МИНИСТЕРСТВО НАУКИ И ВЫСШЕГО ОБРАЗОВАНИЯ РЕСПУБЛИКИ КАЗАХСТАН

ISCA INTERNATIONAL SCIENCE COMPLEX ASTANA

US ATYRAU OIL AND GAS UNIVERSITY

АКИМАТ АТЫРАУСКОЙ ОБЛАСТИ

REGIONAL MAP

OF HUMAN RESOURCE NEEDS OF ATYRAU REGION

LIST OF ABBREVIATIONS

AIC	Agro-Industrial Complex
AI	Artificial Intelligence
ANPZ	Atyrau Oil Refinery
AR	Augmented Reality
BIM	Building Information Modeling
CAD/CAE/CAM	Computer-Aided Design/Engineering/Manufacturing
CI/CD	Continuous Integration/Continuous Delivery
E-gov	Electronic government
EP	Educational Program
ERP	Enterprise Resource Planning
ESG	Environmental, Social, Governance
GIS	Geographic Information System
GPS	Global Positioning System
GRP	Gross Regional Product
HACCP	Hazard Analysis and Critical Control Points
Halal	Halal (Permitted/lawful according to Islamic standards)
HSE	Health, Safety, Environment
ISO	International Organization for Standardization
IoT	Internet of Things
IT	Information Technology
MES	Manufacturing Execution System

ML	Machine Learning
NCOC	North Caspian Operating Company
NDVI	Normalized Difference Vegetation Index
PLC	Programmable Logic Controller
R&D	Research and Development
Refinery	Oil Refinery
SCADA	Supervisory Control and Data Acquisition
SME	Small and Medium-sized Enterprises
SMM	Social Media Marketing
SOC	Security Operations Center
SW	Software
TCO	Tengizchevroil
TVET	Technical and Vocational Education and Training
VR	Virtual Reality

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INTRODUCTION

The sustainable development of the socio-economic system of any region, including the Atyrau Region, is inextricably linked to the systematization of personnel policy and mitigating the imbalance in the labor market.

The Atyrau Region, one of the most dynamically developing regions of Kazakhstan, faces the problem of high dependence on the raw materials sector: the share of the oil and gas sector in the volume of industrial production stands at 88%.

The personnel problem is exacerbated by technological transformation, which requires constant changes in the complex of specialist competencies.

In this regard, to ensure the staffing of the region's strategic objectives, a Regional Card of Personnel Needs has been developed. This is the result of a comprehensive socio-economic study, including the following quantitative, qualitative, and strategic methods:

- Preliminary strategic analysis of the region's socio-economic development, aiming to identify points of growth and five priority industries for the diversification of the regional economy.
- Sociological research: 830 respondents from the general population were surveyed, as well as 406 representatives of educational organizations and 201 business representatives. The purpose of the survey was to identify the level of public satisfaction with their profession, analyze personnel training issues, and determine new competency requirements.
- Foresight session: Expert forecasting became a key methodological tool that allowed for the definition of the Vision of the Future, the identification of main trends, threats, and opportunities, as well as the compilation of a complete list of new and transforming professions. It was this analysis that allowed information to be structured across five priority industries: Tourism, the Agro-industrial complex, Manufacturing and Food Industry, as well as the IT industry and Digitalization.
- In-depth interviews with experts became a key element of the methodological approach in developing the Regional Card of Personnel Needs for the Atyrau Region. These supplemented the quantitative analysis (surveys) with strategic and qualitative data, allowing for the identification of strategic factors influencing regional development, personnel requirements, new professions, trends, and threats for the five priority industries of the Atyrau Region under consideration.
- Professional diagnostics of schoolchildren: Within the framework of the project on the EduNavigator platform, 10,233 9th-grade students from 101 schools in the region were tested. The diagnostics, based on J. Holland's theory (RIASEC model), allow for the correlation of students' interests and abilities with current labor market requirements, which is critically important for the effective planning of educational trajectories.

The Regional Card of Personnel Needs is designed to serve as a connecting link between the labor market, the education system, and economic development. It helps identify imbalances between supply and demand and allows educational institutions to adapt educational programs to real market requests.

The Card must become the basis for the formation of human capital in the context of the transition to a new economic formation, where strategic stability is ensured by the development of digital competencies, support for small and medium-sized businesses, infrastructure modernization, and environmental sustainability.

Serik Zhambylovich Shapkenov
Akim of the Atyrau Region

WELCOMING SPEECH BY THE AKIM OF THE ATYRAU REGION

The modern era is a period of rapid change in which technology, knowledge, and human capital play a decisive role. The Atyrau region is one of the economic pillars of our country and a donor region making the largest contribution to the republican budget. However, the current stage of development demands that we diversify the economy, strengthen new sectors, and adapt the labor market to future requirements. In this regard, quality personnel training is the main prerequisite for the region's sustainable development.

Developed with this goal in mind, the Atlas of New Professions of Atyrau Region is a strategic document that defines the new face of the regional economy. It covers not only the current situation in the labor market but also the professions that will be in demand in the coming 5–10 years, enabling systematic planning of personnel policy.

The Atlas was prepared based on an in-depth analysis of socio-economic indicators, as well as surveys and expert meetings conducted with the business community, educational organizations, and representatives of local society. As a result, five key priority directions for the region were identified.

The first direction is Tourism. The Caspian coast, historical and cultural heritage, and the development of eco-tourism and domestic tourism open new economic opportunities for the Atyrau region. In this sector, the demand for tourism managers, guides, service specialists, and employees in the hotel and restaurant business is growing.

The second direction is the Agro-industrial Complex. The technological modernization of agriculture, product processing, and the development of logistics and agro-service sectors strengthen the need for agronomists, veterinarians, agro-engineers, and farm management specialists.

The third direction is the Food Industry. Processing local produce, ensuring food security, and developing export-oriented production require technologists, quality control specialists, production managers, and marketers.

The fourth direction is the Manufacturing Industry. While the oil and gas sector continues to play an important role in the region's economy, in the coming period, primary growth must be ensured through the development of the manufacturing sector. The production of construction materials, machine building, chemical, and service industries will increase the demand for engineers, technical specialists, and skilled workers.

The fifth direction is Digitalization and IT Industries. The efficiency of every sector is directly linked to digital solutions. IT specialists, data analysts, and managers of automation, cybersecurity, and digital projects are becoming the new drivers of the regional economy.

Thus, the Atlas of New Professions is aimed at diversifying the economy by gradually reducing the Atyrau region's dependence on the oil and gas sector. While the need for personnel in the oil and gas sector remains, priority is given to training competitive, universal, and modern specialists in new industries.

Within the framework of the Year of Working Professions – 2025, declared by the Head of State, the technical and vocational education system in the Atyrau region is being modernized, and dual education is being expanded. Colleges and universities are adapting to the specific demands of the regional economy and are working in close partnership with employers.

The role of the business community in this process is exceptional. I invite entrepreneurs, investors, and production representatives to actively participate in personnel training. Internships, targeted training, and professional development programs are effective mechanisms for strengthening the region's human capital.

The Atlas of New Professions is not merely a career guidance tool; it is a shared strategic guideline for the future development of the Atyrau region. It opens new opportunities for youth and unites the education system, business, and society toward a single goal.

May the Atlas of New Professions serve to increase the economic power and sustainable development of the Atyrau region! I am confident that it will pave the way for every citizen to realize their professional potential and serve as a solid foundation for the region's bright future..

NURBEK SAYASAT
Minister of Science
and Higher Education
of the Republic of Kazakhstan

WELCOME SPEECH BY THE MINISTER OF SCIENCE AND HIGHER EDUCATION OF THE REPUBLIC OF KAZAKHSTAN

Dear Friends

In welcoming you today, I believe it is crucial to highlight one of the priority tasks for our region's development: the creation of the Regional Personnel Needs Map.

This tool is designed to play a pivotal role in training the specialists who will form the foundation of the Atyrau region's sustainable development.

The Head of State, Kassym-Jomart Kemelevich Tokayev, has declared 2025 the "Year of Working Professions." This declaration underscores, once again, the growing importance of vocational trades and working professions to our national economy.

Establishing the Regional Personnel Needs Map is a strategic decision aimed at building a solid foundation for the economic growth and development of the Atyrau region.

This Map will enable us to better understand which professions will be in demand in the coming years and to focus our efforts on training specialists for priority industries.

The development of the following key economic sectors is vital for the region: the agro-industrial complex, the food industry, manufacturing, digitalization and the IT industry, and tourism. To analyze these priority industries, foresight sessions were conducted involving over 90 experts employed at the region's leading enterprises and institutions.

