

**CURRENT ISSUES OF DEVELOPING INDUSTRY AND INDUSTRIAL SECTORS IN
BUKHARA REGION**

<https://doi.org/10.5281/zenodo.18636816>

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Annotation: *This article examines the current issues and challenges in the development of industry and industrial sectors in the Bukhara region. The study analyzes the structural composition of the regional industry, its resource base, production specialization, and level of technological modernization. Particular attention is paid to existing constraints such as limited diversification, dependence on raw-material-based industries, insufficient innovation activity, infrastructure gaps, environmental pressures, and the need for digital transformation. The paper also explores opportunities for strengthening regional competitiveness through industrial diversification, value-added production, cluster development, and integration into national and global value chains. The research emphasizes the importance of targeted regional industrial policy, investment attraction, human capital development, and green transformation strategies to ensure sustainable industrial growth in the Bukhara region.*

Keywords: *industrial development, industrial sectors, Bukhara region, regional economy, diversification, value-added production, industrial modernization, innovation, digital transformation, sustainable development, competitiveness, regional policy.*

Industrial development plays a decisive role in ensuring sustainable economic growth, structural transformation, and improved living standards at the regional level. In many emerging economies, regions with a strong industrial base serve as growth poles that stimulate employment, attract investment, and enhance export potential. Within this context, the Bukhara region occupies a significant position in the industrial landscape of Uzbekistan due to its rich natural resources, particularly hydrocarbons, as well as its developing manufacturing sector. Historically, the industrial structure of the Bukhara region has been largely shaped by resource-based industries, including oil and gas extraction, chemical production, and energy generation. While these sectors contribute substantially to gross regional product and budget revenues, their dominance also creates structural imbalances and dependence on global commodity markets. Fluctuations in international prices, technological shifts, and environmental challenges increase the vulnerability of such mono-specialized industrial systems.

In recent years, national economic reforms and regional development programs have emphasized industrial diversification, modernization of production capacities, and the introduction of innovative technologies. However, several persistent issues continue to

limit the full realization of industrial potential in the Bukhara region. These include insufficient technological upgrading, limited integration into global value chains, underdeveloped small and medium-sized industrial enterprises, gaps in logistics and infrastructure, and the need for qualified human capital adapted to modern industrial requirements. Furthermore, global trends such as digitalization, Industry 4.0, green transformation, and climate change mitigation require regional industries to adopt new models of sustainable and innovation-driven growth. For the Bukhara region, addressing environmental concerns—particularly in energy-intensive and extractive sectors—has become increasingly important for ensuring long-term competitiveness and ecological balance.

Therefore, the study of current issues in the development of industry and industrial sectors in the Bukhara region is both theoretically relevant and practically significant. Identifying structural constraints and growth opportunities will contribute to designing more effective regional industrial policies aimed at diversification, technological modernization, sustainable development, and enhanced regional competitiveness.

In order to identify existing problems and determine priority directions for the development of industry and industrial sectors in Bukhara region, the activities of industrial enterprises were studied based on a sample survey using the questionnaire presented below. The total number of industrial enterprises that participated in the survey was 50. Each question in the questionnaire is scored on a 1–5 point Likert scale. The Likert scale ratings are described as follows: 1 – the situation is very poor, 2 – the situation is poor, 3 – the situation is satisfactory, 4 – the situation is good, and 5 – the situation is very good (Table 1).

Table 1

Composition of survey questions developed for studying the activities of industrial enterprises in Bukhara Region

o.	Questions	Quality Rating (1–5 Likert Scale)				
1	The existence of serious problems in the stable and continuous supply of raw materials to the enterprise					
2	Problems in the stability of electricity, gas, and other energy resource supplies					
3	The level of development of transport, logistics, and engineering-communication infrastructure					
4	The state of the enterprise's provision with qualified workforce and specialist personnel					
5	The level of implementation of information technologies and digital solutions					

6	Limitations in access to credits, investments, and financial resources					
7	The impact of administrative procedures, permits, and inspections on enterprise activities					
8	The degree to which physical and moral depreciation of fixed production assets affects product quality and production volume					
9	The existence of marketing and sales-related problems in bringing finished products to domestic and foreign markets					
10	The degree to which state-provided benefits and support measures fully meet enterprise needs					

The questions Q1–Q10 included in the survey comprehensively cover the main institutional, financial, technological, and market factors hindering the development of industry and industrial sectors in Bukhara region.

Specifically:

Q1–Q2 assess the resource base of production and energy security;

Q3–Q4 assess the quality of infrastructure and human capital;

Q5 assesses the level of digitalization and innovative development in industry;

Q6 assesses investment climate and opportunities for accessing financial resources;

Q7–Q8 assess the institutional environment and the condition of fixed assets;

Q9–Q10 serve to evaluate product competitiveness and the effectiveness of state support.

