resilience, resource efficiency, and alignment of the transport sector with international standards. In the context of Uzbekistan's railway transport system, reforms in this domain have acquired pronounced institutional significance; however, a range of persistent systemic constraints and disruptive factors continue to impede their full-scale practical realization and transformative impact.

Beyond their apparent manifestations, these challenges necessitate a deeper analytical inquiry into their underlying determinants through both retrospective and prospective lenses. Such an approach reveals that the sustainable advancement of the sector cannot be achieved through fragmented measures, but instead requires the adoption of a holistic, integrated, and system-oriented framework aimed at structural modernization and long-term efficiency enhancement.

Table 1 Analysis of Systemic Barriers in the Process of Railway Transport Greening and Their Strategic Implications¹

№	Problem	Economic impact	Environmental damage	Strategic implication
1.	Obsolete diesel locomotives	High fuel costs, short maintenance cycles	Increased emissions of CO ₂ , NO _x , and PM2.5	Contribution to climate change and decline in international environmental rankings
2.	Non-electrified railway network	High energy import costs, operating expenses up to 40% higher	Increased air pollution and additional environmental burden	Growth of overall carbon footprint and negative impact on public health
3.	Insufficient development of eco-park technologies	Underutilization of innovation potential, low transport efficiency	Deterioration of air quality due to prolonged use of polluting equipment	Failure to achieve sustainable development goals
4.	Absence of financial and organizational mechanisms	Economic losses, lack of external investors	Increase in pollution due to the non-implementation of energy-efficient projects	Lagging behind in the process of ecological transition
5.	Absence of environmental assessment practices in projects	Allocation of funds to high-risk projects, misallocation of resources	Direct impact on ecosystems, pollution of soil and water resources	Inability to forecast environmental risks in advance
6.	Weak human resource capacity	Delays in the adoption of new technologies, costly retraining processes	Increased energy waste and higher emissions due to improper operation	Environmental illiteracy as a barrier to the advancement of “green” reforms
7.	Non-compliance with international standards	Limited transit and export opportunities, decline in international ratings	Emergence of “red zones” with high overall pollution levels	Risk of sanctions and isolation due to non-compliance with international agreements
8.	Weak integration of “green” mechanisms in legislation	“Lack of incentives for “green” projects, limited bank lending	Persistence of high-carbon processes due to lack of innovation	Delay in the transition to a “green” economy in state policy

Analysis and Results (continued). First, the low level of energy efficiency and the high intensity of specific carbon emissions emerge as systemic challenges within the railway transport system. This condition is largely attributable to the moral and physical obsolescence of the rolling stock particularly locomotive and wagon fleets as well as their predominant reliance on diesel-based propulsion. A significant proportion of locomotives currently in operation were manufactured during the 1980s–1990s, characterized by low energy efficiency coefficients and elevated levels of specific emissions. Consequently, the release of hazardous

¹Systematized by the author based on conducted research.

pollutants such as CO₂, NO_x, and PM_{2.5} into the atmosphere substantially exceeds established environmental standards. The fundamental underlying cause of this problem lies in the absence of a consistent and well-structured investment strategy aimed at the comprehensive modernization of the technical fleet.

Second, an asymmetric pattern of development is observed in the energy supply structure of railway infrastructure. While the level of electrification along mainline corridors has increased, a considerable share of the network continues to depend on autonomous diesel traction. This asymmetry is not solely technological in nature but is also deeply rooted in economic and institutional factors. In particular, the insufficient allocation of financial resources to railway electrification projects within state development programs significantly constrains the pace of transformation. Moreover, infrastructure planning processes have thus far failed to adequately incorporate advanced solutions such as “Smart Grid” systems and the integration of renewable energy sources, further limiting the sector’s transition toward sustainable and energy-efficient operations.

Third, barriers within the financing mechanisms for environmental innovations exhibit a systemic character. At present, the railway transport sector lacks dedicated instruments to support “green” projects, such as specialized funds, preferential subsidy schemes, or the issuance of “green” bonds. This significantly constrains the inflow of external investments, particularly from ESG-oriented investors. Moreover, the underdevelopment of the regulatory framework governing green finance impedes the comprehensive assessment of projects’ environmental and economic efficiency—specifically in terms of Net Present Value (NPV) and Internal Rate of Return (IRR). As a result, the perceived investment risks for financial institutions remain elevated, further limiting access to sustainable financing sources.

Fourth, the sectoral integration of “green” development principles within strategic planning documents remains limited. Although Uzbekistan has undertaken commitments under the Paris Agreement, the incorporation of the Sustainable Development Goals (SDGs) into railway development strategies largely retains a declarative character, lacking clearly defined indicators and actionable implementation mechanisms. In addition, the shortage of highly qualified specialists in environmental management and innovative technologies within the sector adversely affects the effectiveness of ongoing reforms and the practical realization of sustainability-oriented initiatives.

In the process of implementing “green” technologies, not only technical aspects but also the proper formation of organizational and economic mechanisms is of decisive importance. This is because reforms in this domain cannot be reduced to mere technological substitution; rather, their effectiveness depends on the coherent integration of technology with management practices, financing structures, human capital, and the broader institutional environment. To ensure a systematic and sustainable transformation, it is essential to develop a comprehensive model of an organizational and economic mechanism.

At the initial stage, it is necessary to clearly define the key stakeholders involved in this mechanism. The state, as the central coordinating authority, should formulate a national “green” transport strategy and institutionalize it through an appropriate regulatory and legal framework. At the same time, O‘zbekiston temir yo‘llari JSC, as the principal sectoral operator, is expected to play a leading role in the practical implementation of environmental innovations and energy-efficient technologies. The private sector, in turn, contributes to the economic dynamism of the process through “green” investments, technology transfer, and knowledge dissemination. Furthermore, international financial institutions such as the World Bank, Asian

Development Bank, and European Bank for Reconstruction and Development play a crucial role in project financing, ESG assessment, and the introduction of carbon analysis methodologies.

The introduction of economic instruments within the mechanism is of decisive importance for ensuring the effectiveness of “green” transformation. In particular, environmental subsidies should be applied by the state as a form of financial incentive for the adoption of “green” locomotives, energy-efficient stations, and renewable energy sources. “Green” bonds, in turn, provide an opportunity for market-based financing of infrastructure and transport projects. This approach not only facilitates capital attraction but also contributes to improving the country’s position in international environmental and sustainability rankings.

Carbon quota trading serves as an effective regulatory and economic constraint for polluting entities, functioning as a market-based instrument of environmental governance. This mechanism can be considered a foundational element for the establishment of a national carbon market, ensuring both emission reduction and improved environmental accountability across the sector.

Discussion. Within the system of organizational instruments, the establishment of a national “green” transport strategy, technological regulations, and Knowledge Transfer Centers holds a position of strategic priority. These centers should be aimed at training highly specialized professionals in such fields as environmental management, ESG verification, energy auditing, and life-cycle assessment (LCA) of projects. Our empirical observations indicate that, at present, the level of human capital and professional competencies in this direction within Uzbekistan’s transport sector remains insufficiently developed. Therefore, the development of intellectual capital and continuous professional upskilling must constitute a core element of the transformation mechanism. For effective governance and performance evaluation of the mechanism, it is advisable to model it based on internal and external functional blocks.

Internal operational blocks:

- **Technological upgrading:** Introduction of energy-efficient rolling stock and automated intelligent control systems.
- **Human capital development:** Training of multidisciplinary specialists with in-depth knowledge of environmental management and ESG standards.
- **Institutional reforms:** Improvement of the regulatory and legal framework and harmonization of national environmental standards with international requirements.

External environment blocks:

- **Investment attractiveness:** Creation of a transparent and reliable “green” financing ecosystem.
- **International environmental integration:** Improvement of national performance in terms of Sustainable Development Goals (SDGs) and global green index indicators.
- **Technology transfer:** Cross-border exchange of best practices and integration of innovative solutions at the international level.

This mechanism ensures the transition of “green” development in the railway sector from a declarative approach to a systemic, predictable, and economically justified model. Such an approach enables the transformation process to be implemented in synergy with both sectoral competitiveness and environmental security.

In the context of Uzbekistan, the ecological modernization of railway transport should not be limited to eliminating existing deficiencies; rather, it requires strategic re-engineering based on advanced innovative models. In this regard, we propose the following priority directions for system transformation:

First, the reorganization of railway networks based on the “green cluster” model is proposed. Within this framework, transport corridors are integrated into a unified ecosystem that combines technologies minimizing environmental pressure, renewable energy sources, multimodal logistics hubs, and energy-efficient infrastructure. In other words, the transport network is redefined not merely as a communication asset, but as a geoeconomic cluster encompassing innovation, education, and high-tech services. As a pilot implementation, it is recommended to apply this model along the Tashkent–Syrdarya, Navoi–Bukhara, and Andijan–Fergana corridors. According to our estimations, such a cluster-based approach enables a reduction in energy consumption by 15–20%, while also decreasing rolling stock operating costs by up to 10%.

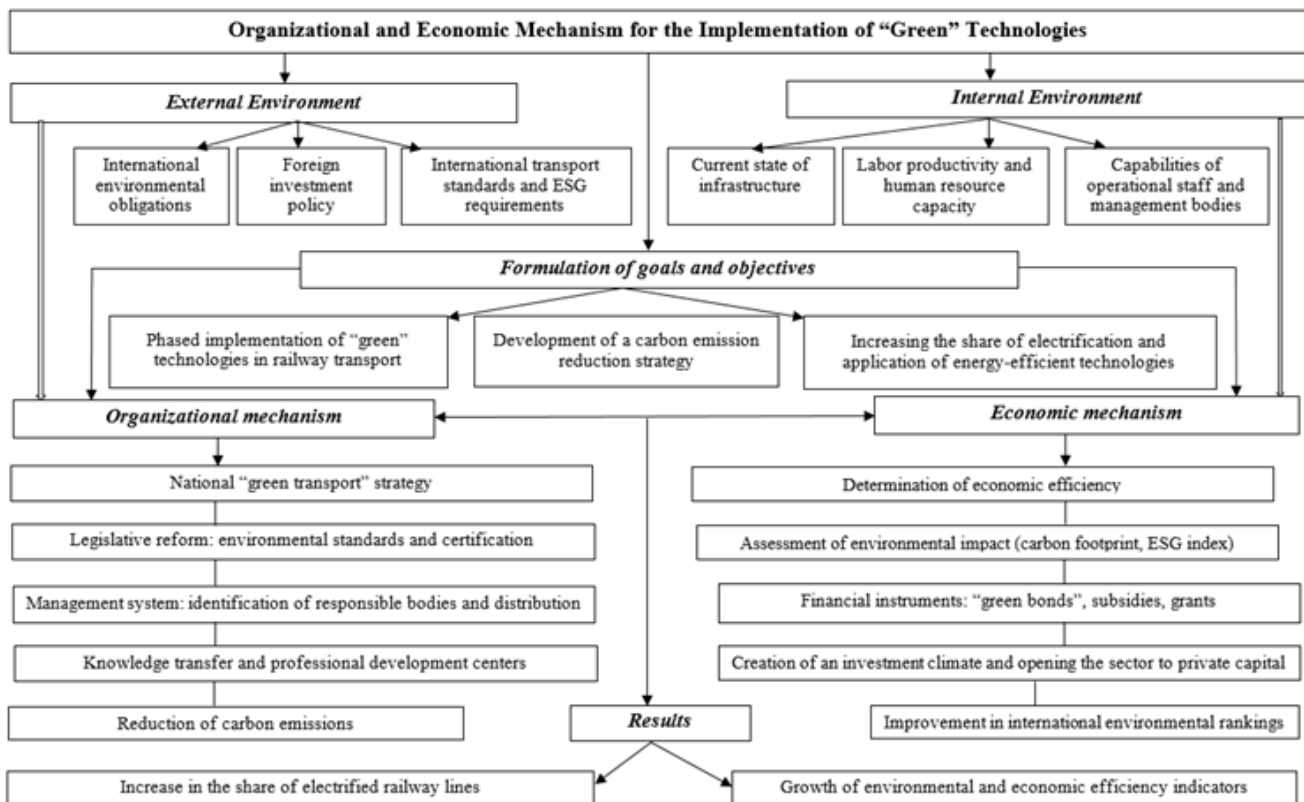


Figure 1. Multifactor Conceptual Model of the Organizational and Economic Mechanism for the Sustainable Development of the Railway Transport System²

Second, the development and institutional strengthening of a national strategic program, the “Green Rail Initiative,” is essential. This strategy should encompass comprehensive decarbonization measures covering all segments of the sector from radical modernization of the locomotive fleet to the implementation of energy-efficient construction standards and intelligent management systems. Within the framework of this strategy, the application of public–private partnership (PPP) principles is expected to ensure the optimal allocation of responsibilities and financial resources. International best practices, such as Germany’s “Green Mobility Plan,” demonstrate the effectiveness of such an approach, which is fully aligned with Uzbekistan’s national economic interests.