The Regional Personnel Needs Map will allow for more precise planning of educational programs and the enhancement of both vocational training and higher education systems. Furthermore, it will ensure that industries critical to the region's economic growth are supplied with qualified personnel.

During the development of the Regional Map, career guidance diagnostics were administered to students in 100 schools across the region, covering more than 10,000 schoolchildren.

For high school students and their parents, the Regional Map will serve as a tool for making an informed choice regarding their future profession. At the same time, we face the large-scale task of training highly qualified personnel for the future.

We must act proactively to provide the Atyrau region with personnel capable of shaping the economy of tomorrow.

Thank you for your attention, and I wish you success in the implementation of this important mission.

1. WHY IS THE REGIONAL MAP OF PERSONNEL NEEDS NECESSARY, AND WHO NEEDS IT?

Economic Planning and Development:

• The Map allows for the identification of industries experiencing a shortage or surplus of qualified workers, which helps optimize the development of key economic sectors.

• It helps avoid imbalances between supply and demand in the labor market.

Alignment of Educational Programs:

• Enables educational institutions to **adapt educational programs** to meet actual market demands.

• Mitigates the risk of graduating specialists who cannot find employment in their field.

Support for Social Stability:

• Helps reduce unemployment rates by training personnel for in-demand professions.

• Reduces the out-migration of the working-age population to other regions.

Optimization of Investments:

• Enables government authorities and businesses to allocate resources more effectively for the training and retraining of specialists.

WHO NEEDS IT?

Government Authorities:

• For developing employment policies, as well as educational and social programs.

• For stimulating investment in key sectors of the economy.

Educational Institutions:

• For understanding which specialists will be in demand in the coming years.

• For adjusting the profile and content of instruction.

Employers:

• For planning long-term HR policies and employee training.

• For participating in the shaping of educational programs through partnerships with universities and colleges.

Regional Residents:

• For identifying the most promising professions and planning career paths.

• For selecting educational tracks that will ensure employment.

The Regional Map of Personnel Needs serves as a connecting link between the labor market, the education system, and economic development, fostering the harmonious development of the region.

2. OPINIONS OF BUSINESS, EDUCATORS, AND REGIONAL RESIDENTS ON THE REGION'S FUTURE

The sustainable development of the socio-economic system of any region, including the Atyrau region—one of the most dynamically developing regions of Kazakhstan—is inextricably linked to the systematization of personnel policy and the mitigation of labor market imbalances. Problems regarding workforce training are exacerbated by technological transformation, political instability, and foreign sanctions, which necessitate constant adjustments to the competency profiles of specialists. The Atyrau region, where the oil and gas sector accounts for **88%** of industrial production volume, plans further development in oil refining, petrochemicals, the production of building materials, and the agro-industrial and fishery sectors.

To investigate the opinions of key groups regarding staffing, major training challenges, and new competency requirements, a sociological survey was conducted involving **830** respondents from the general population, as well as representatives from educational organizations and the business sector (**406 and 201** individuals, respectively). Studying the opinions of the population, educators, and business representatives allows for the development of educational programs that align with the region's current demands.

2.1 Business: The Future We Anticipate

Representatives of industry and business in the Atyrau region 201 respondents, including:

view the region's future through the prism of intensive technological and sectoral development.

Intensively Developing Industries and Staffing Problems

According to business representatives, the most intensively developing industries in the Atyrau region are:

- Mining and quarrying.
- Transportation and warehousing.
- Water supply, sewerage, waste management, and remediation activities.
- Electricity, gas, steam, and air conditioning supply.
- Wholesale and retail trade; repair of motor vehicles and motorcycles.

Despite this development, respondents highlight acute staffing problems in sectors such as Construction, Manufacturing, Financial and Insurance activities, as well as in Mining and quarrying.

Key issues regarding staffing and motivation identified by business include:

1. **The workforce does not meet employer requirements** (in terms of education level, training profile, and qualification level).
2. Employers **fail to create attractive conditions** for employment within the domestic market.
3. The accelerated implementation of innovative methods and modern technologies creates a **lag in the training of personnel** with the necessary qualifications.
4. Employees often work outside their specialty because their **actual qualifications are lower** than the required level.

Factors and Trends Shaping the Future

The primary factors influencing the future of the industries in which respondents operate were identified as the General State of the Regional Economy and the Resource Potential of the Industry (availability of labor, natural, material, and information resources). Notably, 94% of respondents believe that current legislation has a positive impact on the future of their industry.

Among the current trends and future technologies observed in Kazakhstan, the following were highlighted:

- **Digitalization** of all spheres of life
- **Automation** the widespread introduction of robots and smart systems
- **Acceleration** of technological and social changes
- **Eco-friendly production and services,** strengthening of environmental regulations

In-Demand Competencies

In a rapidly changing environment, organizations must concentrate on unique combinations of skills. When assessing their own skills, business representatives highly rated

48% **Digital Literacy**

21% **Emotional Literacy**

Regarding specific competencies possessed by respondents (and, consequently, those important for the future):

Possess the competency "Project and Process Management" at a high level	32%
Possess the competency "Lean Manufacturing" at a sufficient level	17%
Possess it at a sufficient level	11%

2.2. Educators: Education as the Gravity of the Future

Representatives of the education system (406 individuals, 41% of whom have over 20 years of experience) assessed the system's readiness to train personnel of a new formation required for the implementation of the region's major investment projects. The survey included educators from secondary schools (37%), TVET organizations (35%), and HEIs (24%).

Quality of Training and Developed Competencies

The assessment of the quality of pedagogical training in the modern education system is mixed:

Overall, the modern education system successfully develops the following qualities and competencies in teaching staff:

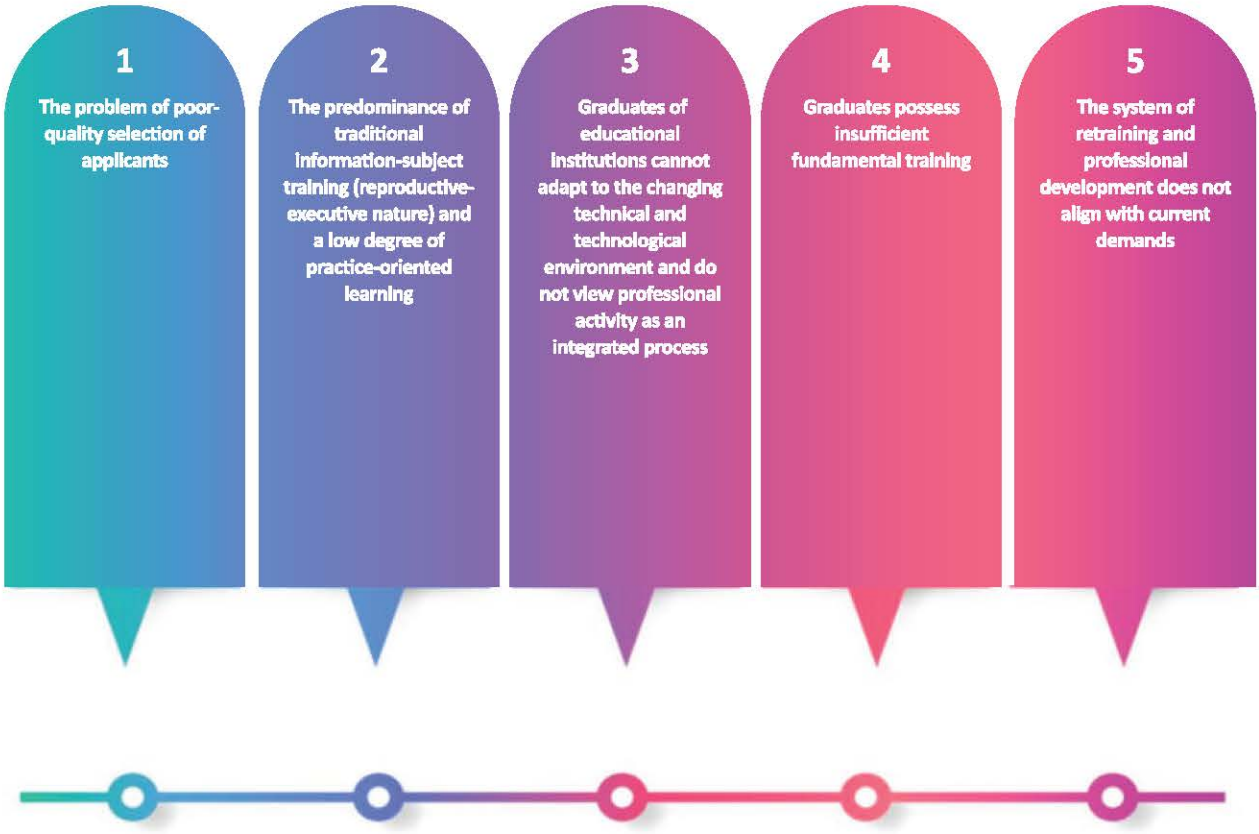
- **Empathy** the ability to "sense" the student
- **Self-organization** high work capacity, planning
- **Self-reflection** analysis of one's own feelings and behavior
- **Ability to set goals and objectives** in accordance with the age characteristics of students.
- **Creation of conditions ensuring positive motivation** of students

Among competencies in the informational basis of activity, **competence in teaching methods and competence in the subject of teaching** are developing qualitatively.