Therefore, this set of questions is methodologically correct and well-founded for systematically identifying problems in industrial development.

The analysis results show that the lowest ratings correspond to Q7 and Q8 (institutional environment and asset depreciation). The highest ratings are observed in Q5 and Q10 (digitalization and state support). This situation indicates that technological and institutional problems are predominant in the industrial enterprises under study (Figure 3.7).

The analysis of average scores shows that the main obstacles in the activities of industrial enterprises in Bukhara region are related to the institutional environment, financing opportunities, and depreciation of fixed assets. At the same time, there are certain positive shifts in the areas of digitalization and state support, and these directions can serve as a reference point for industrial development.

Figure 3.7. Average scores of respondents for each question in the survey developed to study the activities of industrial enterprises in Bukhara region

The internal consistency and reliability of the survey questions were assessed using Cronbach's Alpha coefficient:

where k is the number of questions (10), σ_i^2 is the variance for each question, and σ_t^2 is the total score variance.

According to the calculation results, the Cronbach's Alpha coefficient equals $\alpha = 0.82$, which indicates that if $\alpha \geq 0.7$, reliability is good, and if $\alpha \geq 0.8$, reliability is high. Therefore, this survey is considered reliable and suitable for analysis.

In addition to checking the internal consistency and reliability of the questions (Cronbach's Alpha) in the above survey, it is also appropriate to conduct KMO (Kaiser-Meyer-Olkin) index, Bartlett's Test of Sphericity, and Exploratory Factor Analysis (EFA), which is explained by the following:

First, the KMO index evaluates the degree of intercorrelation among survey questions and determines whether the data are of sufficient quality for factor analysis. If the KMO value is low, EFA results will not be reliable.

Second, Bartlett's Test of Sphericity proves the existence of statistically significant correlations among questions by testing whether the correlation matrix is not equal to the identity matrix. This is one of the necessary conditions for conducting factor analysis.

Third, Exploratory Factor Analysis enables the identification and grouping of underlying latent factors behind numerous questions. Through this method, survey results can be systematized and generalized.

Fourth, with the help of these analyses, the degree to which questions complement or duplicate each other is determined, creating an opportunity for methodological improvement of the questionnaire.

Fifth, based on EFA results, it becomes possible to separate the problems troubling industrial enterprises into large factor blocks, which is of significant importance in economic policy and practical decision-making.

Sixth, KMO and Bartlett tests confirm that EFA results are statistically grounded, increasing the reliability of conclusions drawn in the scientific work.

Table 2

Summary of KMO Index, Bartlett's Test, and EFA Analysis for the Survey Developed to Study the Activities of Industrial Enterprises

Method	Formula	Description
KMO (Kaiser-Meyer-Olkin) Index	<i>[Formula]</i>	The KMO index evaluates the suitability of survey data for factor analysis, assesses the existence of common (latent) factors among questions, and answers the question: "Are the questions sufficiently intercorrelated and can they be explained through several common factors?"
Bartlett's Test of Sphericity	<i>[Formula]</i>	Bartlett's test examines the following hypothesis: H_0 (null hypothesis): the correlation matrix equals the identity matrix (I), i.e.,

		questions are not intercorrelated. H_1 (alternative): questions are intercorrelated, factor analysis can be conducted. If H_0 is rejected, EFA can be performed.
Exploratory Factor Analysis (EFA)	<i>[Formula]</i>	EFA aims to identify the common (latent) factors hidden behind numerous survey questions. Through this, the internal structure of the data is revealed. This analysis enables combining questions into thematically related groups, i.e., simplifying complex data. EFA shows the extent to which survey questions measure a single factor, evaluating their conceptual consistency. As a result of the analysis, repetitive or low-significance questions are identified, creating an opportunity to improve the questionnaire. The factors identified through EFA serve to strategically determine priority problems in industrial development.

The analysis results show that $KMO = 0.80$, which confirms that the survey data are very well suited for factor analysis and that full application of the EFA analysis method is appropriate. Additionally, since Bartlett's Test ($\chi^2 = 176.5$; $p < 0.05$), it confirms the existence of correlation among the questionnaire questions, i.e., the presence of statistically significant relationships, which in turn confirms the feasibility of conducting factor analysis.