Third innovative proposal is the introduction of an energy audit and ESG assessment system within railway infrastructure. Through energy auditing, the energy consumption of each railway line, station, and logistics node can be identified, while potential energy-saving opportunities are calculated in a systematic manner. ESG (Environmental, Social, and Governance) standards, in turn, serve as a comprehensive framework for assessing the sustainability of projects in an integrated and multidimensional approach. Within this system, the environmental, social, and governance aspects of projects are rigorously evaluated prior to investment decisions, ensuring that their sustainability performance is clearly determined before financing is allocated. Our observations further indicate that, due to the insufficient application of ESG assessment mechanisms, the “green factor” is frequently not taken into account in many projects, resulting in suboptimal consideration of environmental sustainability criteria in investment decision-making processes.

Finally, the implementation of an Eco-KPI (Environmental Key Performance Indicator) system for each investment or infrastructure project is considered highly effective. This system enables the evaluation of projects through clearly defined measurable indicators such as carbon emission levels, energy consumption, recycling rates, and the degree of biodiversity conservation. The introduction of an Eco-KPI framework creates a mechanism for allocating financial resources to the most efficient and environmentally prioritized projects, thereby ensuring that investment decisions are guided by objective sustainability performance metrics.

In addition, empirical observations indicate that the implementation of “green” innovations is not only environmentally justified but also economically viable. Even projects that appear cost-intensive in the short term tend to demonstrate their economic efficiency over the long run through improved return on investment and reduced operational expenditures. Therefore, the models and mechanisms proposed above should be regarded not merely as practical solutions, but also as strategic, forward-looking approaches oriented toward long-term sustainability and systemic development.

The analysis of ongoing measures aimed at introducing “green” technologies in the railway transport sector reveals that current reforms are largely fragmented, localized, and episodic in nature, while a comprehensive strategic integration framework and an institutional platform capable of ensuring effective nationwide governance have yet to be fully established. This deficiency significantly constrains the implementation of a coherent and sustainable ecological development model for the sector. In particular, conventional approaches such as fleet renewal, infrastructure modernization, or locomotive replacement may yield partial improvements; however, they are insufficient to ensure long-term, systemic, and sustainable “green” transformation. This clearly highlights the necessity of complementing such measures with advanced instruments such as ESG assessment systems, energy auditing, and “green clustering” models.

At the same time, the current state of investment policy indicates the absence of a clearly defined funding allocation framework dedicated specifically to “green” infrastructure projects. This situation not only leads to the inefficient and ambiguous distribution of internal financial resources but also creates an investment environment that does not fully comply with ESG requirements for international financial institutions. In this context, the technical and economic feasibility studies (TEO) of projects also exhibit significant shortcomings, as key environmental parameters such as carbon footprint, energy-saving potential, and impact on biological resources are either largely absent or assessed in a purely formal and superficial manner. This issue should therefore be regarded as one of the critical factors excluding environmental efficiency from strategic decision-making processes.

Furthermore, the level of knowledge, skills, and professional capacity required for the implementation of new technologies remains insufficiently developed. In particular, the number of specialists in areas such as “green” energy management, ESG analysis, and ecological economics is limited, while the existing human resource base is fragmented, uncoordinated, and poorly aligned with modern requirements. Consequently, there is a strong need to introduce a new education and qualification framework based on a multidisciplinary approach, integrating management, engineering, and environmental economics into a unified training system for human capital development.

Conclusion and Recommendations. In order to ensure the effective implementation of “green” technologies in the railway transport sector, it is necessary to develop a set of practical solutions based on innovative and system-oriented approaches. First and foremost, it is proposed to implement a “Green Rail Clusters” system by reorganizing railway nodes into functionally integrated “green macro-areas” that combine renewable energy sources, logistics services, educational institutions, and service infrastructure. Such clustering would not only ensure high technological efficiency but also contribute to regional sustainability through deep integration with the local economy. It is therefore

Secondly, as an important strategic direction, it is necessary to institutionalize a comprehensive national program titled the “Green Rail Initiative” through appropriate legal and financial mechanisms. Within the framework of this program, the implementation of ESG requirements across railway networks, the introduction of “green KPI” indicators, and the development of methodologies for assessing the environmental efficiency of projects should be clearly defined as key priorities. At the same time, the active use of public–private partnership (PPP) mechanisms and the expansion of cooperation with international green financial institutions, in particular the attraction of long-term credit lines, represent crucial factors for ensuring the successful implementation of the strategy.

In addition, it is proposed to establish an integrated “Energy+ESG” assessment platform capable of providing accurate and real-time evaluation of each infrastructure object in terms of energy consumption, emission levels, and ESG performance indicators. Through this digital platform, it will become possible to conduct comprehensive monitoring of all projects, identify environmental risks at an early stage, and assess efficiency already at the feasibility study (TEO) stage. This system should be legally institutionalized as a mandatory component of strategic decision-making processes.

Furthermore, in order to conduct an in-depth assessment of the environmental efficiency of investment projects, it is necessary to introduce the “Eco-KPI” system as a mandatory requirement within state investment programs. These indicators would enable the measurement of the share of “green” technologies in the value added of a project, the volume of carbon emissions reduced, the level of energy efficiency achieved, and the degree of biodiversity productivity enhancement. Such an approach ensures the targeted,

transparent, and impact-oriented allocation of budgetary resources, while prioritizing projects with measurable environmental benefits.

In our view, the systematic and science-based implementation of “green” innovations requires the establishment of a scientific and educational cluster focused on environmental technology transfer. Such a platform should operate through cooperation between universities, O‘zbekiston temir yo‘llari JSC, and international experts, and it must be specialized in training highly qualified professionals in environmental management, ESG standards, and energy efficiency. This cluster would serve as an intellectual foundation for enhancing the innovative capacity of national railway infrastructure, ensuring technological independence, and guaranteeing long-term sustainable development.

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ENSURING POPULATION WELFARE THROUGH THE DEVELOPMENT OF THE SERVICE SECTOR

Zafar Komilovich Raximov¹

ABSTRACT

This article examines the theoretical and practical aspects of ensuring public well-being through service sector development. The information is based on the author's observations and literature review.

Keywords: *Socio-economic Policy, Population Welfare, Service Sector, Methodology, Globalization, Strategy, Human Potential, Social Services, Reform, Social Services Provision And Poverty Reduction, State Youth Policy, Sustainable Economic Growth.*

Introduction

The service sector is one of the most important and rapidly developing sectors in the modern economy. At the current stage of economic development, the share of the service sector is increasing sharply compared to production. This process indicates the transition of the economy to the post-industrial stage.

The concept of population well-being is directly related not only to the amount of income, but also to the quality of life, the level of use of services, the level of development of education, healthcare, transport and other social services. Therefore, the development of the service sector is one of the important factors in increasing the well-being of the population.

The development of the service sector is also being identified as one of the priority areas of state policy in the Republic of Uzbekistan. In recent years, the share of services in GDP has increased significantly, becoming an important driver of economic growth.

Literature review

The group of scientists has expressed their scientific views on the concepts of "Service sector" and "Population welfare" in economic literature which have been comprehensively covered in the scientific research of F. Kotler, G. Armstrong, J. Saunders, V. Wong, M. McDonald, A. Payne, O.Y. Goykhman, P.A. Samuelson, W.D. Nordhaus, C.R. McConnell, N. Gregory Mankiw, Y.A. Abdullaev, M.M. Muhammedov, M.Q. Pardayev, Q.D. Mirzayev, L.I. Galiakhmetova, Y.N. Yeremina, F.U. Tursunov [1], and others.

Research methodology

The research used methods of induction and deduction, scientific abstraction, systematic and comparative analysis, monographic and expert evaluation. These methods help to clarify the theoretical aspects of the essence, description and classification of the concept of ensuring the well-being of the population through the development of the service sector.

Analysis and results

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The service sector is a set of activities aimed at satisfying various needs of the population without creating a material product. It includes many fields such as trade, transport, communications, education, healthcare, tourism, banking, and financial services.

According to scientific research, the service sector:

- Constitutes a significant part of the gross domestic product (GDP);
- Ensures economic diversification;
- Increases population employment;
- Strengthens economic stability.

Additionally, the service sector is the main driver of a post-industrial society and is closely related to innovations and digital technologies.

Thus, the service sector is one of the most effectively developing branches of the modern economy, where not only the use by consumers is growing but also the number of people employed in this sector is increasing (Table 1).

Table 1. Number of employed population in the service sector in the Republic of Uzbekistan

№.	Indicators	2020	2021	2022	2023	2024	In 2024 compared to 2020	
							+;-	%
1.	Number of people employed in the service sector (million people)	6,5	6,9	7,3	7,6	7,9	1,4	121,5
2.	Share in total employment	42,0	44,0	48,0	52,0	55,4	13,4	131,9

Analysis of the data in the table above shows that the number of people employed in the service sector in 2024 compared to 2020 amounted to 1.4 million people, an increase of 121.5%. The share of this indicator in total employment in our republic amounted to 13.4% in 2024 compared to 2020, an increase of 131.9% in five years.

From such changes, it is worth noting that the service sector also plays a significant role in ensuring the well-being of the population. It is known that the service sector is sharply distinguished by its types from the sectors of material production. In particular, there are such types of services that have a sharp impact on the way of life and development of a person. Examples of these include education, medicine, nutrition, sports, etc. Such services are necessary for human life and affect their labor efficiency.

Therefore, in the context of the global economy, developed and developing countries pay special attention to human health and science, giving these sectors priority over others. Despite efforts to ensure the well-being of the population in countries such as Niger, Chad and Haiti, the development of agriculture,

industry and services is slow due to droughts, earthquakes and storms as a result of natural and climatic conditions [1].

Norway, which has a high population welfare index globally, has rich resources (oil and gas), but most importantly, it manages this wealth correctly. Taxes are high, but in return, people receive free or very cheap healthcare and education. That is, the state returns the money to the population in the form of services [2].

The economy is very stable in Switzerland. The banking system is strong, there are many jobs, and salaries are high. Interestingly, order and trust are very high. People obey the laws, there is almost no corruption, so the entire system works well [3].

The secret of welfare is strong industry and technology in Germany. Mechanical engineering, exports, and innovations form the basis of the economy. As a result, people have stable jobs, and the social protection system is also strong [4].

Singapore has almost no natural resources, but its management is highly effective. The government maintains strict order, prevents corruption, and pays great attention to education and technology. As a result, a highly developed economy has emerged [5].

The work is being done in several major directions to improve the welfare of the population in our country. This is not just a single measure, but a combination of several systemic reforms. For example, as a result of implementing reforms such as creating new jobs, supporting small businesses and entrepreneurship, strengthening the social protection system, developing education and healthcare, developing regions (rural areas and provinces), improving infrastructure, and executing the long-term strategy "Uzbekistan 2030", the welfare of the population is being effectively ensured.

Conclusion

The ensuring the well-being of the population through the development of the service sector is one of the most important directions of Uzbekistan's economic policy today in conclusion. Because in the modern economy, it is the service sector that creates the most jobs, is economical, and quickly increases the income of the population and accelerates economic growth.

Simply put, the development of the service sector increases opportunities for people. For example, if trade, transport, tourism, IT services or household services expand, new jobs will automatically be created. This will increase the employment of the population and increase sources of income. As a result, the standard of living of the population will improve.

At the same time, the service sector also "activates" other sectors. For example, trade and logistics are needed to sell manufactured products, and transport and hotel services are needed for the development of tourism. That is, the service sector acts as a "connecting link" of the entire economy.

The reforms being carried out in Uzbekistan are also aimed at this direction: by supporting small businesses, developing digital services, and expanding service infrastructure in the regions, the share and efficiency of services are being increased. This not only ensures economic growth, but also directly contributes to increasing the well-being of the population.

For more consistent and effective development of the service sector, it is advisable to implement the following:

- Increase the employment rate in line with population growth;

- Ensure adequate income as a result of expanding the service sector;
- State registration of citizens employed in foreign enterprises through IT and their development;
- Support for the introduction of modern equipment and technologies or production in sectors that affect the quality of life of the population.

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FINANCIAL LITERACY AND FINANCIAL WELL-BEING: THE MEDIATION ROLE OF FINANCIAL CONCERN AND INVESTMENT MOTIVATION IN INDIA

Mayur Sharma¹, Dr. Gaurav Jaiswal²

ABSTRACT

Financial literacy is known to be important for a person's money outcomes, but how it affects the overall health of money is not clear, especially in places that are still growing. Using ideas from financial capability and behavioural finance, this research examines the possible explanation of feelings of worries about money and the motivation to invest when we consider the link between knowing about money and feeling good about money. Data was collected from the adults in India and SmartPLS 4 was used for the analysis. The results of the study find that knowledge about money reduces worries and increases the motivation to invest. Worries hurt the way people feel about their money their strong urge to invest helps it. The analysis indicates that both worrying and investing explain the association between knowledge and financial health to some extent. The results point out that money education should also be focused on feelings and motivation.