In the area of activity program development and decision-making, educators note the ability to **select and implement an educational program and make decisions in pedagogical situations.**

Major Challenges of the Education System

Despite positive aspects, educators highlight a number of systemic problems related to personnel training that must be resolved to secure the region's future:



For the Atyrau region, where the Comprehensive Development Plan is being implemented (creating 9,200 jobs in industry and 1,700 jobs in entrepreneurship by 2025), providing "new formation" personnel is critically important.

2.3. The Population: Readiness for New Professions

A survey among the population (**830 people, 78% from the city of Atyrau, 73% male**) allows for an assessment of their satisfaction with the current situation and their readiness for the changes necessary for the region's development.

Labor Activity and Satisfaction

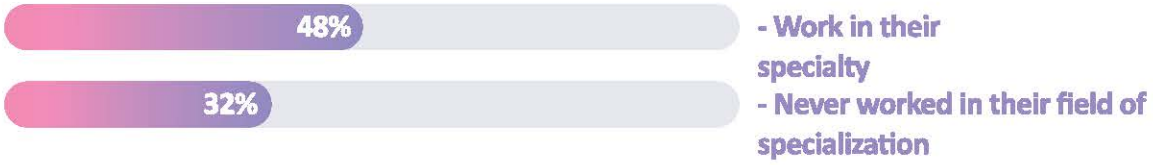
A significant portion of respondents **(41%)** are employed in state organizations, while **40%** of working respondents are employed in **industry.**

41% is employed

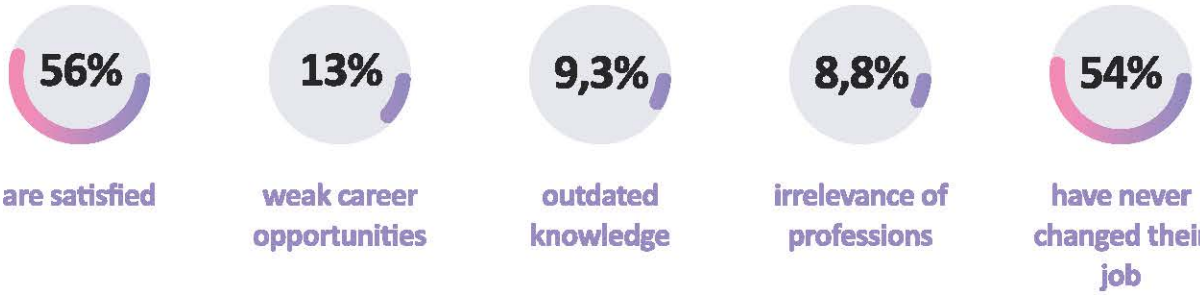
40% work in industry

Satisfaction with their labor activity among the population of the Atyrau region is quite high:

However, despite general satisfaction with current work, there are difficulties utilizing the specialty obtained via their diploma:



Satisfaction with the specialty itself is also high



Confidence in the Future and Mastering New Skills

The population of the Atyrau region demonstrates a high level of confidence in their future:

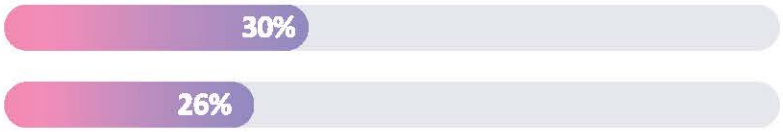
49% fully confident

30% are confident

When assessing their emotional attitude toward the future, **34%** noted **"Confidence (hope, joy, delight),"** and **25%** noted **"Calmness."**

Readiness to Master New Professions:

The region shows significant potential for retraining, which is critically important in the context of digitalization and automation.



The population is ready to master new specialties in sectors that correspond to the strategic development of the region:

- Industry
- Education
- Transport
- Agriculture

The preferred formats of learning for mastering new professions are **blended (hybrid) and distance learning formats.**

Financial Situation

The level of material well-being in the region, where the GRP exceeds 9.5 million tenge per capita, is quite high

Businesses, educators, and the general public all agree on one thing

The opinions of business, educators, and the population converge on one point: the future of the Atyrau region is inextricably linked to technological renewal and deepening specialization. The region has strong economic potential and a highly motivated population, 30% of whom are ready to master new professions, primarily in key development sectors (Industry, Agriculture, Transport).

INDUSTRY

AGRICULTURE

TRANSPORT

However, to successfully transition to an economy of a new formation, serious skills gaps must be eliminated. Business notes that the workforce does not meet requirements in terms of qualification levels and records a low level of competence in Programming, Robotics, and AI. Educators confirm this problem, pointing to poor quality selection of applicants and low practice-orientation of training.

PROGRAMMING

AI

ROBOTICS

Implementing the Comprehensive Development Plan of the region and securing investments exceeding 5.5 trillion tenge requires personnel of a new formation who possess digital and emotional literacy as well as management competencies. Given the population's readiness for hybrid and distance learning formats, as well as the identified problems in the traditional training system, the transition to continuous education oriented toward practical skills and current industry demands becomes a key condition for ensuring the sustainable future of the region.

3. THE FUTURE OF THE TOURISM INDUSTRY IN THE ATYRAU REGION

3.1. Expert Opinions

THE FUTURE OF THE TOURISM INDUSTRY IN THE ATYRAU REGION

SULTANOVA LYAZZAT TALGATOVNA
Deputy Director of the KSI "Tourist Information Center 'Visit Atyrau'" of the Department of Physical Culture, Sports and Tourism of the Atyrau Region

- What are the main factors determining the socio-economic development process of your region?

The main driver of the Atyrau region's economy is the **oil and gas sector,** which generates the bulk of budget revenues and provides jobs. Economic growth is also facilitated by the region's geographical location, proximity to the Caspian Sea, developed transport infrastructure, and wealth of natural resources (oil, gas, fishery resources). A significant role is played by social infrastructure (education, healthcare, housing construction), as well as the investment climate and the attraction of domestic and foreign investment.

The region leads in the share of the country's GDP structure—about 11%. The industrial sector is actively developing: of 52 implemented projects, 80% are concentrated in the city of Atyrau, with investments in these projects totaling 728.4 billion tenge.

Tourism can become a strategic direction for the diversification of the regional economy. The experience of developed countries shows that tourism can become a primary source of income, creating new jobs and developing related infrastructure—hotels, restaurants, and excursion routes.

Identify the negative development trends in your region.

The Atyrau region faces a number of negative trends slowing socio-economic development. First and foremost is the **economic dependence on the oil and gas industry,** which makes the economy vulnerable to external shocks caused by fluctuations in world oil prices. There is **weak development of small and medium-sized enterprises (SMEs),** which experience difficulties accessing financing and implementing technologies, limiting economic diversification. Additionally, there is a **migration of youth** leaving the region in search of better career opportunities, leading to a shortage of personnel in promising industries, including tourism and IT. Furthermore, there are **environmental risks** associated with the burden on the environment from the oil and gas industry, threatening public health and tourism development.

In your opinion, what threats exist that the leadership of your region will need to eliminate in the near future?

The main threats include **environmental degradation,** a reduction of jobs in traditional industries, a **shortage of qualified personnel** in tourism, IT, and service sectors, as well as a slowdown in the implementation of digital technologies. Without active measures to diversify the economy, the region will remain heavily dependent on the oil and gas sector. Eliminating these threats requires a comprehensive approach, including diversification, tourism development, personnel training, and investment in infrastructure and environmental protection.

Provide an approximate forecast of the state of your region if current trends continue over a 5-10 year horizon.

If current trends persist (industrial growth of about 17.6% for January-September 2025 and the activation of tourism), the region will **remain key to the country's economy.** Provided tourism and services develop, an expansion of the non-resource sector, improvement in the quality of life, and increased employment in the service sector are possible. However, if diversification is not pursued, there is a risk of stagnation outside the oil and gas sector

3.1. Expert Opinions

THE FUTURE OF THE TOURISM INDUSTRY IN THE ATYRAU REGION

UTEGALIEVA AYGUL AMANKUSOVNA
Head of "ALDANATUR" LLP

What are the most promising areas of activity, work options, and future developments that need to be cultivated in your region?