As a result of EFA analysis, 3 main factors were identified (Factor 1: Production-Resource Factor (Q1, Q2, Q8); Factor 2: Institutional-Financial Factor (Q6, Q7, Q10); Factor 3: Human Capital and Market Factor (Q3, Q4, Q5, Q9)). "These factors explain 71.2 percent of the total variance," meaning that according to the Exploratory Factor Analysis (EFA) results, a large portion of the variance observed in the survey data corresponds to several main factors. That is, 71.2 percent of the dispersion (variance) of responses across all observed questions was formed under the influence of the three identified latent factors. This means that the main portion of differences and changes among the survey questions can be explained not by separate, independent random causes, but through common, systematic factors. The remaining 28.8 percent of variance corresponds to specific factors, individual characteristics, or measurement errors.

From a statistical perspective, in socio-economic research, explaining 60–70 percent or more of variance by factors is considered a good and sufficient result. Therefore, the 71.2 percent indicator shows that the selected factors adequately and reliably reflect the

internal structure of the survey data. Hence, this result means that the factor model is substantively grounded, methodologically correct, and suitable for further analyses and scientific conclusions.

Thus, based on the results of KMO and Bartlett tests and Exploratory Factor Analysis, the main problems affecting the activities of industrial enterprises in Bukhara region consist of three main factors related to production-resources, institutional-financial aspects, and human capital and market.

In conclusion, the analysis results show that in Bukhara region's industry: the main problems are related to the institutional environment, financing, and the condition of fixed assets; digitalization and state support measures are being evaluated relatively positively; and for the intensive development of production, it is necessary to facilitate access to financial resources, reduce administrative barriers, and accelerate technical modernization.

The analysis of current issues in the development of industry and industrial sectors in the Bukhara region shows that the region possesses substantial industrial potential, yet its structural composition requires deep modernization and diversification to ensure long-term sustainable growth. Historically, the industrial profile of the Bukhara region has been strongly influenced by extractive and energy-intensive sectors, particularly oil and gas production, petrochemicals, and related processing industries. These sectors generate significant revenues and contribute to regional economic stability; however, their dominance also creates structural dependence on global commodity markets and exposes the region to price volatility and external economic risks.

One of the central challenges is the limited diversification of industrial activities. The share of high value-added manufacturing industries remains insufficient, and the development of technologically advanced sectors is relatively slow. As a result, the region's industrial growth is often quantitative rather than qualitative. Productivity levels in certain sectors lag behind international standards, partly due to outdated equipment, insufficient digital integration, and limited research and development activity.

Another important issue concerns innovation capacity and technological modernization. While national industrial policies promote digital transformation and modernization, the practical implementation at the regional level faces financial, institutional, and human capital constraints. Enterprises, particularly small and medium-sized industrial firms, often lack access to long-term investment resources necessary for technological upgrading. Moreover, cooperation between industrial enterprises and research institutions remains underdeveloped, limiting the creation of innovation ecosystems.

Infrastructure and logistics also play a crucial role in industrial competitiveness. Although Bukhara has strategic geographic advantages, improvements in transport connectivity, energy efficiency, and digital infrastructure are necessary to enhance

integration into national and international markets. Efficient infrastructure directly influences production costs, export potential, and investment attractiveness.

Environmental sustainability represents an additional strategic challenge. The dominance of energy-intensive and extractive industries increases ecological pressure, including air pollution, water use intensity, and greenhouse gas emissions. In the context of global climate change and green transformation, industrial development must align with environmental standards and sustainable development principles. Without the adoption of resource-saving technologies and renewable energy solutions, long-term industrial competitiveness may be compromised.

In light of these challenges, several strategic directions should be prioritized. First, the region must actively pursue industrial diversification by supporting sectors capable of generating higher value-added output, such as advanced manufacturing, food processing, textile clusters, construction materials, and chemical processing. Diversification will reduce structural dependence and enhance economic resilience.

Second, technological modernization and digital transformation should become core priorities. The introduction of automation, smart manufacturing systems, digital management platforms, and energy-efficient technologies will increase productivity and product quality. Government support mechanisms—such as tax incentives, preferential financing, and innovation grants—can accelerate this process.

Third, strengthening human capital development is essential. Modern industrial growth requires qualified engineers, technicians, and innovation specialists. Expanding vocational education programs, improving technical training, and encouraging collaboration between universities and enterprises will create a skilled workforce aligned with industry needs.

Fourth, environmental transformation must be integrated into industrial policy. Promoting green technologies, circular economy practices, and renewable energy integration will reduce ecological risks and align regional development with global sustainability trends.

Finally, enhancing integration into global value chains is crucial for improving competitiveness. Supporting export-oriented enterprises, improving quality standards, and developing certification systems will allow Bukhara's industrial products to access broader markets.

In conclusion, the sustainable development of industry in the Bukhara region depends on a balanced approach that combines diversification, innovation, modernization, environmental responsibility, and human capital investment. A comprehensive regional industrial strategy based on these principles will strengthen economic resilience, increase competitiveness, and ensure long-term socio-economic development.

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