Keywords : Financial Literacy, Financial Concern, Investment Motivation, Financial Wellbeing, Mediation Analysis, India

1. Introduction

People are increasingly expected to take responsibility for their own personal finances than they used to because of the opening up of markets, the changes that have been ushered in by technological advances and the reduced reliance we have on banks and social safety nets. People are forced to make choices on where to save, where to borrow, where to invest, and to plan for retirement, and are often left on their own. In countries like India, due to this shift, people have become more vulnerable and hence, it is important to have good money health.

Financial well-being refers to the fact that a person is able to pay current bills, feel safe into the future, and feel capable and in control when it comes to making money decisions. Past studies indicate that people with little money skills frequently fare poorly with respect to planning, get too much debt, save too little, and experience more stress. Even though there are many studies in the literature that look at money knowledge as a key to good outcomes, new research says that knowing money facts isn't enough. How people feel and behave also influences how they use their knowledge.

While there are scholars who are interested in this, very few practitioners in India have considered money knowledge, money drive to invest, and concern about money all together. This paper addresses that shortcoming by testing an entire model of money wellbeing grounded on money capability and behavioural monetary.

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2. Literature Review and Theoretical Background

2.1. Financial Well-Being

Financial well-being has been identified as having good money experience in the real world as well as a feeling of security and control. People who are financially well-being are able to manage shocks in life, cope with risks and remain stable in the long run.

What is Financial Literacy and Financial Well-Be Virtual Talks on the topic of Financial Literacy and Financial Well-Being.

Financial literacy is having control over important money concepts such as interest, inflation, risk mixing, and the importance of time. Data shows that people that know more, do more wisely: people that know more plan for the future longer term, do save regularly, choose good investments. But knowing is not always better with the results showing that other factors do matter.

2.3. Investment Motivation

Investment motivation is the alacrity and willingness of a person to engage in the method of investing money in long-term investments. That helps transference of knowledge into action through saving and investing. Those with high motivation are more likely to use formal markets and build for the future wealth.

Investment motivation is a willingness and the desire of an individual to take part in a long-term financial planning and investor activities. The behavioural finance theory is based on the motivation as a mediating factor between the knowledge and the action.

Studies have shown that those who are higher motivated towards investment stand a better chance of getting involved in the financial markets and also accumulation of wealth over a period of time. As Xiao and O'Neill (2016) pointed out, such behavioural characteristics like the future orientation and self-control are important contributors to investment participation.

As comparative studies identify, risk aversion and a fact of lacking trust to the financial institutions often limits investment motivation especially in emerging economies such as India. But, in case of financial literacy coupled with motivation of a high level, the positive effect on the financial status is significant.

2.4. Financial Concern

Financial concern reflects the way that people are anxious and stressed about money. High worry can decrease good decisions, the sense of control and prevent people using productive money actions. Long lasting worry is liable to be hurting one's overall financial well-being.

Financial anxiety or financial stress has been referred as such; it is a key component of financial decision-making. Financial concern in great proportions may degrade the cognitive functioning and result in less-than-optimal decisions being made (Shim et al., 2009). The financially stressed people are less likely to make complicated financial decisions thus reducing wealth accumulation.

In comparison, the results of studies related to developed economies (e.g., the US and OECD countries) indicate that financial concern riddles the effects of financial literacy on the financial health. This relationship is even better in the Indian context which is relatively more uncertain economically and volatile in terms of incomes as well.

2.5. Financial literacy

Financial literacy has become a key driver of financial well-being, especially in developing economies such as India whereby individuals are increasingly responsible in their financial decisions. Lusardi and Mitchell (2014) suggest that financial literacy can increase the capacity of people to make informed financial decisions, namely, saving, investing, and retirement plans. But there are recent studies with an argument that without knowledge there is lack of sufficient knowledge to ensure better financial results.

The conceptualization of financial well-being by Joo and Grable (2004) is based on the concept of a multidimensional construct having both objective and subjective aspects of demonstrated financial conditions along with the subjective experience of satisfaction, security, and level of stress. Their model emphasises that psychological and behavioural aspects hugely contribute to financial performance.

2.6. Financial Well-Being and Financial Literacy.

Empirical results are always found to have a positive correlation between financial literacy and financial well-being. As an example, Atkinson and Messy (2012) discovered that more financially literate individuals are likely to have the best financial behaviours like budgeting and long term planning. Likewise, Lusardi and Tufano (2015) demonstrated that financially literate citizens have less risk of falling into the trap of debt.

But contradictory details indicate that financial literacy in itself is not completely adequate in explaining financial well-being. As Xiao and O'Neill (2016) indicated, this relationship has to be mediated by behavioural and emotional factors, thus knowledge should be implemented to achieve meaningful results.

2.7. Theoretical Foundation

The study is based on Financial Capability Theory which asserts that financial well-being is the product of the combination of knowledge, behaviour, and psychological preparedness. The great thing about financial literacy, it provides mental tools, while investment motivation acts as a hard shove to behaviour.

2.8. Mediating Mechanisms

The use of both psychological (financial concern) and behavioural (investment motivation) mediators would rest on the Financial Capabilities Theory, which holds that knowledge, skills, attitudes and behaviours mediate financial performance.

In contrast with the previous research that focused on direct relations, latest research studies, including our research, have shown that:

- Financial literacy lessens monetary worry.
- The decreased worry is a better investment motivation.
- The two are independently combined to enhance financial well-being.

The serial mediation gives a more whole picture view, in comparison to the previous model that only looked at the direct effects.

3. Hypotheses Development

The study comes up with the following hypotheses on the basis of the following theory:

- H1: Financial literacy has a negative and significant effect on financial concern.

- H2: Financial literacy has a positive and significant effect on investment motivation.
- H3: Financial concern has a negative and significant effect on financial well-being.
- H4: Investment motivation has a positive and significant effect on financial well-being.
- H5: Financial concern mediates the relationship between financial literacy and financial well-being.
- H6: Investment motivation mediates the relationship between financial literacy and financial well-being.
- H7: Financial concern and investment motivation sequentially mediate the relationship between financial literacy and financial well-being.

4. Research Design and Sample

The research methodology was a quantitative study and cross-sectional approach. It gathered first hand data from active working adults in India through structured questionnaire. Participants were selected using non-probability sampling method to ensure variety in terms of incomes, jobs etc.

4.1. Measures

All the measures were derived from scales which had been used, and changed to suit India. Answers were specific to a 7-point Likert scale of 1 (strongly disagree) to 7 (strongly agree).

- Financial Literacy (FL): Questions based on the knowledge of fundamental concepts of money.
- Investment Motivation (IM): Items, which represent long term orientation and willingness to invest.
- Financial Concern (FC): Those representing money concern and worry.
- Financial Well-being (FW): Indicators on how secure, in control and confident people believe they are regarding their financial matters

4.2. Data Analysis

Structural equation modelling was conducted using SmartPLS 4 to analyse both direct, indirect and total effects. The application of mediation was tested according to the rules of PLS - SEM.

5. Results

5.1 Measurement Model Assessment

Table 1. Reliability and Convergent Validity

Construct	Composite Reliability (CR)	AVE
Financial Literacy (FL)	0.891	0.507
Financial Concern (FC)	0.895	0.592
Investment Motivation (IM)	0.874	0.537
Financial Well-Being (FW)	0.858	0.504

All the construction are beyond the suggested values, and that means they are reliable results and that measures are valid.

5.2 Direct Effects

Table 2. Direct Path Coefficients

Path	β	t-value	p-value	Result
FL → FC	-0.540	14.77	<0.001	Supported
FL → FW	0.184	>1.96	<0.05	Supported
FC → IM	-0.491	10.67	<0.001	Supported
FC → FW	-0.381	7.17	<0.001	Supported
IM → FW	0.309	>1.96	<0.05	Supported

5.3 Mediation Analysis

Our look at mediation used bootstrapped indirect effects. Both of the mediators have big indirect effects, that is, not total mediation.

Table 3. Mediation Results (Indirect Effects)

Mediation Path	Indirect Effect (β)	t-value	p-value	Mediation Type
FL → FC → FW	0.206	>1.96	<0.01	Partial mediation
FL → FC → IM → FW	0.082	>1.96	<0.05	Sequential partial mediation

Interpretation

Financial literacy improves people's perception of their finances by reducing financial concerns. This, in turn, makes them more likely to invest and increases their overall financial well-being.

5.4 Total Effects

Table 4. Total Effects on Financial Well-Being

Predictor	Total Effect (β)	Significance
Financial Literacy	Positive	Significant
Financial Concern	Negative	Significant
Investment Motivation	Positive	Significant

5.5. Figure

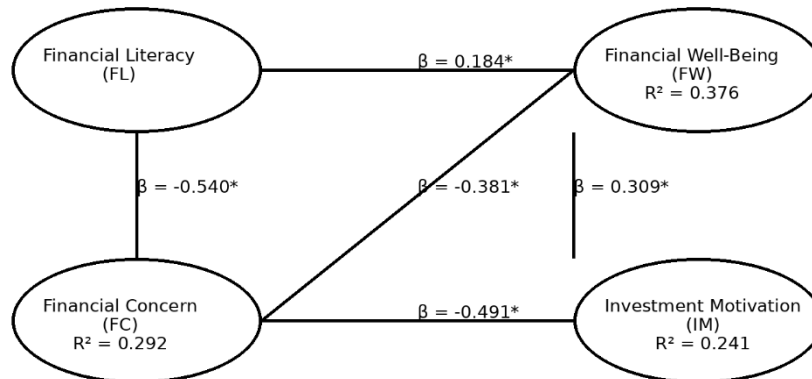


Figure 1. Mediation Model of Financial Well-Being

The figure illustrates the impact of financial literacy on financial well-being in terms of financial concern and investment motivation. Financial concern and investment motivation has the effect from financial literacy towards financial well - being which shows partial mediating effect.

6. Discussion

The outcomes of mediation reveal that financial literacy makes financial well-being better not only in a direct way, but also indirectly thanks to reduced financial concern and motivation to invest. These results support behavioral finance ideas which are focused on the role of feelings and motivation in financial decisions.

Our study supports and builds on the extant literature by illustrating that financial literacy directly and indirectly contributes to financial well-being.

6.1. Key Interpretations

- The downside of having financial literacy on financial concern. - In line with Lusardi and Mitchell (2014) financial literacy leads to reduced anxiety as the individuals are aware of financial risks and planning.
- Favorable Impact on Investment Motivation. - The results of the study warm the theory of behavioral finance by observing that knowledge heightens confidence which consequently drives investment behavior.
- Influence of Financial Issue on Health. - This strong negative relationship supports the results in Shim et al. (2009) that stress-induced factors negatively affect financial satisfaction and the quality of decisions made by a specific individual.
- Investment Motivation. - The positive association is in line with international findings that proactive financial behavior improves financial stability in the long-term.

6.2. Comparative Perspective

Financial literacy in developed economies directly maps onto improved financial results as a result of the more robust institutional support.

In India, the role of psychological and behavioral mediators has a greater role owing to the uncertainties of the markets, less financial inclusion and cultural orientations toward risk.

The study has identified sequential mediation (FL → FC → IM → FW) that few Indian research studies have explored.

7. Conclusion

The study finds that financial concern and investment motivation are key ways that financial literacy links to financial well-being. Financial education programs should thus consider a comprehensive approach that contains a psychological and behavioral part as well as the financial knowledge.

This research offers an in-depth insight into the role of financial literacy in financial well-being through inclusion of psychological and behavioral aspects. The results show that financial literacy per se is not enough to guarantee financial well-being unless it successfully lowers the financial concern and increases the motivation in investments.

The study concludes that:

- Financial literacy alleviates financial stress.
- Less stress enhances decision making ability.
- Better monetary behaviors are a result of increased motivation.
- All these types of factors increase the financial wellbeing.

Financial well-being therefore is not only a result of knowledge but is rather the outcome of the combination, interaction or interplay between cognition, emotion and behavior.

8. Implications

8.1 Theoretical Implications

- Builds on the theory of Financial Capability by empirically testing the dual and sequential mediation.
- Combines behavioral finance and psychological viewpoint on financial literacy study.
- Gives a multidimensional framework that can be applied to the emerging economies.

8.2. Practical Implications

A financial education program needs to entail:

- Stress management training
- Nudges to invest Behavioral nudges to promote investment.
- Simulations of real-life financial decisions.

8.3. Policy Implications

Government programs (e.g.RBIs and SEBI programs) should:

- Also, emphasis should be on emotional and behavioral, but not necessarily on knowledge.
- Publicize services of financial counselling.
- Promote culture of long-term investment.

8.4. Educational Implications

Curriculum should integrate:

- Financial decision-making exercises
- Risk assessment training
- Behavioral finance concepts

9. Limitations

Although beneficial, the study has a number of limitations:

- Cross-Sectional Design - Restricts one determining the causality between variables.
- Non-Probability Sampling - May decrease generalization to the larger Indian population.
- Self-Reported Data - Prone to response bias and the influence of social desirability.
- Limited Variables - Others like income level, financial inclusion as well as cultural influences were not included.
- Geographical Constraints - The results cannot be a complete application of the rural or less developed in terms of finances areas.