It is worth developing the sphere of tourism, the hotel business, and IT services. Professions such as tour guides, tourism managers, marketers, and PR and SMM specialists are in demand. The development of small businesses—coffee shops and family hotels—is also promising.

In your view, which professional knowledge, skills, and abilities do modern college and HEI educational programs fail to form sufficiently?

Modern programs insufficiently develop **communication skills,** project management, **digital marketing, and sales.** Students often receive only theoretical knowledge but do not know how to apply it in practice, which reduces their readiness for real work.

What promising professions, specialties, and qualifications currently in demand in your region can you list?

Promising and in-demand professions include **tourism manager, SMM specialist, marketer, IT developer, and ecologist.** It is expected that all these professions will actively develop in the coming years.

What actual trends and technologies of the future do you observe globally?

Modern global trends include **digitalization and automation** in all spheres, from oil and gas to tourism. There is a trend towards **green and renewable energy,** opening opportunities for the development of environmental projects and **tourism** in the region. Global trends show that tourism is becoming a key source of income. **Artificial intelligence and data analytics** are also of significant importance, helping to optimize business processes and increase marketing effectiveness.

3.1. Expert Opinions

THE FUTURE OF THE TOURISM INDUSTRY IN THE ATYRAU REGION

SYDYKOV NURBOL
Head of the Department of Physical Culture, Sports and Tourism of the Atyrau Region

What factors influencing the development of your professional industry (tourism) can you name?

Tourism development is facilitated by state support measures implemented since 2022. These include subsidizing the costs of maintaining sanitary facilities, reimbursing part of the costs for the construction of roadside service facilities, as well as compensating part of the costs for the construction/ reconstruction of tourism activity objects. Furthermore, a portion of the costs for purchasing vehicles with a capacity of more than eight seats for tourism activities is compensated. To promote the industry, the "Visit Atyrau" tourist information center was created.

What key trends and future technologies do you observe at this time in your region?

Trends related to digitalization, Smart City elements, digital educational platforms, and remote learning systems are actively developing in the region. in the field of tourism, the "Visit Atyrau" tourism website was created in 2024, constantly updated with information in three languages; virtual tours and interactive maps of historical sites using 3D modeling are also being developed. For the convenience of tourists, QR codes with information about the region's tourism potential are placed at the airport, railway stations, bus stations, and stationary police posts.

Identify the key moments and potential opportunities that should be relied upon for the development of your region.

One should bet on eco-tourism, utilizing objects such as the Inder Salt Lake with its healing properties and muds, as well as the lotus field in the Kigash River area, which is rare globally. The Inder Salt Lake, containing 16 types of minerals, has great potential for the development of health and wellness tourism and attracting both domestic and international tourists. It is important to use these and many other natural resources to stimulate the local economy.

What directions of transformation in the professional training system would you suggest (in the sphere of tourism)?

To ensure high-quality and sustainable tourism development, it is necessary to open tourism specialties in all colleges and HEIs in the region, including the training of tourism managers, guide-interpreters, tour guides, and specialists for the hotel and restaurant business. Curricula should be updated taking into account international experience. Students need to undergo internships directly in travel agencies, hotels, and airports. It is extremely important to include the mandatory study of foreign languages, including English, as well as the in-demand Chinese, Turkish, German, and French languages.

3.1. Expert Opinions

THE FUTURE OF THE TOURISM INDUSTRY IN THE ATYRAU REGION

TASKALIEVA GAUKHAR BOLATOVNA
Senior Lecturer, Faculty of Natural Sciences, NJSC "Kh. Dosmukhamedov Atyrau University"

List the strengths of your region at the current stage.

Strengths include the **youth, who are not afraid of learning new things** and strive for maximum development. Thanks to social networks, young people find new professions, which contributes to an **increase in the number of small businesses.** Also, workers in the oil industry and business people, thanks to high incomes in the oil sphere, vacation more often and choose more interesting destinations, which stimulates the development of tourism and service.

In your opinion, in which industry of your region are business organizations developing most intensively and increasing in number?

Atyrau leads in business projects, with a large number of business services. Speaking more specifically, **travel agents, dentists, and coffee shops** are developing most intensively. Also, the self-distribution of products produced within Atyrau is being observed.

What actual staffing problems are observed in the industry (tourism) where you work?

There is an acute personnel problem because today's youth **want to earn a lot and immediately**. At the same time, young people do not always understand that **experience, patience, and the development of communication skills** are important in tourism.

In which industry of your region are staffing problems felt most acutely?

The greatest shortage of personnel is felt in the sphere of tourism, hotel management, service, and IT. There is often a lack of qualified specialists who know how to work with clients, use modern technologies, promote products online, and speak competently.

3.1. Expert Opinions

THE FUTURE OF THE TOURISM INDUSTRY IN THE ATYRAU REGION

BEKENOVA ROZA ABILMAZHINOVNA
Director of "PLANETA.KZ" LLP

What knowledge, skills, and abilities are current and in demand today in the Atyrau region?

Currently, the following are especially important:

— Knowledge of native and foreign languages (Kazakh, Russian, English, Chinese),

— Communication skills with patients,

— Digital literacy, working with online consultations,

— Service and attention to detail,

— Treatment via modern and minimally invasive methods,

— Compliance with international standards and qualifications.

What factors influencing the development of your professional industry (medical tourism) can you name?

The main factor is economic: treatment here is cheaper than in Russia. The second is geographical: proximity to Astrakhan and Volgograd. There is railway transport or access by car.

If our residents go to Astrakhan for a diagnosis, then by developing medicine, we can direct the flow to us in Atyrau.

Improving the quality and reputation of medicine in Atyrau. Internships for doctors abroad, certificates, and international licenses. Popularization of reviews and patient cases.

Information activity: having a website, social networks, reviews, videos, and photos of clinic services. Online consultations before arrival are an important tool: the patient is calm, knowing what awaits them.

Visas are not required for many CIS countries, and there are direct flights.

Region's image: If the region starts promoting itself as a medical center of the Caspian region, this will attract not only Russians but also neighboring countries.

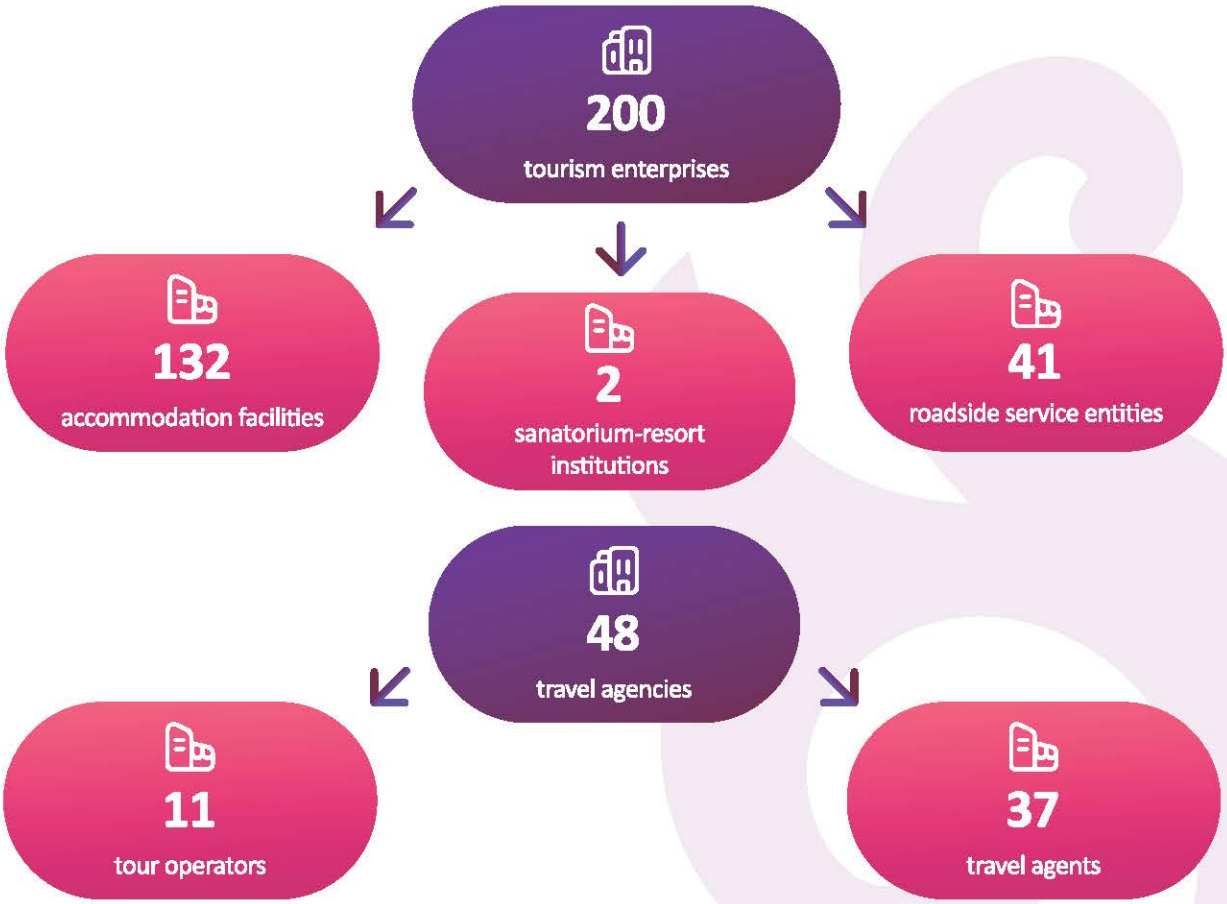
For the development of medical tourism, new professions are needed: medical coordinator, medical translator, and medical tourism manager. If a clinic wants to accept foreign patients, an International Department is needed: coordinators, translators, registrars, logistics, service, and marketing. This creates convenience and trust for patients.