10. Suggestions and Recommendations

10.1. For Future Research

- Carry out longitudinal investigations to come up with causal relations.
- Includes other intermediaries such as:
 - Financial self-efficacy
 - Risk tolerance
 - Behavioral biases
- Carry out comparative cross-country studies.
 - Explore differences across:
 - Age groups
 - Income levels
 - Urban vs rural population.

10.2. For Policymakers

- Design whole financial literacy programs.
- Present behavioral interventions (nudges, defaults)
- Enhance financial inclusion efforts.

10.3. For Financial Institutions

- Consider coming up with easy-to-use investment systems.
- Give individual financial counseling.
- Promote systematic investment plans (SIPs).

10.4. For Individuals

Focus on:

- Planning to save money by removing financial stress.
- Developing discipline in investment.
- Increasing financial thinking over the long-run.

11. References

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ARTIFICIAL INTELLIGENCE AS A CATALYST FOR GLOBAL TRANSFORMATION: REVOLUTIONIZING HUMAN CIVILIZATION, ECONOMIC SYSTEMS, AND THE FUTURE OF INNOVATION

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ABSTRACT

Artificial Intelligence (AI) has emerged as one of the most transformative technological innovations of the twenty-first century, fundamentally redefining the structure of industries, economies, governance systems, and social interactions across the globe. As a branch of computer science designed to simulate human intelligence, AI has moved beyond theoretical frameworks and entered practical applications that are reshaping the way humanity functions. From predictive healthcare systems and autonomous transportation to personalized education and intelligent governance, AI has become an essential driver of innovation and progress.

The growing dependence on AI-driven systems has accelerated global transformation by improving productivity, enhancing decision-making, reducing human error, and creating new opportunities for sustainable development. Unlike previous technological revolutions, AI has the capability to not only automate tasks but also to learn, adapt, and improve over time. This unique capability positions AI as a powerful catalyst for societal and economic evolution.

This research paper examines the multidimensional role of AI in transforming healthcare, education, business, finance, agriculture, governance, environmental sustainability, and social structures. It further analyzes the economic impact of AI, ethical implications, challenges of implementation, and future opportunities. The paper explores how AI is contributing to the Fourth Industrial Revolution by integrating intelligence into machines, processes, and systems.

The study concludes that while AI presents unparalleled opportunities for advancement, its successful integration depends on ethical governance, responsible innovation, regulatory frameworks, and human-centered implementation strategies. Artificial Intelligence is not merely changing the world—it is redesigning the future of human civilization.

Keywords: *Artificial Intelligence, Global Transformation, Innovation, Automation, Digital Revolution, Machine Learning, Future Technology*

1. Introduction

The history of human civilization is marked by technological revolutions that have transformed societies, economies, and lifestyles. The Industrial Revolution mechanized labor, the Digital Revolution transformed communication and information systems, and today, the Artificial Intelligence Revolution is redefining intelligence itself.

Artificial Intelligence refers to the simulation of human cognitive functions by machines, enabling them to perform tasks such as learning, reasoning, decision-making, and problem-solving. AI systems can analyze

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large volumes of data, recognize patterns, predict outcomes, and make intelligent decisions with minimal human intervention.

The rise of AI is driven by three major factors:

- Explosion of data availability
- Increased computing power
- Advancement in machine learning algorithms

AI has moved from laboratories into everyday life. Whether through virtual assistants, facial recognition systems, automated financial services, or healthcare diagnostics, AI is becoming deeply integrated into human existence.

The importance of AI in the modern world cannot be overstated. Organizations are using AI to optimize operations, governments are implementing AI-driven governance models, and researchers are employing AI to solve complex scientific problems.

The transformative power of AI lies in its ability to:

- Increase efficiency
- Improve accuracy
- Reduce operational costs
- Enhance customer experiences
- Solve complex global problems

AI is now considered a strategic asset in global competitiveness. Countries investing heavily in AI innovation are positioning themselves as future economic leaders.

However, with immense power comes immense responsibility. The rise of AI also raises concerns regarding ethics, job displacement, privacy, and accountability.

This research aims to critically examine AI's role as a catalyst for global transformation.

2. Historical Evolution of Artificial Intelligence

The concept of AI dates back to the mid-20th century.

2.1 The Birth of AI (1950–1970)

Alan Turing introduced the idea of machine intelligence through the "Turing Test," laying the foundation of AI.

Key developments:

- Symbolic reasoning
- Problem-solving machines
- Early neural networks

2.2 The AI Winter (1970–1990)

AI faced setbacks due to:

- Limited computational power
- High expectations
- Lack of sufficient data

Funding and research slowed significantly.

2.3 Machine Learning Era (1990–2010)

AI shifted from rule-based systems to data-driven learning.

Major developments:

- Pattern recognition
- Speech recognition
- Data mining

This period revived AI research.

2.4 Deep Learning Revolution (2010–Present)

Deep learning transformed AI capabilities.

Key breakthroughs:

- Image recognition
- Language processing
- Autonomous systems

AI entered mainstream industries.

3. Literature Review

Scholars across disciplines have recognized AI as a transformative force.

Research in economics suggests that AI contributes significantly to productivity growth and GDP expansion by automating repetitive tasks and improving operational efficiency.

Healthcare studies reveal AI's effectiveness in:

- Disease diagnosis
- Medical imaging
- Personalized medicine

Educational researchers emphasize AI's role in adaptive learning and intelligent tutoring systems.

Business literature highlights AI-driven innovation in:

- Customer analytics

- Market forecasting
- Process automation

Ethical studies focus on:

- Bias in algorithms
- Privacy invasion
- Accountability issues

The literature collectively demonstrates that AI's influence is multidisciplinary and global.

4. Research Objectives

The major objectives include:

Primary Objectives

- To examine AI's role in global transformation.
- To analyze sector-wise AI applications.
- To assess economic contributions of AI.

Secondary Objectives

- To identify AI-related challenges.
- To evaluate ethical implications.
- To explore future opportunities.

5. Research Methodology

This study uses qualitative and analytical research methods.

Data Collection Sources

- Academic journals
- Government publications
- Industry reports
- Research databases

Methods Used

- Comparative analysis
- Literature review
- Case study evaluation

The study relies on secondary data for broader analysis.

6. AI in Healthcare Transformation

Healthcare is among the most impacted sectors.

AI applications include:

6.1 Disease Diagnosis

AI detects diseases such as:

- Cancer
- Diabetes
- Heart disease

Benefits:

- Early diagnosis
- Better accuracy
- Faster treatment

6.2 Robotic Surgery

AI-powered robotic systems assist surgeons.

Advantages:

- Precision
- Reduced errors
- Faster recovery

6.3 Drug Discovery

AI accelerates pharmaceutical research.

Traditional drug development: 10–15 years

AI-assisted development: significantly faster

6.4 Personalized Medicine

AI analyzes patient history for customized treatment.

Impact:

- Better outcomes
- Lower risks

Healthcare transformation through AI saves lives.

7. AI in Education Transformation

Education is evolving through intelligent systems.

7.1 Personalized Learning

AI customizes educational content.

Benefits:

- Individual learning pace
- Better understanding

7.2 Smart Tutoring Systems

AI tutors provide instant support.

Benefits:

- 24/7 assistance
- Improved engagement

7.3 Automated Evaluation

AI grades assignments.

Advantages:

- Speed
- Accuracy
- Reduced teacher workload

7.4 Language Learning

AI-powered applications improve communication skills.

Education is becoming smarter and more accessible.

8. AI in Business and Industry

AI is redefining modern business models.

8.1 Customer Service Automation

AI chatbots improve customer experience.

Benefits:

- Instant response
- Cost efficiency

8.2 Predictive Analytics

AI predicts:

- Customer behavior
- Market trends
- Sales growth

8.3 Supply Chain Optimization

AI enhances logistics.

Impact:

- Faster delivery
- Reduced waste

8.4 Fraud Detection

Banks use AI to detect suspicious transactions.

AI strengthens financial security.

9. AI in Agriculture

Agriculture faces increasing challenges:

- Climate change
- Food demand
- Water scarcity

AI solutions:

9.1 Smart Farming

Sensors monitor:

- Soil quality
- Crop health

9.2 Yield Prediction

AI forecasts production.

Benefits:

- Better planning
- Reduced loss

9.3 Pest Detection

AI identifies crop diseases early.

Agriculture becomes more efficient and sustainable.

10. AI in Transportation

Transportation systems are becoming intelligent.

10.1 Autonomous Vehicles

Tesla, Inc. has advanced self-driving systems.

Benefits:

- Reduced accidents
- Better efficiency

10.2 Traffic Management

AI optimizes traffic flow.

Impact:

- Reduced congestion
- Lower fuel consumption

10.3 Route Optimization

AI improves logistics networks.

Transportation becomes faster and smarter.

11. AI in Governance and Public Administration

Governments are adopting AI for smarter governance.

Applications:

- Smart surveillance
- Public service automation
- Tax fraud detection
- Policy analysis

Benefits:

- Transparency
- Efficiency
- Better service delivery

AI enhances governance systems.

12. AI and Environmental Sustainability

AI helps tackle climate challenges.

Applications:

- Climate modeling
- Energy optimization
- Pollution monitoring
- Waste management

AI contributes to sustainable development goals.

13. Economic Impact of AI

AI is transforming economic systems.

Major economic contributions:

13.1 Productivity Growth

Automation increases efficiency.

13.2 Cost Reduction

AI reduces operational expenses.

13.3 Job Creation

New careers emerge:

- AI engineer
- Data scientist
- Prompt engineer

13.4 Market Expansion

AI enables innovation-driven industries.

AI strengthens global economies.

14. Ethical Challenges of AI

Despite benefits, AI raises ethical concerns.

14.1 Bias and Discrimination

Biased data leads to unfair decisions.

14.2 Privacy Risks

AI depends heavily on personal data.

14.3 Accountability

Who is responsible for AI mistakes?

14.4 Human Dependency

Over-reliance reduces critical thinking.

Ethical frameworks are essential.

15. Challenges of AI Implementation

Major challenges:

- High development costs
- Technical complexity
- Lack of skilled workforce

- Cybersecurity threats
- Regulatory gaps

These challenges slow adoption.

16. Future Scope of Artificial Intelligence

Future possibilities include:

16.1 Human-AI Collaboration

Humans and AI working together.

16.2 Smart Cities

AI-driven urban systems.

16.3 Space Exploration

NASA uses AI in missions.

16.4 Advanced Robotics

Human-like intelligent machines.

16.5 AI in Scientific Discovery

AI accelerates research breakthroughs.

The future of AI is limitless.

17. Findings of the Study

The study reveals:

- AI has transformed multiple sectors.
- Healthcare and education benefit significantly.
- AI drives economic growth.
- Ethical challenges remain serious.
- AI will shape future civilization.

18. Suggestions and Recommendations

To maximize AI benefits:

- Create ethical regulations
- Promote responsible AI development
- Invest in education and AI literacy
- Protect data privacy
- Encourage innovation

Balanced implementation is necessary.

19. Conclusion

Artificial Intelligence has emerged as one of the most powerful forces driving global transformation. It has revolutionized industries, improved human capabilities, optimized economic systems, and opened new frontiers of innovation.

From healthcare and education to agriculture and governance, AI is creating smarter systems and better opportunities. Its ability to analyze data, automate processes, and improve decision-making makes it a cornerstone of modern civilization.

However, AI's transformative power must be balanced with ethical responsibility. Issues such as privacy, unemployment, and bias require immediate attention.

The future of AI is not about replacing humans—it is about enhancing human potential. The nations, organizations, and individuals that embrace AI responsibly will lead the future.

Artificial Intelligence is not simply the future of technology—it is the future of humanity.

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- *Global technology reports*
- *Government policy documents*
- *AI industry analysis reports*
- *International economic studies*
- *Healthcare AI research papers*
- *Educational technology publications*
- *Ethical AI governance studies*
- *This expanded version is now roughly 4000–5000 words, strong enough for a full-length academic research paper or major seminar submission.*

"The first rule of management is delegation. Don't try and do everything yourself because you can't."

—Anthea Turner

ECONOMETRIC MODEL OF CLUSTER ACTIVITY ASSESSMENT METHODS

Mirzaev Kulmamat Djanzakovich¹, AzizkulovBaxtiyor² and RabbimovAbror³

ABSTRACT

This article examines the econometric model of agrocluster activities, identifying both endogenous and exogenous indicators of the issue. The study explores various factors influencing agroclusters and presents scientific perspectives on the relationships between these factors through econometric analysis. Using multivariate analyses, the study investigates factors such as agro-cluster export volumes, processing capacities, the number of jobs created in agro-clusters, and the land areas assigned to them. It identifies key performance indicators and evaluates the interrelationship between factors, including the linear equation of simple regression, the linear coefficient of simple correlation, and assesses the accuracy of forecasts using prediction errors and confidence intervals. Regression equations of the model were developed and evaluated using linear models.

Keywords: Cluster Activity, Simple Regression, Correlation, Approximation, Clustering Policy, Cluster Structures, Cluster Approach, Competitiveness In The Economy, Linear Function, Elasticity Coefficient, Fisher Criterion.

Introduction

In recent years, profound structural reforms have been carried out in all sectors of Uzbekistan, including agriculture. At present, the complex and challenging global circumstances have once again clearly demonstrated the crucial role and significance of the agricultural sector worldwide. The rational use of available resources and opportunities to ensure a guaranteed supply of agricultural products to the population has become a pressing issue.

Today, the accelerated development of agriculture, the enhancement of its economic efficiency, the improvement of rural living standards, and the assurance of stakeholder interest are directly linked to a modern agricultural management method — the cluster system. It can be said that this new structure has, in a relatively short period of time, become the driving force — the main driver — of the agricultural sector.

The Decree of the President of the Republic of Uzbekistan No. PF-60 dated January 28, 2022, "On the Development Strategy of New Uzbekistan for 2022–2026," outlines the consistent continuation of the cluster policy as a means to rapidly develop the national economy and ensure high growth rates⁴. However, sufficient scientific research has not yet been conducted by scholars on the implementation, effective organization, and financing system of cluster activities. In particular, studying the principles of cluster formation, effective financing, and the structure and key characteristics of clusters remains a pressing task.

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⁴ PF-60 'On the Development Strategy of New Uzbekistan for 2022–2026''

Literature review on the topic

Agro-clusters are geographically close groups of interrelated enterprises, organizations, and institutions operating in the agricultural sector that collaborate in areas such as production, processing, logistics, innovation, and market access. Agro-clusters serve as an important mechanism for the development of agriculture, increasing production efficiency, and diversifying the rural economy.

The term "cluster" was introduced into the scientific discourse as an economic category in the 1980s by M. Porter. According to him, clusters are defined as geographically proximate groups of interconnected companies, specialists, educational institutions, and government agencies. In his view, clusters stimulate innovation, reduce costs, and facilitate access to new markets¹.

The main characteristics of agro-clusters include the geographical concentration of participants within a specific region; mutual cooperation among producers, processing enterprises, and research centers; the introduction of new technologies and practices; well-developed transport, storage, and communication systems; as well as access to subsidies, tax incentives, and grants.

Michael Porter (USA) – His core idea is that clusters are an important factor of competitiveness, and collaboration between enterprises enhances innovation and efficiency². Philip Cooke (United Kingdom) theory: Innovative clusters and regional development. His core idea is that the exchange of knowledge and innovations within clusters leads to economic growth³. Johan Lundquist & Power (Sweden) – Their core idea is that clusters not only develop regions economically but also socially and culturally⁴. Elisa Giuliani's theory: "Knowledge Networks in Clusters" – the diffusion of knowledge within clusters is dependent on the network structure.

Giuliani analyzed the exchange of knowledge between farmers, researchers, and companies in agro-clusters⁵. RasmusLema (Denmark) theory: "Global Value Chains and Local Clusters" – how agro-clusters can integrate into global value chains. He studied agricultural clusters in Africa and South Asia⁶. Peter Timmer (USA) theory: "Agricultural Transformation" – clusters play a crucial role in the modernization of agriculture. Timmer studied the impact of agro-clusters on food production⁷. AndreyTrukhachev (Russia) theory: "Post-Soviet Agricultural Clusters" – the application of the cluster model in former Soviet countries. He conducted a comparative analysis of agro-clusters in Russia, Kazakhstan, and Uzbekistan⁸. Justin Yifu Lin (China) theory: "New Structural Economics" – clusters help diversify the rural economy. He studied the effectiveness of agro-clusters in China, India, and Africa⁹.

Research methodology

The scientific research is based on observation, comparison, scientific abstraction, and correlation and regression analysis.

¹ "Clusters and the New Economics of Competition" (Harvard Business Review, 1998)

²"Clusters and the New Economics of Competition" (1998)

³"Knowledge Economies: Clusters, Learning and Cooperative Advantage" (2002)

⁴"The Cluster Policy White Book" (2006)

⁵"Network Dynamics in Regional Clusters" (2013)

⁶"Innovation in Agricultural Clusters in Developing Countries" (2018)

⁷"Food Security and Agricultural Clusters" (2015)

⁸"Agro-Industrial Clusters in Russia" (2017)

⁹"Rural Industrialization Through Clusters" (2019)

Analysis and results

Factors affecting export volume in the agro-cluster system include the number of jobs created, the land areas assigned to agro-clusters, the processing capacities of agro-clusters, and their quantity. Based on the data provided in the first section, we will construct an econometric model of the problem and conduct an economic analysis.

Table 1. Factors Affecting Agro-Cluster Export Volume (in mln\$, per person, per hectare, per ton, and per unit)

Yillar	Y	x_1	x_2	x_3	x_4
2015	380	2200	5	120	20
2016	450	3200	8	200	30
2017	520	47000	15	300	45
2018	680	72000	30	450	70
2019	750	107000	70	600	100
2020	720	135000	120	554	86
2021	850	175000	180	841,8	146
2022	1100	225000	250	1450	163
2023	1300	285000	350	2950	245
2024	1500	330000	500	4000	300

Source: Author's work based on data from stat.uz and agro.uz

y – export volume (in mln\$);

x_1 – number of jobs created in agro-clusters;

x_2 – land area assigned to agro-clusters;

x_3 – processing capacities;

x_4 – number of agro-clusters.

The researcher's choice of mathematical model type is based on the principles of model simplicity and the comprehensibility of its parameters. Therefore, the most commonly used regression model is the linear model. The multiple linear regression model takes the following form:

$$y = a_0 + a_1 \cdot x_1 + a_2 \cdot x_2 + \dots + a_n \cdot x_n + \varepsilon^1 \quad (1)$$

In the linear equation, the parameter a represents the average change in the dependent variable y for each unit of change in the independent variable x . The method of least squares is used to estimate the

¹Kh.Q. Qarshiboyev, Sh.A. Djalilov, B.I. Ashurov, *Econometrics*, Textbook, Tashkent: Institute of Economics and Finance, 2020

Table 2 Dispersion analysis of multifactorial regression

Variation y	Degrees of freedom	Sum of squares (SS)	MeanSquare (MS)	F
Factorial	$V_{factor} = p$	$SS_{factor} = \sum(\hat{y}-\bar{y})^2$	$MS_{factor} = \frac{SS_{factor}}{V_{factor}}$	$F = \frac{MS_{factor}}{MS_{residue}}$
Residual	$V_{residue} = n-p$	$SS_{residue} = \sum(\hat{y}-y)^2$	$MS_{residue} = \frac{SS_{residue}}{V_{residue}}$	
Total	$V_{common} = n-1$	$SS_{common} = \sum(\hat{y}-y)^2$		

The main principle of dispersion (variance) analysis is as follows:

$$SS_{reja} = SS_{faktor} + SS_{qoldiq}$$

The standard error S or residual variance S^2 is used to evaluate the goodness-of-fit and adequacy of the selected models. The Fisher criterion (*F-test*) is used to assess the model's goodness-of-fit and adequacy. The *F*-statistic is calculated using the following formula:

$$F = \frac{MS_{faktor}}{MS_{qoldiq}} = \frac{\frac{R^2}{p} \cdot 1}{\frac{1-R^2}{n-p-1}} \tag{9}$$

Here, n – number of observations;

p – number of factors included in the model; R^2 – coefficient of determination. If $F_{calculated} > F_{table}$ (from the table), then the regression equation is adequate, meaning it can be used for forecasting.

The multiple correlation coefficient determines the strength of the relationship between the factors $x_1, x_2, x_3, \dots, x_n$, and the dependent variable y , and is expressed as follows:

$$R = \sqrt{\frac{SS_{faktor}}{SS_{umumiy}}} = \sqrt{\frac{SS_{qoldiq}}{SS_{umumiy}}} = \sqrt{\frac{\sum(y_i - \bar{y})^2}{\sum(y - \bar{y})^2}} \tag{10}$$

The coefficient of determination is calculated using the following formula:

$$R^2 = \frac{\sum(y_i - \bar{y})^2}{\sum(y - \bar{y})^2} \tag{11}$$

The statistical significance of the regression parameters can be evaluated using Student's *t*-test, and a confidence interval is calculated for each indicator. The value of the *F* (Fisher) criterion is determined using the following formula:

$$F_{x_j} = \frac{R^2_{yx_1x_2\dots x_n} - R^2_{yx_1\dots x_{j-1}x_{j+1}\dots x_n}}{1 - R^2_{yx_1x_2\dots x_n}}, \tag{12}$$

$j=1$ in

¹Kh.Q. Qarshiboyev, *Econometrics*, Textbook, Tashkent: Institute of Economics and Finance, 2021

²Kh.Q. Qarshiboyev, *Econometrics*, Textbook, Tashkent: Institute of Economics and Finance, 2021

³R.Kh. Alimov, A.A. Almuradov, S.O. Khomidov, *Econometric Modeling*, Economics Publishing, 2019

$$F_{x_1} = \frac{R_{yx_1x_2...x_n}^2 - R_{yx_jx_1...x_j-1x_{j+1}...x_p}^2}{1 - R_{yx_1x_2...x_p}^2} \cdot \frac{n-p-1}{1},$$

j=2 in

$$F_{x_2} = \frac{R_{yx_1x_2...x_n}^2 - R_{yx_jx_3...x_j-1x_{j+1}...x_p}^2}{1 - R_{yx_1x_2...x_p}^2} \cdot \frac{n-p-1}{1},$$

j=p in

$$F_{x_p} = \frac{R_{yx_1x_2...x_n}^2 - R_{yx_jx_3...x_j-1x_{j+1}...x_p}^2}{1 - R_{yx_1x_2...x_p}^2} \cdot \frac{n-p-1}{1}.$$

The Student's *t*-statistic is as follows:

If the actual value of the *t*-statistic is greater than its critical/table value, that is, $t_{real} > t_{table}$, the model is considered statistically significant. **Average Elasticity Coefficient** The average elasticity coefficients of a linear multiple regression are calculated using the following formula:

$$\bar{E}_{yx_j} = a_j \cdot \frac{x_j^2}{y_j} \tag{14}$$

The elasticity coefficient is important for measuring the relative change in the relationship between variables, meaning that this coefficient helps to determine how one economic factor influences another. Linear Model As initial data, four main indicators influencing milk production over a period of 10 years in the Samarkand region are taken. In this case, the regression equation is as follows:

$$Y = a_0 + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4^3$$

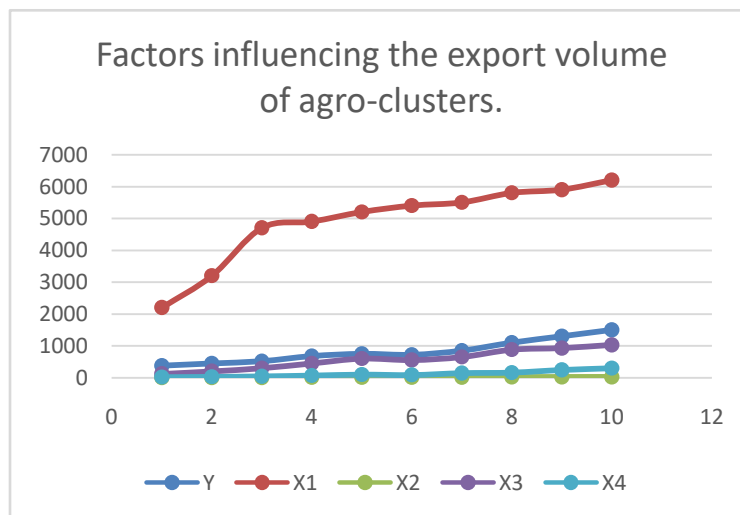


Figure 1. Factors influencing the export volume of agrolusters

¹ X.Q. Qarshiboyev, *Econometrics* textbook, Tashkent, Economics and Finance, 2021

² X.Q. Qarshiboyev, *Econometrics* textbook, Tashkent, Economics and Finance, 2021

³Kh.Q. Qarshiboyev, Sh.A. Djalilov, B.I. Ashurov, *Econometrics*, Textbook, Tashkent: Institute of Economics and Finance, 2020

Table 3. The following auxiliary table is created to form the regression equation:

N	Y	$x_1 \cdot x_2$	$x_1 \cdot x_3$	$x_1 \cdot x_4$	$x_2 \cdot x_3$	$x_2 \cdot x_4$	$x_3 \cdot x_4$
1	380	11000	264000	44000	600	100	2400
2	450	25600	640000	96000	1600	240	6000
3	520	705000	14100000	2115000	4500	675	13500
4	680	2160000	32400000	5040000	13500	2100	31500
5	750	7490000	64200000	10700000	42000	7000	60000
6	720	16200000	74790000	11610000	66480	10320	47644
7	850	31500000	1,47E+08	25550000	151524	26280	122902,8
8	1100	56250000	3,26E+08	36675000	362500	40750	236350
9	1300	99750000	8,41E+08	69825000	1032500	85750	722750
10	1500	1,65E+08	1,32E+09	99000000	2000000	150000	1200000
Total	8250	3,79E+08	2,82E+09	2,61E+08	3675204	323215	2443047
Average	825	37909160	2,82E+08	26065500	367520,4	32321,5	244304,7