Limiting factors: Insufficient advertising activity of Atyrau medicine and private clinics abroad. Lack of specialized "check-up" packages for the population and foreign tourists. Preventive examinations are conducted for employees of foreign or contractor companies. A shortage of narrow specialists of an international level.

3.2. Current State of the Industry

The Atyrau region possesses substantial potential for the development of various tourism directions, including cultural-educational, sports-amateur, ethnographic, youth, ecological, health, and agro-tourism. The presence of the Caspian Sea, the diversity of cultural and historical objects, sacred sites, and natural zones also create unique opportunities for business, event, gastronomic, and other types of tourism.

In 2024, more than 200 tourism enterprises operated in the Atyrau region: 132 accommodation facilities, 2 sanatorium-resort institutions, 41 roadside service entities, and 48 travel agencies (11 tour operators and 37 travel agents) licensed to conduct tourism activities.



The number of foreign tourists arriving in the Atyrau region over the last year was 72,844 people, which constitutes 5.7% of the total number of arrivals in Kazakhstan. In total, 171,775 people were serviced during the year.

The volume of investment in the tourism sphere amounted to more than **15.7 billion tenge**, demonstrating growth of **83%** compared to 2023, with **83%** of these investments being private.

According to tourstat.kz data, the region is among the **TOP 10 popular regions** of Kazakhstan.

Despite this, tourism remains an insufficiently developed direction of the regional economy.

The industry faces a number of systemic problems. One of the key issues is the insufficient level of professional personnel training, expressed in a shortage of specialized professionals and educational programs in the fields of tourism management, hospitality, and marketing.

Significant difficulties are observed in infrastructure:

- **Shortage of modern hotel complexes.**
- **Insufficient accessibility of tourist locations and weak tourist navigation.**
- **Low transport connectivity of districts.**

Additional challenges include a limited level of investment which, despite state support programs, hinders the modernization of facilities and the development of eco-tourism, as well as insufficient digitalization of services, causing many processes (booking, promotion) to remain fragmented.

Tourism development has the capacity to become one of the drivers of the Atyrau region's economy.

Key directions for growth are:

- Implementation of modern digital solutions, such as the use of artificial intelligence technologies, online platforms, and automated systems for promotion and tourist flow analysis.
- Improvement of infrastructure, enhancement of service quality, strengthening of state support, and attraction of investments.
- Training of qualified personnel capable of working with modern technologies and developing tourism products.

With the successful implementation of state initiatives, improvement of service levels, and active introduction of innovations, tourism possesses all the prerequisites for sustainable long-term growth and may occupy a key place in the structure of the regional economy.

3.3. Trends

1 trends *Growth in the number of cafes and restaurants/ expansion of the food service sector*

The region is seeing active expansion in the food service sector, especially establishments offering ethnic and local cuisine. This is linked to the growing interest of tourists in national gastronomy and the demand for authentic cultural experiences. This trend forms prerequisites for the development of gastronomic tourism and requires improving service levels, standardizing quality, and training professional chefs specializing in regional cuisine.

2 trends *Increase in historical and architectural research*

Attention is increasing toward the study of the cultural heritage of the Atyrau region and the development of projects to preserve and research historical and architectural objects. This trend strengthens interest in cultural-educational tourism and contributes to the emergence of new routes and interactive museums. However, it requires funding, qualified specialists, and programs to popularize historical materials among the population and tourists.

3 trends *Growth in demand for medical examinations and treatment abroad*

There is a tendency for an increasing number of regional residents to travel to other countries for medical examinations, treatment, and rehabilitation. This is associated with the desire to receive high-tech care, access to highly specialized experts, and modern diagnostic methods. This trend stimulates the development of medical tourism while simultaneously highlighting the necessity of modernizing local medicine and improving the quality of medical services in the region.

4 trends *Growth in demand for ethno-tourism through participation in real traditional economic practices.*

Tourists are increasingly showing interest in deep immersion into the traditional way of life and participation in craft, pastoral, and economic practices. This forms a new format of ethno-tourism, where the central element is the experience, not just observation. The trend requires the creation of professionally organized ethno-villages (auyls), safe conditions for participation, trained guides, and systemic support programs for local communities.

5 trends *Increased interest in eco-tourism, retreats, and wellness directions*

The region demonstrates steady growth in requests for eco-friendly types of recreation, retreat centers, health recovery programs, meditation, and solitude in nature. This is connected to the general global trend of caring for mental and physical health. Realizing this potential requires the development of ecological infrastructure—eco-trails, glamping sites, conservation projects, and quality media support.

6 trends *Growth in the number of expats in the oil and gas industry and related sectors*

The presence of major oil and gas projects leads to an increase in the number of foreign specialists residing in the region. This strengthens the demand for comfortable urban infrastructure, quality services, international schools, and English-language services. Expats become a significant audience for both domestic tourism and the international image of the region.

7 trends *Increased tourist attention to the Atyrau region as a driver of industrial tour*

The Atyrau region is strengthening its position as an industrial center, which forms interest in industrial tourism: visiting production facilities, oil and gas enterprises, training centers, and technoparks. The trend requires the development of safety standards, routes, training programs, and cooperation with industrial companies to open sites accessible for visitation.

8 trends *Growth in demand for online learning and interest in the virtual world*

A noticeable increase in the number of users of online courses, webinars, and digital educational platforms is observed. This tendency contributes to the development of virtual tourism products: 3D excursions, VR routes through sacred sites, and digital guides. The trend requires increasing digital literacy and implementing virtual reality technologies in tourism services.

9 trends *Growth in holding sports events and marathons*

The number of sports events—marathons, cycling races, triathlons, and mass outdoor activities—is increasing in the region. This forms a new segment of event and sports tourism, attracting both local residents and tourists from other regions. Supporting this trend requires infrastructure development, volunteer training, and the creation of an international-level event calendar.

Trend Clusters:

- Cultural-Historical Cluster: Unites trends related to strengthening interest in traditions, national identity, and regional heritage.

- Ecological and Wellness Cluster: Focuses on trends related to sustainability, nature recreation, and care for physical and mental health.

- Technological and Digital Cluster: Covers trends related to digital transformation, virtual formats, and online education.

3.4. THREATS

- Market saturation, decreased demand, sanitary risks, uniformity of establishments, pressure on infrastructure.

- Low wage levels: Low incomes of agricultural workers continue to contribute to labor migration to other industries.

- Income instability, lack of qualified guides.

- Rising housing and service prices for the local population, overloading of urban infrastructure.

- High costs for organization and safety, possible injuries and incidents among participants, seasonality of events, and income instability.

3.5. OPPORTUNITIES

- Growth of the region's cultural value, development of tourist routes, attraction of investments and grants, job creation, enhancement of local identity.

- Improvement of local medical service quality, development of domestic medical tourism, attraction of investments in clinics and equipment, increased competition and higher service standards, implementation of new technologies and treatment methods, strengthening of international medical cooperation.

- Development of unique tourism products, growth of local community incomes, preservation and transmission of traditional crafts and customs, creation of jobs for guides and artisans, formation of a sustainable regional image, increased interest in culture and history, attraction of domestic and international tourist flow.