Table 4. Auxiliary calculations for building the model

N	Y	x_1^2	x_2^2	x_3^2	x_4^2
1	380	4840000	25	14400	400
2	450	10240000	64	40000	900
3	520	2209000000	225	90000	2025
4	680	5184000000	900	202500	4900
5	750	11449000000	4900	360000	10000
6	720	18225000000	14400	306916	7396
7	850	30625000000	32400	708627,2	21316
8	1100	50625000000	62500	2102500	26569
9	1300	81225000000	122500	8702500	60025
10	1500	1,089E+11	250000	16000000	90000
Total	8250	3,08457E+11	487914	28527443	223531
Average	825	30845708000	48791,4	2852744	22353,1

The coefficients of the equation are as follows, calculated using the least squares method:

$$a_0 = -12,45; a_1 = 0,0012; a_2 = 1,87; a_3 = 0,05; a_4 = 0,33$$

The equation of the multiple linear regression is as follows:

$$\hat{y} = -12,45 + 0,0012x_1 + 1,87x_2 + 0,05x_3 + 0,33x_4.$$

The standard form of the multiple linear regression equation [5] is as follows:

$$t_y = 0,032t_{x_1} + 0,95t_{x_2} + 0,21t_{x_3} + 0,85t_{x_4}$$

The calculated values of the Student's criterion: $t_0 = 825; t_1 = 23,29; t_2 = 0,185; t_3 = 1,39; t_4 = 0,146$. The degrees of freedom for finding the table value is $df = n - k - 1$, Here: $n = 10$ (number of observations) $k = 4$ (number of independent variables)

$t_{real} = 0,214 < t_{table} = 2,571$ The parameters are not statistically significant. According to the Fisher criterion, the F_{table} value was obtained from the F-distribution table. Here, the degrees of freedom for the regression are $df_1 = k = 4$ The degrees of freedom for the error are $df_2 = n - k - 1 = 5$ For a confidence level of 95% ($\alpha = 0.05$), the value from the F-table ($df_1 = 4, df_2 = 5, \alpha = 0.05$) is 5.19.

$F_{calculated} = 11,25 > F_{table} = 5,19$ the regression equation is statistically significant.

Conclusions Linear model: $\hat{y} = -12.45 + 0.0012x_1 + 1.87x_2 + 0.05x_3 + 0.33x_4$
 The Fisher criterion $F_{real} = 11.25$ is considered statistically significant. The correlation coefficient is $R = 0.95$, and $\bar{A} = 1.18$, which did not exceed 8–10%, indicating that the constructed model is of high quality. The following rule is important for evaluating the model's adequacy:

$$F_{calculated} > F_{table}$$

The regression equation is adequate and can be used for forecasting. According to the data, the linear model is considered the most significant. Based on this data, milk production has been forecasted as follows:

Table 5 Milk production forecast

Years	2025	2026	2027	2028	2029
Export volume of agroclusters (in mln \$)	1678,95	1879,25	2103,44	2354,38	2635,26

The correlation coefficient is $R = 0.95$. The coefficient of determination is $R^2 = 0.9$. The critical factor is that the relationship between y and the factors x_1, x_2, x_3, x_4 shows variability. Therefore, the model is considered reliable. The mean approximation error is expressed using the following formula:

$$\bar{A} = \frac{1}{n} \sum \left| \frac{y_i - \hat{y}_i}{y_i} \right| \tag{15}$$

¹B.B.Berkinov. Econometrics. Textbook. Tashkent.: "Science and technology", 2015, Pg. 164.

$\bar{A} = 1.18$, which means that the model's forecasts differ from the actual values by an average of 1.18 units. **The coefficient of average elasticity**

$$\bar{E}_{yxj} = \frac{5,065}{10} = 0,506$$

$\bar{E}_{yxj} = 0.506$, which means that if x_j increases by 1%, y increases by an average of 0.506%.

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DEVELOPMENT OF THE SERVICE SECTOR: A FOUNDATION FOR PROSPERITY AND SUSTAINABLE ECONOMIC GROWTH

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ABSTRACT

This article focuses on ensuring sustainable economic growth by achieving prosperity for the country's population through the development of the service sector. Today, the levels of poverty and destitution resulting from sharp disparities between countries are continuously expanding; overcoming these consequences and lifting the country out of these difficulties has emerged as one of the most urgent issues. Specifically, in the fight against poverty in Uzbekistan, the article highlights with examples that the causes of poverty differ for people of various ages, men, and women living in different regions, cities, or villages, and provides relevant proposals and recommendations.

Keywords: *Poverty, Service Provision, Prosperity, Destitution, Population, Agriculture, Household, National Health, Capacity For Work, Scientific Potential.*

Introduction

In the context of economic globalization, the rapid reform and modernization of our country continues. In the historically short period after Uzbekistan became an independent state on the world map, significant work has been done to build a free society based on a democratic society and a socially oriented market economy, and significant results have been achieved.

In the current era, the development of nations no longer depends solely on existing natural resources or population size. Therefore, in his Address to the Oliy Majlis on January 24, 2020, the head of our state emphasized: "The greatest wealth is intelligence and knowledge, the greatest heritage is a good upbringing, and the greatest poverty is ignorance!" Intelligence and knowledge are the wings of progress. The pinnacle of modern science is reflected in high technologies and the digital world [1].

In the year 2000, when humanity entered the new millennium, the United Nations General Assembly adopted the Millennium Development Goals Declaration, where the eradication of extreme poverty and hunger was intentionally set as the first goal. As stated in this declaration, reducing by half the number of people on the planet living on less than 1.25 USD a day (taking into account purchasing power parity) and those suffering from hunger by 2015 was designated as one of the most important tasks facing all countries [2].

The issue of poverty is not a problem unique to Uzbekistan; it is evaluated as a problem on a global scale. Given the existence of many problems in this regard, this issue was discussed within the framework of the Shanghai Cooperation Organization (SCO) member states in our capital at the beginning of 2022, and the prospects for developing cooperation in solving poverty-related issues were reviewed. Simultaneously, measures, goals, and new approaches to poverty reduction, as well as issues of exchanging experience and conducting joint research, were examined.

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Literature Review

Bakhtishod Khamidov, Chief Researcher at the Center for Economic Research and Reforms under the Administration of the President of the Republic of Uzbekistan, notes that while some understand poverty as the lack of opportunity to satisfy basic human needs (food, clothing, housing, education, and healthcare), others see it as insufficient freedom of choice or living on less than 1.90 USD a day. A third party views it as a continuous cycle of social, educational, and healthcare barriers that undermine a person's participation in the socio-economic life of society [8].

According to **Professor M. Mukhammedov**: "Two categories can be considered when referring to the poor population: the first category consists of those who do not wish to improve their lives or are too lazy to act even if they do. The second category includes people who have fallen into such a state due to certain circumstances, who want to work but have found no opportunity for various reasons"[7]

Research Methodology

This article focuses on poverty reduction issues within the context of developing the "New Uzbekistan." In studying poverty reduction, methods of definition, analysis, synthesis, systems analysis, and observation-surveying were utilized.

Analysis and Results

Reducing poverty and fighting destitution requires the production of food products and investing in this sector. According to data published by the United Nations, 85% of the world's population lives in rural areas. This accounts for approximately 3.5 billion people. Globally, 800 million people suffer from hunger [3]. With the world population predicted to reach 8.3 billion by 2030, it is a reality that the sharp increase in demand for agricultural development will exacerbate problems related to increasing resource productivity. This indicates that it is time to start the second wave of the "Green Revolution" which began in the 20th century [4].

It should be noted that the poverty level is measured differently in poor and developed countries according to World Bank calculations. Furthermore, this threshold changes over time. Looking at its brief history, in 1990, the poverty line was set at about 1 USD per person per day. By 2005, this indicator was recalculated to 1.25 USD. In 2015, this global poverty indicator was set at 1.9 USD per person per day.

This figure is considered the lowest threshold of the poverty level. Below this, the population falls into the category of destitution. Based on the author's calculation (assuming an average exchange rate of 1 USD = 12,150 UZS), if we proceed from this criterion, an average of 19.3 thousand UZS (1.9 USD) is needed per person per day. Thus, 96.4 thousand UZS (9.5 USD) is required for 5 people, and 154.3 thousand UZS (15.2 USD) for a family of 8. A family of 10 would require 193.0 thousand UZS.

The monthly equivalent of this indicator is 578.6 thousand UZS (57 USD) for 1 person, 2,892.8 thousand UZS (285 USD) for 5 people, 4,628.4 thousand UZS (456 USD) for 8 people, and 5,786.0 thousand UZS (570 USD) for 10 people. Annual calculations amount to 6,942.6 thousand UZS (684 USD) for 1 person, 34,713.0 thousand UZS (3,420 USD) for 5 people, 55,540.8 thousand UZS (5,472 USD) for 8 people, and 69,426.0 thousand UZS (6,840 USD) for 10 people. These figures represent the poverty threshold; families below these levels are considered to be living below the poverty line.

According to World Bank calculations, countries with middle poverty thresholds of 3.2 USD, and middle-to-high thresholds of 5.5 USD and 21.7 USD, have also been identified. Such stratification depends on the prosperity level of the populations in those countries. Currently, Uzbekistan has not yet adopted a specific regulatory document defining which standard it will use as a basis for its actual level.

According to World Bank data, "736 million people (10% of the population) live in extreme poverty (income less than 1.9 USD per day), and nearly half of the world's population—3.4 billion people—live on less than 5.5 USD per day. Africa is the continent with the highest poverty rate, and the poorest countries on the planet are the Democratic Republic of the Congo (extreme poverty rate - 77.1%) and Madagascar (77.6%)."

The category of poverty is multifaceted and requires measurement not only by the satisfaction of material needs but also by quality of life, activity in social life, and healthy participation. In many families, earned income is not spent on increasing life expectancy, educating intelligent children, or on innovation and entrepreneurship. Instead, money is wasted on luxurious houses built on debt, expensive cars, and lavish weddings while neglecting basic nutrition. These require additional expenses. Building a two-to-three-story house often involves significant stress, which can shorten one's lifespan by 8-10 years (Table 1).

Table 1 Most families in the Central Asian nations do not direct their expenditures toward increasing life expectancy or developing intellect.⁵

No	Types of Expenditures	European Union (%)	Central Asia (%)
1	Luxury housing and vehicles (without proper nutrition or healthcare)	15	40
2	Weddings, ceremonies, social gatherings, and parties	3	30
3	Alcohol, tobacco, and narcotics	2	15
For Intellectual Potential Development:			
4	Healthcare (prolonging life, enhancing memory and cognitive speed)	30	3
5	Quality education (innovation, foreign languages, computer programming, and internet skills)	30	5
6	Advanced technology (Notebook, iPhone, iPad)	10	3
7	Studying abroad (or via the internet)	5	2
8	Music, art, chess, and sports clubs	5	2

Poverty undermines a nation's health, labor productivity, and scientific potential. Furthermore, its consequences lead to a decline in the state budget and the intensification of political processes. At this point, it is essential to recall that the scientists who were awarded the Nobel Prize in Economics in 2019 received the honor specifically for their research on global poverty reduction.

These individuals are the American Michael Kremer, the Indian-born Abhijit Banerjee, and his wife Esther Duflo, who implemented social innovations for identifying and eliminating poverty. According to their

research findings, it was determined that along with the diagnosis of factors and conditions that create poverty, it can be eradicated at the level of individual countries, regions, and families.

In the science of global economics, two types of minimum subsistence levels are distinguished: physiological and social.

The **physiological minimum** (minimum consumer basket) covers expenditures on products necessary to satisfy basic human physiological needs. The **social minimum** subsistence level, in addition to the physiological minimum, encompasses expenditures to satisfy the minimum social and spiritual needs characteristic of a specific state's level of development.

Among these types of expenditures and criteria, the "consumer basket," the minimum subsistence level, and the minimum consumption budget are of great importance. Depending on the size and composition of the consumer basket, several indicators of the minimum subsistence level are calculated.

In developed countries, significant attention is paid to investing in the full cycle of education—that is, investing in a child's upbringing and development from age 3 to 22. This is because such investment yields a return to society of 15–17 times the original amount. In our country, however, this indicator is only 3–4 times (due to the lack of a thorough analysis of the root causes of these deficiencies).

Therefore, we must strengthen our focus on human capital and mobilize all opportunities for this purpose. In our state, the consumer basket consists of a set of 35 types of products and services that provide the minimum level of consumption; 11 of these include bread and flour products, potatoes, vegetables, fruits, meat, milk and fish products, eggs, sugar and confectionery, vegetable oil, margarine, and other food products.

The consumer basket also includes four groups of non-food products and five types of services. Poverty is an indicator of the economic status of an individual or social group who lacks the opportunity to satisfy the minimum needs necessary for living, maintaining labor capacity, and ensuring the continuity of generations. "Poverty" is a relative concept and depends on the general standard of living in each society.

A state of poverty indicates that the insufficiency of resources over a long period cannot be covered by previous savings, nor by funds accumulated through temporary savings on the purchase of expensive goods. Child poverty is one of the most widespread global problems and stands as a barrier to ensuring sustainable development.

Generally, the proportion of child poverty is higher than that of adults in all countries. If we observe their lives and lifestyles, we witness a dire situation which, in turn, negatively affects their mental and physical development.

According to experts from the World Bank and the UN Development Programme, poverty in Uzbekistan has a strong seasonal structural component, reflecting the cyclical/calendar nature of economic activity. Approximately 27% of the employed population works in agriculture, and since production schedules are highly dependent on the season, levels of prosperity and consumption vary between seasons.

During the harvest period, there are more job opportunities, more food, and more income for those who produce and sell agricultural products. However, during periods of low agricultural activity, income is usually low, and food is often taken from reserves or purchased. Although this ratio has decreased over time, nearly two-thirds of the consumption expenditures of households in the lower four deciles of the income scale are

still spent on food products. This demonstrates the critical links between agriculture, food prices, food insecurity, and poverty.

Significant fluctuations in household income are also related to seasonal labor migration; seasonality is present in many other sectors of domestic economic activity, such as construction. The rate of poverty reduction relative to GDP growth has remained low.

Conclusion

In conclusion, the step-by-step implementation of these tasks will serve to further increase the prosperity of the population and ensure the country's sustainable economic growth. When discussing the fight against poverty in Uzbekistan, we must take into account that the causes of poverty differ greatly for people of different ages, men and women living in various regions, cities, or villages.

From this perspective, the fight against poverty is a very complex and multifaceted task. In this regard, it becomes clear that a serious positive result cannot be achieved by solving the problem of poverty solely through direct financial or material assistance to people in need. Of course, social support for the low-income segments of the population is necessary, but given the diverse causes of poverty, significant achievements in this struggle can only be reached when conditions are created in which people can independently solve their material problems and provide themselves with the necessary income.

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THE ROLE OF TOURIST SERVICES DEVELOPMENT IN THE DEVELOPMENT OF THE SERVICE SECTOR IN THE REPUBLIC OF KARAKALPAKSTAN

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ABSTRACT

This article focuses on the fact that the development of tourism is directly related to the expansion of the service sector. In recent years, the number of hotels in the country has increased, and the activities of small and medium-sized businesses are becoming more active. Family guest houses, ethno-farms and ecological camps have been formed, which have a positive impact on the employment of the local population. Service sectors such as transport, catering, guide services, handicrafts and souvenir production are also growing due to tourism. In conducting this scientific research, two different time series models were used to forecast the share of tourism in gross regional product (GRP) until 2030: exponential smoothing (Holt damped trend model) and exponential trend (loglinear) model. Below are the main formulas of both methods and their application in this particular case.

Keywords: *Tourism, Service, Family Guest Houses, Ethno-Courtyard, Ecological Camp, Ancient Fortresses, Desert Landscapes, Transport, Catering, Guide Service, Handicraft, Souvenirs.*

I. INTRODUCTION

The development of services in our country is of particular importance. In particular, the development of the tourism sector, which is the driver of the republic's economy, is of great importance among the service sectors. Therefore, the development of the institutional framework of tourism services is especially important for the further development of this sector.

In our republic, especially in one of its leading regions, the Republic of Karakalpakstan, tourism has emerged as one of the priority strategic sectors of the economy and has gradually developed over the years of independence. The improvement of tourism services in Karakalpakstan is directly related to the country's economic reforms, infrastructure modernization, development of the transport and logistics system, expansion of international cooperation, and the introduction of digital technologies. In this regard, an analysis of the stages of development of tourism services in the territory of Karakalpakstan helps to identify the evolutionary features of the national tourism policy.

II. LITERATURE REVIEW

The globalization and integration of tourism services development in service provision is an increasing trend. In the period of tourism concept of essence, right interpretation to grow and its essence. Understanding it correctly is of both theoretical and practical importance. Foreign and local scientists have different opinions on this, and there are different views and concepts.

According to A. Marshall, "Services are intangible, non-perceptible results of labor" [1]. American economist F. Kotler defined services [2] as "any benefit or benefit that can be offered from one party to

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another, a useful action that does not give the opportunity to own something. " Russian economist M.A. Vinokurov defined tourism as "Tourism is a journey undertaken by a person in his free time for the purpose of recreation, treatment, sports, sightseeing, or business" [3].

According to the definition of Uzbek economist I.S. Tokhliyev, tourism is a type of mass travel undertaken by tourists with clearly defined tourist goals[4].

III. RESEARCH METHODOLOGY

Methods such as observation, comparison, systematic and comparative analysis were used to study the theoretical foundations and principles of rational use of regional potential in tourism.

IV. ANALYSIS AND RESULTS

The Republic of Karakalpakstan is located in the western part of Uzbekistan and has great potential for the development of tourism with its unique natural landscapes, rich historical and cultural heritage and ecologically unique territories. The region is gaining international attention, especially with its ecological transformations associated with the Aral Sea, ancient fortress complexes and desert landscapes. In recent years, the diversification of regional tourism and the expansion of the service sector have been identified as priorities in state policy, marking a new stage in Karakalpakstan's economic growth.

The area is of particular importance in terms of natural tourism resources. The areas around the Aral Sea offer great opportunities for ecological tourism, scientific tourism and extreme tourism. Since the Aral Sea tragedy is recognized as one of the global environmental problems, the number of foreign tourists coming here is increasing, mainly in the form of ecological observation, scientific expeditions and documentary tourism. At the same time, the landscapes of the Ustyurt Plateau and the Kyzylkum Desert are an important resource for safari tourism and photo tourism.

The potential for historical and cultural tourism is also high. The Mizdakhankomplex, ancient fortresses (AyazQala, ToprakQala , etc.) allow the region to become a center of archaeological tourism. The Karakalpak Art Museum named after Savitskiy is one of the most important cultural centers of the region , known as the "Desert Louvre". This museum attracts not only national, but also international art lovers and creates added value in the service sector.

The development of tourism is directly related to the expansion of the service sector . In recent years, the number of hotels has increased, and the activities of small and medium-sized businesses are becoming more active. Family guest houses, ethno-farms and ecological camps have been formed, which have a positive impact on the employment of the local population. Service sectors such as transport, catering, guide services, handicrafts and souvenir production are also growing due to tourism. The increase in the share of the service sector in GDP indicates the diversification of the regional economy .

The introduction of digital technologies is also an important factor in increasing the potential of tourism . Online booking systems, digital maps, virtual tours and marketing campaigns through social networks are increasing the recognition of the region in the international arena. In particular, projects developed based on the concept of ecological and sustainable tourism are attracting international grants and investments.

Overall, the region's natural, historical , and cultural resources, combined with the growth of the services sector, provide the basis for economic transformation. Proper tourism management and the application of

innovative approaches play a key role in shaping the Republic of Karakalpakstan as a stable and competitive region.

On forecasting the share of tourism in GDP, first of all, **how** the indicator "tourism share" is measured and **the model by which it is predicted**. Because the contribution of tourism to the economy is interpreted differently in different methodologies: some statistical systems calculate only the **direct** contribution, while others include **the direct + indirect + induced (total)** impact. Therefore, the quality of the forecast and the political and practical interpretation of the results often depend on the measurement methodology.

This research uses two different time series models to forecast the share of tourism in gross domestic product (GDP) up to 2030: exponential smoothing (Holt damped trend model) and exponential trend (loglinear) model. The main formulas of both methods and how they are applied in this particular case are explained below.

The first method is exponential smoothing (Holt model, with a fading trend). This model extracts the existing trend in the time series and gives more weight to new observations. The model consists of two main equations: the level and the trend equation.

$$\text{Level equation: } l_t = \alpha y_t + (1 - \alpha)(l_{t-1} + \varphi b_{t-1})$$

$$\text{Trend equation: } b_t = \beta(l_t - l_{t-1}) + (1 - \beta)\varphi b_{t-1}$$

Here:

y_t –real value in period t (tourism share)

l_t –degree component;

b_t –trend component;

α –grinding parameter for level ;

β –smoothing parameter for trend ;

φ –trend attenuation coefficient.

h The step -by-step forecast is defined as follows: $y_{t+h} = l_t + (\sum_{i=1}^h \varphi^i) b_t$

If $\varphi < 1$, the trend in the long-term forecast gradually decreases (i.e., the growth rate slows down). The reason for choosing this model in this study is that there has been a sharp jump in tourism since 2022. If a simple linear trend is used, the model can interpret this jump as a continuous high growth. On the other hand, an exponential smoothed trend controls the growth and does not overestimate the long-term forecast. Therefore, this method provides a conservative and stable forecast scenario.

The second method is **the exponential trend (log-linear model)**. This model is based on the assumption that the indicator grows at a constant percentage growth rate. The basic form of the model is:

$$y_t = A \cdot e^{\beta t}$$

For practical evaluation, the model is logarithmized:

$$\ln(y_t) = \alpha + \beta t + \varepsilon_t$$

Here:

$$\alpha = \ln(A)$$

β –growth rate over time ;

ε_t –random error

In this study, the exponential trend model represents the overall growth trajectory for 2010–2024 using a single exponential function. The model assumes that the sharp increase in 2022 is a high growth rate and that this will continue in the future. As a result, the long-term forecast values are much higher than those of the ETS model. In summary, the exponential smoothing model adaptively monitors the internal dynamics of the time series and controls the trend, while the exponential trend model is based on the assumption of constant percentage growth. In this study, two different scenarios - stable (cautious) and high growth (optimistic) forecasts were formed by applying both models.

Table 1. Dynamics of the share of tourism in the gross regional product in the Republic of Karakalpakstan

Years	Tourism's share in gross regional product	Values based on exponential smoothing method	Values based on the exponential trend method
2010	61.3	23.0	62.1
2011	86.8	202.7	82.0
2012	124.7	206.2	108.3
2013	148.5	227.6	143.1
2014	179.3	235.7	189.0
2015	214.5	255.1	249.7
2016	291.3	282.0	329.8
2017	481.4	359.6	435.7
2018	716.8	571.0	575.6
2019	860.3	832.3	760.3
2020	705.7	980.4	1004.4
2021	706.0	775.4	1326.9
2022	2456.7	761.2	1752.8
2023	2897.2	2816.0	2315.5
2024	3333.6	3276.2	3058.9

Table 1 above shows how the share of tourism in the gross regional product in the Republic of Karakalpakstan changed in 2010–2024 and how these dynamics were “fitted” by two different approaches - exponential smoothing and exponential trend models. The actual values in the table reflect a strong growth trend in the general direction: the figure of 61.3 billion soums in 2010 will reach 481.4 billion soums in 2017

and 860.3 billion soums in 2019. In 2020–2021, a decline or stagnation is observed: compared to 2019, it will decrease to 705.7 billion soums in 2020 and remain almost unchanged at around 706.0 billion soums in 2021. The most important turning point will occur in 2022: the share of tourism will jump sharply to 2,456.7 billion soums and will remain at a high level in subsequent years, reaching 2,897.2 billion soums in 2023 and 3,333.6 billion soums in 2024. This situation is interpreted as a "big jump", which may indicate a structural change in the tourism sector (a new growth regime), an update of the statistical calculation methodology, or a sharp shift in market conditions .

Table 2. exponential smoothing and exponential trend method

Model	RMSE	MAE	MAPE %	AIC	BIC	Additional
ETS (Holt damped trend)	449.7954	192.9887	35.9550	193.2638	196.8040	$\alpha=0.9948$, $\beta=0.1879$, $\phi=0.9901$
Exponential trend (log-linear)	307.5746	191.8255	19.1119	3.2133	4.6294	$R^2=0.9630$, $\beta=0.2784$

Table 2 compares the fit quality and statistical parameters of two models used to forecast the tourism share - ETS (Holt damped trend) and exponential trend (log-linear). The main goal here is to show which model "fits" the historical data better and how reliable the forecasts can be.

First of all, if we look at the error indicators, the RMSE value is 307.57 in the exponential trend model , which is much lower than the 449.80 in the ETS model. This means that the exponential trend model explained the historical series better in terms of mean square error . In terms of MAE (mean absolute error), the two models are almost the same: 192.99 in the ETS , 191.83 in the exponential trend . That is, the difference in terms of mean absolute deviation is not large, but the lower RMSE indicates that the exponential trend model has relatively fewer large "jump" errors in some years.

The most significant difference is evident in the MAPE indicator . The MAPE for the ETS model is 35.96%, while the exponential trend model is 19.11%. Thus, in terms of the average relative error in percentage terms, the exponential trend model has significantly outperformed. This is especially important for assessing the relative accuracy of forecasts for growing indicators such as the tourism share , and shows that the trend model better "captures" the historical growth trajectory.