- **Attraction of domestic and international tourist flow, integration with cultural and gastronomic tours.**

- **Stimulation of infrastructure development (transport, housing, medicine), growth in demand for hotel, restaurant, and entertainment services, development of industrial and business tourism, increased consumption of local goods and services, exchange of experience and knowledge between foreign specialists and local workers, attraction of foreign investment.**

- **Accessibility of education for remote regions and various population categories, growth in the number of online platforms and educational services, development of new learning formats (VR/AR, gamification, interactive courses), increase in digital literacy, expansion of international cooperation and knowledge exchange, reduction of infrastructure costs for educational institutions, integration of virtual technologies into professional and corporate training.**

- **Job creation for organizers, trainers, and volunteers, enhancement of the region's image as active and sporty, attraction of international attention and investment, integration of sports events with cultural and gastronomic festivals.**

3.6. Vision of the Future

Tourism industry personnel will become motivated and competent thanks to transparent career trajectories, competitive pay, and professional development opportunities. New skills will emerge in eco-tourism, industrial tourism, medical tourism, and digital services (VR/AR guides, wellness consultants, industrial tour coordinators).

Online learning systems, mentorship, and digital progress monitoring will allow employees to quickly adapt to market changes and new technologies. High qualification and personnel engagement will ensure growth in service quality, tourist satisfaction, and enterprise competitiveness.

Tourism enterprises will become more efficient and competitive through the implementation of modern technologies, digitalization of processes, and cost optimization. The use of online platforms, automation of booking and marketing, as well as flexible management models, will allow for reduced costs and increased profit margins.

Companies will be able to adapt to growing competition, offer personalized tourism products, and attract new customer segments. A high level of digital maturity and innovation will ensure profitability growth, resilience to external risks, and the long-term development of the industry.

3.7. NEW PROFESSIONS

1.ECO-DATA AND ECOSYSTEM DIGITAL MONITORING SPECIALIST

Horizon of Appearance: In the next 3–5 years.

Description: Works with big data to collect, analyze, and visualize information on the state of natural ecosystems (e.g., water bodies, flora, and fauna). Uses digital tools, IoT sensors, satellite data, and Geographic Information Systems (GIS) for ecosystem monitoring.

Necessary Skills: Working with IoT sensors, Geographic Information Systems (GIS), and satellite data.

2.ECO-GUIDE / TOURISM EDUCATOR

Horizon of Appearance: In the next 3–5 years.

Description: A specialist working in the field of ecological tourism who provides travelers with knowledge about natural resources, ecosystems, and the importance of their preservation. Their main task is to teach tourists environmentally responsible behavior by explaining local ecosystems and principles of sustainable tourism.

Necessary Skills: Conducting excursions, teaching tourists rules of conduct in natural zones, and ensuring safe interaction with the environment.

3.VR/AR GUIDE / INTERACTIVE EXCURSION SPECIALIST

Horizon of Appearance: In the next 3–5 years.

Description: A specialist who organizes and conducts interactive excursions using Virtual Reality (VR) and Augmented Reality (AR) technologies, immersing participants in educational and entertaining virtual worlds. They are responsible for creating unique experiences where participants can interact with digital models of objects and scenes. The profession combines knowledge in tourism, technology, and pedagogy.

Necessary Skills: Knowledge in the fields of tourism, technology, and pedagogy; the ability to create unique interactive experiences.

3.7. NEW PROFESSIONS

4.SMART SECURITY SYSTEMS OPERATOR

Horizon of Appearance: In the next 3–5 years

Description: Oversees the operation of automated and intelligent security systems: video surveillance, access control, motion sensors, and AI analytics. The specialist monitors facilities, analyzes events, prevents incidents, and ensures the safe functioning of technological solutions.

Necessary Skills: Interaction with AI systems, robotic security complexes, and digital control panels.

5.FINANCIAL ARCHITECT OF TOURISM SERVICES

Horizon of Appearance: In the next 3–5 years.

Description: Develops and manages the financial structure of digital platforms and tourism products. This professional forecasts revenue, optimizes costs, models the economics of tours, and integrates financial instruments into digital booking systems.

Necessary Skills: Analytics, strategic planning, and working with big data to increase the profitability of tourism projects.

6.SPECIALIST IN SOCIAL TOURISM AND PREFERENTIAL PROGRAMS

Horizon of Appearance: In the next 3–5 years.

Description: Develops, coordinates, and controls access to tourism services for socially vulnerable groups: children, retirees, people with disabilities, and large families. This specialist organizes preferential and subsidized programs, collaborates with government bodies, and monitors the effectiveness of implemented measures.

Necessary Skills: Social work, project management, and knowledge of the tourism industry

3.7. NEW PROFESSIONS

7.ANALYST OF CULTURAL TRENDS AND TOURISM PREFERENCES

Horizon of Appearance: In the next 3–5 years.

Description: Researches tourist behavior, identifies new destinations, popular leisure activities, and cultural practices to form in-demand tourism products. The specialist uses data from social media, booking platforms, surveys, and analytical tools to forecast demand and create tour products.

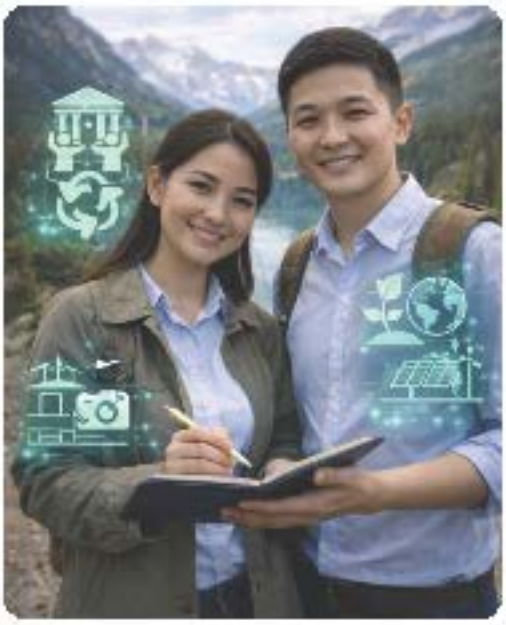
Necessary Skills: Analytical tools, demand forecasting, working with data from social media and booking platforms.

8.EXPERT IN INTEGRATING CULTURAL INITIATIVES WITH SUSTAINABLE TOURISM

Horizon of Appearance: In the next 3–5 years.

Description: Develops and implements projects that combine cultural heritage preservation with environmentally and socially responsible tourism. The specialist coordinates work with local communities, cultural organizations, and tourism companies.

Necessary Skills: Coordination with local communities and cultural organizations, project management, knowledge of sustainable tourism.



9.CONTENT CREATOR FOR TOURISM SOCIAL MEDIA

Horizon of Appearance: In the next 3–5 years.

Description: Creates visual and text content to promote tourism services, routes, hotels, and cultural events. Forms a unique brand image on social networks, interacts with the audience, and analyzes the effectiveness of publications to increase engagement and sales.

Necessary Skills: Creation of visual and text content, analysis of publication effectiveness, audience interaction

3.7. NEW PROFESSIONS

10.GAME DESIGNER FOR TOURISM QUESTS AND VR/AR EXPERIENCES

Horizon of Appearance: In the next 3–5 years

Description: Develops interactive gaming and immersive formats for tourist sites and routes. The specialist creates quest scenarios, designs levels and virtual spaces, and integrates educational and entertainment elements.

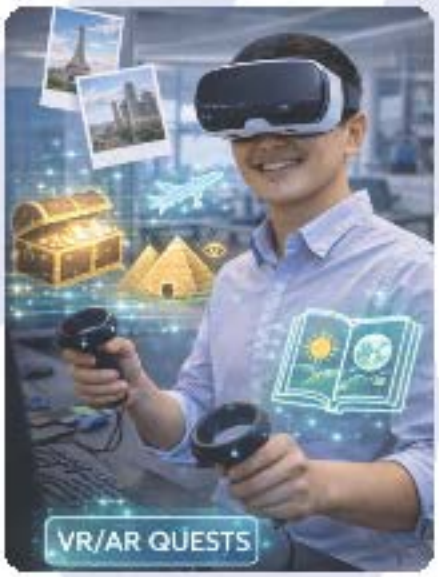
Necessary Skills: Scenario creation, level design, integration of educational and entertainment elements, user engagement analysis.

11.ROBOTICS ENGINEER IN TOURISM

Horizon of Appearance: In the next 3–5 years

Description: A professional who develops, configures, and maintains robots and automated devices for serving tourists: service robots in hotels, robot guides, and interactive navigation systems. Ensures reliable equipment operation and integration with digital platforms.

Necessary Skills: Ensuring reliable equipment operation, integration with digital platforms, adaptation of robots to the needs of tourists and tourist sites.