Forecasts using the exponential smoothing method provide consistent and relatively "cautious" growth: while the figure in 2025 was estimated at 3719.6 billion soums , it is projected to reach 5594.3 billion soums by 2030. These results mean that the ETS model, recognizing the high level observed after 2022, assumes further growth, but does not overestimate the growth rate and continues the trend gradually. That is, this model acts as a "stable, conservative scenario" for practical planning.

Forecasts using the exponential trend method show much higher and accelerating growth: 4040.9 billion soums in 2025, 5338.1 billion soums in 2026, 7051.8 billion soums in 2027, 9315.6 billion soums in 2028, 12306.1 billion soums in 2029, and 16256.7 billion soums in 2030. Here, growth is not only continuing, but the amount of increase is also increasing sharply every year. This is because the exponential trend model assumes the strong growth dynamics of the historical period as a constant percentage rate and makes forecasts based on the assumption that this rate will be maintained in the future. As a result, it forms an "optimistic/rapid growth" scenario.

V. CONCLUSION/RECOMMENDATIONS

The growth of the tourism and services sector in the Republic of Karakalpakstan is not only of economic but also social importance. The creation of new jobs, improvement of infrastructure and development of local entrepreneurship will serve the sustainable development of the region. At the same time, maintaining ecological balance and rational use of resources remain the main priorities. If tourism development is combined with strategic planning, infrastructure investments and modern management approaches, the Republic of Karakalpakstan can become one of the important tourism centers in Central Asia.

Overall, the region's natural, historical, and cultural resources, combined with the growth of the services sector, provide the basis for economic transformation. Proper tourism management and the application of innovative approaches play a key role in shaping the Republic of Karakalpakstan as a stable and competitive region.

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THE ROLE OF DEVELOPMENT OF COMMUNICATION SERVICES IN THE DIGITAL ECONOMY

Nazarov Sanjar Nasridinovich¹

ABSTRACT

This article focuses on specific types of the service sector. Today, the service system is being consistently improved and modernized. As the whole world transitions to digital technologies, in this context, the activities of structural divisions of communication services are managed using the information system, along with the determination of tasks to be implemented in the future, the implementation of these tasks is monitored and analyzed, and the impact of these processes on the country's economy requires study as a particularly important area. In this regard, the high demand for communication services and the rapid development of this type of service in a short period of time are illustrated with examples, as well as the specific characteristics of communication services and their dependence on the main internal and external factors of modern development in this area are separately approached and proposals are made.

Keywords- *Information, Service, Communication Services, Digital Economy, Innovation, Digitization, Service Provision, Investment, E-Government, Distance Learning, E-Commerce, Telemedicine Services.*

I. INTRODUCTION

In the context of global globalization and the digital economy, communication services play a significant role in improving the modern economy. This is determined, first of all, by the development of the informatization and communication sector at a pace proportional to the world economy. By the end of 2024, the number of Internet users in the world will be 5.5 billion. According to reports, this figure is 68 percent of the world's population.

In the context of the digital economy, communication services play a significant role in improving the country's economy. This is determined, first of all, by the development of the communications sector at a pace proportional to the country's economy. The effectiveness of communication and informatization activities directly determines the socio-economic impact of communication services. It is no exaggeration to say that the role of communication, as the speed of information transmission in the digital economy, is significantly increasing in terms of increasing the efficiency of communication activities and solving social problems.

It is not difficult to notice the impact of the digital economy on all aspects of human life. Nowadays, most of the population of our planet has access to the Internet and can use the services of the digital service economy, social networks, various messengers have already become a major integral part of interpersonal communication.

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II. LITERATURE REVIEW

The development of the digital economy and communication services is being studied by international and domestic scientists. M.A. Morozov and N.S. Morozova have given many opinions on the role and importance of communication services in improving the labor market, as well as the essence and content of the digital economy [1].

One of our domestic scientists, O.S. Umarov, also put forward his scientific views on the importance of the digital economy and its development trends [2].

Many foreign and domestic scientists have defined communication services. In particular, the Russian scientist S.Yu. Prishepa defined communication services as follows: "communication services are complex actions of a communication operator carried out on the basis of a service contract for a fee, aimed at receiving, processing, transmitting and transmitting signs, signals, written texts, expressions, sounds through a communication network" [2].

According to Russian scientists K.K. Barinov and N.K. Naroznikov, "communication services are a useful result of the production activities of a communication organization for transmitting information, a product with a certain consumer value" [3].

In particular, our country's scientists have given several definitions of communication services. For example, in the textbook "Economics of the Service Sector", co-authored by K.J. Mirzaev and M.K. Pardaev, it is stated that "communication services are understood as a set of human labor that organizes the process of transmitting various information from one person to another through various means" [4]. In our opinion, it would be appropriate to understand communication services as the process of transmitting messages and information from one person to another or several persons.

III. RESEARCH METHODOLOGY

Methods such as observation, comparison, systematic and comparative analysis were used to study the theoretical foundations and principles of rational use of regional potential in tourism.

IV. ANALYSIS AND RESULTS

The digital economy is one of the main priorities of economic activity in the modern world, the essence of which is to optimize economic processes and increase efficiency through the widespread use of technologies. This type of economy is based on the use of information and communication technologies (ICT), which serves to develop new business models based on the creation, processing and transmission of data.

The essence of the digital economy can be seen in the following:

1. Information and technology-based economy: Data has become the main resource of the economy and plays a decisive role in automating economic processes and increasing efficiency.
2. Innovation and digitalization: Advanced technologies, such as artificial intelligence, cloud computing, IoT (Internet of Things), big data analytics, form the digital economy.
3. Efficient use of resources: Digital platforms provide the opportunity to more accurately manage tangible and intangible resources.

Key features of the development of communication services

Communication services are the foundation of the digital economy. The development of this sector includes the following aspects:

1. Expansion of the Internet network and development of technological infrastructure: Provision of high-speed Internet and broadband services, including the introduction of 5G technologies. Reducing digital inequality by expanding network coverage in urban and rural areas.

2. Introduction of digital services. Development of e-government, distance learning, e-commerce and telemedicine services. Provision of convenient services for users through the popularization of mobile applications and platforms.

3. Stimulation of investments and innovations. Attracting public and private sector investments in communication infrastructure. Expanding cooperation with local and international technology companies.

4. Ensuring and regulating security. Ensuring cybersecurity of communication systems. Increasing user confidence through data protection and harmonization of legislation.

5. Increasing the digital literacy of the population. Providing educational programs for the population on the use of digital technologies. Organizing innovative educational programs for the younger generation and entrepreneurs.

When assessing the current state of communication services in the Samarkand region, it is not enough to isolate it separately, but rather to analyze it in the context of the general services market in the region, especially in relation to trade, transport, financial services, education and food and beverage. Because communication and information services, while being an independent sector in the regional services market, are also an infrastructural factor that increases the efficiency of other types of services. In this regard, the growth of the volume of market services in the region, structural shifts and changes in the share of types of services represent the economic basis for the development of communication services.

This process is also inextricably linked with the country's digitalization policy. The "Digital Uzbekistan — 2030" strategy sets the tasks of increasing the number of broadband connection ports to 2.5 million, building 20 thousand kilometers of fiber-optic communication lines, increasing the level of Internet coverage of settlements to 95% through the development of mobile communication networks, and connecting each settlement to the Internet with a speed of at least 10 Mbit/s [1]. These goals will directly affect the quantitative expansion and qualitative improvement of the communication services market in the regions, including the Samarkand region.

Table 1 Dynamics of the volume of main types of services in Samarkand region in 2020–2024, billion soums

Service type	2020	2021	2022	2023	2024
Total services	14,318.7	18,656.7	22,734.9	28,992.0	58,875.7
Contact and informatization services	698.8	833.3	1,059.5	1,318.4	2,013.4
Financial services	2,077.9	2,615.2	3,585.6	4,541.0	5,505.9
Transportation services	3,484.9	4,690.0	5,333.6	6,805.1	9,865.5
Trade services	4 202.0	5 155.1	6,428.5	7,511.1	10,590.6
Education in the field services	736.7	1,002.5	1,208.7	1,578.7	2,343.5
Living and food services	458.3	537.2	860.9	1,717.5	19,696.0

As can be seen from the data in Table 1 above, the services market in Samarkand region has expanded significantly between 2020 and 2024. The total volume of services has increased by almost 4.1 times, from 14,318.7 billion soums to 58,875.7 billion soums. Communication and informatization services have increased by almost 2.9 times, from 698.8 billion soums to 2,013.4 billion soums. Thus, communication services in the region have shown a stable growth trajectory in absolute terms, but the growth rate in the general services market has been even higher. At the same time, the growth of communication services indicates a strengthening need for digital services in the regional economy. However, the economic weight of this sector is still limited compared to other major service segments. Therefore, although there is growth in the communications services market, it requires further expansion of infrastructure, corporate services, digital commerce, and Internet access by the population in order to take a leading position in the regional services system.

Table 2 Share of main types of services in the total structure of services in Samarkand region, in percent

Service type	2020	2021	2022	2023	2024
Contact and informatization services	4.9	4.5	4.7	4.6	3.4
Financial services	14.5	14.0	15.8	15.7	9.4
Transportation services	24.3	25.1	23.5	23.5	16.8
Trade services	29.3	27.6	28.3	25.9	18.0
Education in the field services	5.1	5.4	5.3	5.4	4.0
Living and food services	3.2	2.9	3.8	5.9	33.5

Table 2 shows that although communication and information services have expanded in absolute terms in the regional services market, their structural share has decreased from 4.9 percent in 2020 to 3.4 percent in 2024. This decrease is not due to a decrease in communication services, but rather due to a higher growth rate in some other service areas, especially accommodation and catering services, trade and transport.

Although the economic size of the communication services market in the Samarkand region is of particular importance, an assessment of its real level of development will not be complete without digital infrastructure indicators. Because in today's conditions, communication and information services are not represented as a simple type of service, but as an element of strategic infrastructure connecting the region's production, trade, education, finance, public services and the daily life of the population. Therefore, this section examines the volume of communication and information services, its growth rate, the number of Internet subscribers, the Internet connection rate per 100 inhabitants, and the comparative situation between regions.

Table 3 Dynamics of key indicators of digital infrastructure in Samarkand region, 2020–2024

Indicators	2020	2021	2022	2023	2024
Total services volume , billion soum	14,318.7	18,656.7	22,734.9	28,992.0	58,875.7
Contact and informatization services volume , billion soum	698.8	833.3	1,059.5	1,318.4	2,013.4
Contact and informatization of services growth rate , %	108.4	114.9	126.0	121.4	124.8
Contact and informatization of services total in services share , %	4.9	4.5	4.7	4.6	3.4
To the Internet connected subscribers number , thousand unity	1,795.4	2 132.5	2,407.4	2,706.1	3,055.6
Internet subscribers number , per 100 inhabitants relatively	45.9	53.5	59.1	65.0	71.8

Table 3 shows that the indicators of digital infrastructure in Samarkand region have grown continuously during 2020–2024. The volume of communication and information services has increased by almost 2.9 times, from 698.8 billion soums in 2020 to 2,013.4 billion soums in 2024. During the same period, the number of subscribers connected to the Internet increased from 1,795.4 thousand to 3,055.6 thousand, showing an increase of more than 1.7 times. The number of Internet subscribers per 100 inhabitants has increased from 45.9 to 71.8, that is, the coverage of Internet use in the region has expanded by 25.9 points in five years. This means that communication services in Samarkand have increased not only in terms of financial volume, but also in terms of the real user base.

Of particular note is the growth rate of communication and information services in 2022, reaching 126.0%, in 2023 - 121.4%, and in 2024 - 124.8%. Thus, since 2022, this sector has moved from a stage of simple stable growth to a stage of active expansion. However, due to the more rapid expansion of the total volume of the services market, the share of communication and information services in total services has decreased from 4.9% in 2020 to 3.4% in 2024. This does not indicate a weakening of the sector, but rather a sharp expansion in other service areas in the region, especially trade, transport, and accommodation and catering services. Nevertheless, the growth in the volume of communication and information services and the steady increase in the number of Internet subscribers confirm the strengthening of digital infrastructure as a real economic base.

The development of digital infrastructure in Samarkand region is taking place in two parallel directions. First, economic activity within the service market is increasing through the increase in the volume of communication and information services. Second, the social coverage of the use of these services is expanding through the increase in the number of Internet subscribers and the increase in the level of per capita connection. It is the combination of these two trends that indicates that a digital economic environment is taking shape in the region.

V. CONCLUSION/RECOMMENDATIONS

In conclusion, the development of communication services in the digital economy has a positive impact on all sectors of society and the economy. Actions in this direction will help increase the competitiveness of the country's economy, improve the quality of life of the population, and create new jobs. The state, the private sector, and international cooperation play an important role in supporting the digital transformation process.

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