12.AI PROGRAMMER FOR ROBOT GUIDES AND SERVICES

Horizon of Appearance: In the next 3–5 years.

Description: Develops software for robotic guides and service systems in the tourism industry. The specialist creates artificial intelligence algorithms for navigation, interaction with tourists, voice and face recognition, as well as the integration of robots with digital platforms and databases.

Necessary Skills: Development of AI algorithms for navigation and interaction, integration of robots with digital platforms and databases.

3.8. TRANSFORMING PROFESSIONS

1.TOUR GUIDE / TOURIST GUIDE → INDUSTRIAL GUIDE / INDUSTRIAL SITE GUIDE

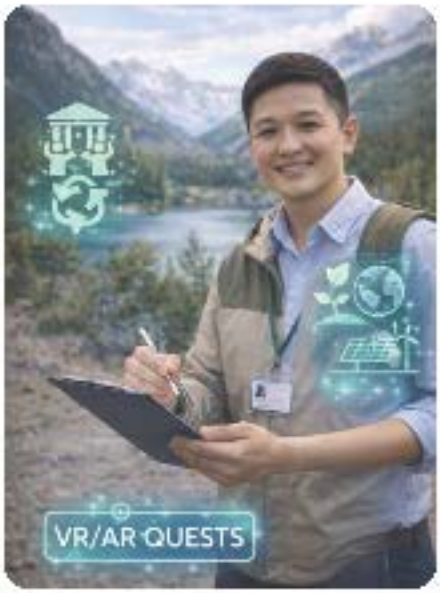
Transformation Horizon: In the next 3–5 years

Description: A specialist who conducts excursions at industrial facilities (e.g., oil and gas sites). They integrate tourism with the oil and gas industry, explaining complex production information in accessible language for tourists.

Necessity of Transformation: In the Atyrau region, there is a need to integrate tourism with the oil and gas industry as the region strengthens its position as an industrial center. New routes include visits to active or historical oil and gas facilities.

Competency Acquisition:

- Specialized knowledge of technologies and safety in the oil and gas industry;
- Skills in explaining complex production information in accessible language for tourists;
- Ability to ensure safety and compliance with environmental standards during excursions.



2. TOURISM INFRASTRUCTURE COORDINATOR / GUIDE FOR TOURIST ZONES → ECOLOGICAL TOURISM COORDINATOR

Transformation Horizon: In the next 3–5 years

Description: A specialist who controls the environmental safety of tourist sites and compliance with climate standards. They integrate sustainable technologies (materials, shading, cooling zones) into tourism infrastructure.

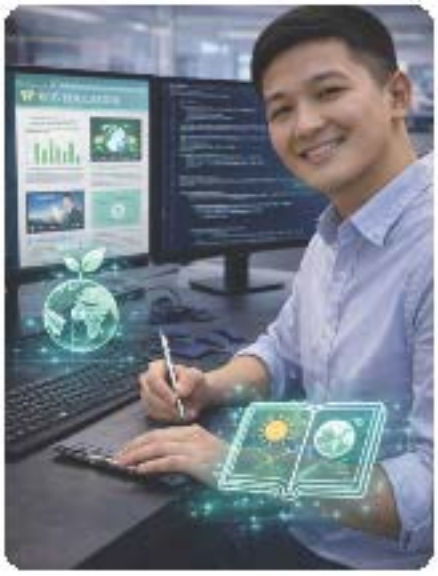
Necessity of Transformation: The need for transformation is driven by the strengthening of the environmental factor and the need to create climate-adapted infrastructure. It is also important to ensure a balance between tourist comfort and environmental preservation, minimizing negative impacts on the ecosystem.

Competency Acquisition:

- Control of environmental safety of tourist sites;
- Integration of sustainable technologies into tourism infrastructure;
- Ensuring a balance between tourist comfort and environmental preservation.

3.8. TRANSFORMING PROFESSIONS

3. DEVELOPER OF SUSTAINABLE DIGITAL SOLUTIONS → DEVELOPER OF DIGITAL TOOLS FOR ECO-EDUCATION

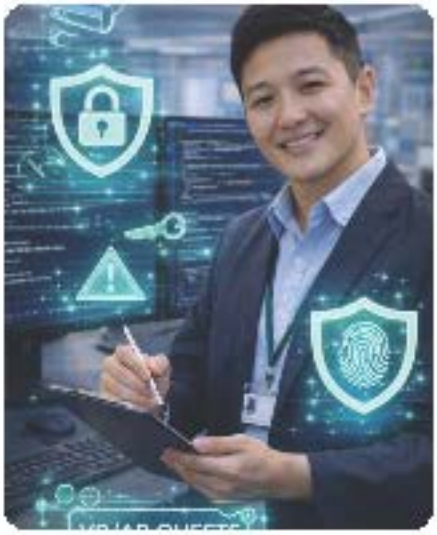


Transformation Horizon: In the next 3–5 years

Description: A specialist who creates digital tools for ecological education.

Necessity of Transformation: Transformation is caused by increasing interest in sustainable tourism and ecology. There is a need to create digital tools that not only inform about environmental problems but also motivate correct behavior.

Competency Acquisition: Creation of digital tools to inform and motivate tourists regarding environmental issues.



4. ARCHITECT OF DIGITAL SECURITY MAPS → ARCHITECT OF DIGITAL SECURITY SYSTEMS

Transformation Horizon: In the next 3–5 years.

Description: A specialist responsible for designing, creating, and managing digital security systems in tourism infrastructure.

Necessity of Transformation: Transformation is caused by the growth of digitalization and automation of security systems.

Competency Acquisition: Design and management of digital security systems.

5. MANAGER OF PERSONALIZED TOURIST SAFETY → DIGITAL PERSONAL SECURITY ANALYST FOR TRAVELERS

Transformation Horizon: In the next 3–5 years.

Description: An analyst dedicated to protecting tourists in the digital environment.

Necessity of Transformation: The need for transformation is caused by the growth of independent travel and the need to protect tourists from online fraud, data spoofing, and other digital risks.

Competency Acquisition: Risk analysis and protection of tourists in the digital environment (online fraud, data spoofing, digital risks).

3.8. TRANSFORMING PROFESSIONS

6. AI ANALYST OF TOURIST PURCHASING POWER → DIGITAL ANALYST OF TRAVELER PURCHASING BEHAVIOR

Transformation Horizon: In the next 3–5 years.

Description: A specialist who uses AI to analyze big data, forecasting spending, preferences, and tourist behavior.

Necessity of Transformation: Transformation is caused by the fact that tourists increasingly choose services online, and companies use AI to forecast their preferences and behavior, shifting the profession toward big data work.

Competency Acquisition: Working with big data, using AI to forecast spending, preferences, and tourist behavior.

7. MANAGER OF ADAPTIVE AND MODULAR TOUR PRODUCTS → MANAGER OF FLEXIBLE TOUR PRODUCTS

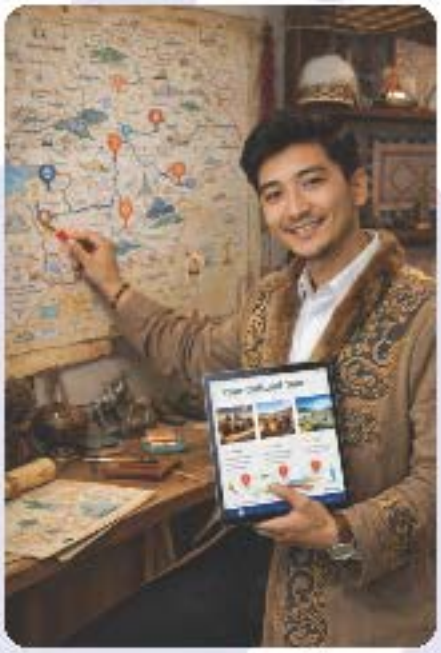
Transformation Horizon: In the next 3–5 years.

Description: A specialist who manages dynamic, client-oriented, and modular tour products

Necessity of Transformation: The tourism market is becoming more personalized, and clients want to choose tour elements themselves. Companies use digital technologies and AI to create flexible and modular offers, shifting the profession from standard tour planning to managing dynamic, client-oriented products.

Competency Acquisition: Management of dynamic, client-oriented products, use of digital technologies and AI to create flexible and modular offers.

8. DESIGNER OF PERSONALIZED CULTURAL ROUTES → SPECIALIST IN PERSONALIZED CULTURAL ROUTES



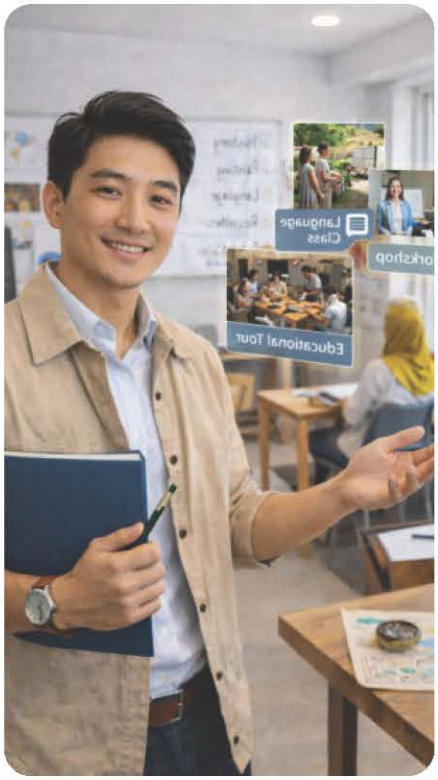
Transformation Horizon: In the next 3–5 years

Description: A specialist who creates unique cultural routes adapted to the interests, values, and preferences of a specific tourist.

Necessity of Transformation: Modern tourists seek unique and personalized impressions. The emergence of digital technologies, AI, and platforms for analyzing client preferences shifts the profession from standard route building to creating unique cultural routes for a specific tourist.

Competency Acquisition: Use of digital technologies and AI to analyze client preferences and create unique cultural routes.

3.8. TRANSFORMING PROFESSIONS



9. COORDINATOR OF EDUCATIONAL TOURISM AND MASTER CLASSES → SPECIALIST IN EDUCATIONAL AND INTERACTIVE TOUR PROGRAMS

Transformation Horizon: In the next 3–5 years.

Description: A specialist who coordinates complex educational programs and interactive tour programs

Necessity of Transformation: Modern travel increasingly combines recreation with learning and skill development. Companies use digital platforms and online resources to organize educational tours and master classes, shifting the profession from standard logistics to coordinating complex educational programs.

Competency Acquisition: Coordination of complex educational programs, use of digital platforms and online resources to organize educational tours.

10. DESIGNER OF INTERACTIVE AND PERSONALIZED TOURS → SPECIALIST IN INTERACTIVE TRAVEL CUSTOMIZATION

Transformation Horizon: In the next 3–5 years.

Description: A specialist engaged in the design of dynamic, interactive, and personalized tours.

Necessity of Transformation: Tourists increasingly seek unique, interactive experiences adapted to their interests and travel style. The emergence of digital technologies, mobile applications, and AI allows for the creation of personalized tours, shifting the profession from standard route building to the design of dynamic, interactive travel.

Competency Acquisition: Design of dynamic, interactive travel; use of digital technologies, mobile applications, and AI for tour customization.

3.8. TRANSFORMING PROFESSIONS

11. COORDINATOR OF AUTOMATED TOURISM SERVICES → SPECIALIST IN AUTOMATION AND ROBOTICS IN TOURISM

Transformation Horizon: In the next 3–5 years.

Description: A specialist who manages robotic processes and AI integration in the tourism industry.

Necessity of Transformation: The tourism industry is increasingly implementing robotic and autonomous solutions, such as robot guides, automated check-in counters, and service robots. The profession is shifting from manual coordination of tourism services to managing robotic processes and AI integration.

Competency Acquisition: Management of robotic processes, AI integration, working with robot guides, automated check-in counters, and service robots.

12. TECHNICIAN FOR ROBOTIC SYSTEMS MAINTENANCE → SPECIALIST IN MAINTENANCE OF AUTONOMOUS ROBOTS

Transformation Horizon: In the next 3–5 years

Description: A specialist who handles not only equipment repair but also the support of intelligent systems integrated with AI and digital platforms.

Necessity of Transformation: With the development of robotic solutions in tourism, hotels, and the service industry, the role of the technician is changing. Competencies are now needed to support intelligent systems integrated with AI and digital platforms.

Competency Acquisition: Maintenance of intelligent systems integrated with AI and digital platforms.

3.9. DISAPPEARING PROFESSIONS

Digitalization processes and the growth of online services in tourism are leading to the disappearance of a number of traditional roles based on routine operations and paper document flow. The functions of these professions are being replaced by online platforms, mobile applications, digital self-service kiosks, and voice/chatbots.

OFFLINE INTERNATIONAL TOUR BOOKING SPECIALIST

Horizon of Disappearance: In the next 1–2 years.

Reason for Disappearance: The functions of this profession, which consists of selecting, organizing, and processing tourist trips through traditional channels, including travel agencies and personal consultations, will be replaced by online platforms, mobile applications, and digital self-service kiosks.

TRADITIONAL GUIDES FOR MASS TOUR GROUPS

Horizon of Disappearance: In the next 3–5 years

Reason for Disappearance: With the development of digital technologies and the use of smart devices (mobile apps), tourists will be able to obtain information about sights and cultural objects without the need for a traditional guide. Furthermore, as the emphasis on sustainable tourism grows, such professions may give way to more specialized guides focusing on smaller groups and ecological education.

TOUR OPERATORS SELLING STANDARD MASS TOURS NOT ORIENTED TOWARD ECOLOGY

Horizon of Disappearance: In the next 3–5 years.

Reason for Disappearance: Tour operators that do not account for the environmental factor will become less in demand. A significant part of processes, such as tour planning and booking, will be automated. The market is shifting toward eco-tours and personalized routes.

CONSULTANT ON VISA ISSUES AND INTERNATIONAL TRAVEL

Horizon of Disappearance: In the next 3–5 years.

Reason for Disappearance: This profession, involving the preparation of document packages, selection of visa categories, applicant support, and consulting on the requirements of different countries, will be gradually displaced by automated services.

3.10. CRITICALLY SCARCE PROFESSIONS

In the Atyrau region, a **shortage of modern tourism specialists** is felt, which exacerbates the skills gap and requires the updating and expansion of educational programs. Scarce specialties in tourism and related industries are largely associated with trends in sustainable development, eco-tourism, and digitalization.

Below is a list of critically scarce professions with indications of necessity and areas of application, according to sources:

EXPERTS IN SUSTAINABLE TOURISM

Necessity: Development of tourism development strategies with minimal impact on the region's nature and culture. These specialists are capable of developing the region as a sustainable destination for Caspian and ethno-tourism.

Where needed: In tourism management bodies (for strategy development) and large tourism companies (for implementing environmental standards).

VR/AR SPECIALISTS FOR TOURISM

Necessity: Creation of virtual and augmented excursions allowing online travel or enhancing real experiences. This work is necessary for developing virtual tourism products, such as 3D excursions and VR routes through sacred sites.

Where needed: In tourism companies, museums, cultural sites, and educational centers for implementing virtual reality technologies in tourism services.

SPECIALISTS IN ECO-DATA AND ECOSYSTEM MONITORING

Necessity: Analyze the state of natural territories and help the tourism industry operate without damaging the environment. They work with big data to collect, analyze, and visualize information on the state of natural ecosystems (flora, fauna, water bodies).

Where needed: In environmental protection organizations, government bodies managing tourist destinations, and companies engaged in eco-tourism.

DIGITAL MARKETERS WITH A FOCUS ON ECO-TOURISM

Necessity: Promote ecological tour products on the internet, attracting the target audience. They are necessary for promoting tourism services in the digital environment, working with online platforms, and managing online reputation.

Where needed: In tourism companies, tour operators, the hotel business, and offices promoting regional destinations.

CONTENT CREATION SPECIALISTS FOR ECOLOGICAL TOURISM

Necessity: Develop texts, photos, videos, and multimedia materials to promote eco-destinations. They form a unique brand image on social networks and analyze publication effectiveness.

Where needed: In tourism companies specializing in eco-tourism, as well as in media and PR departments of regional tourism projects.

CRITICALLY SCARCE PROFESSIONS

ECO-TOURISM GUIDES

Necessity: Conduct excursions, teach tourists rules of conduct in natural zones, and ensure safe interaction with the environment. They play a key role in forming ecological consciousness and promoting sustainable tourism.

Where needed: In nature parks, reserves, ethno-villages (auyls), and with tour operators working with eco-routes.

SPECIALISTS IN NATURE CONSERVATION AND ECO-TECHNOLOGIES

Necessity: Implement modern technologies for ecosystem protection and sustainable use of natural resources. These specialists are necessary for studying sustainable tourism models and environmental impact assessment tools.

Where needed: In environmental protection organizations, as well as at tourist sites striving for sustainable development (eco-trails, glamping sites).

MANAGERS OF ECO-TOURISM AND SUSTAINABLE DEVELOPMENT

Necessity: Coordinate projects, manage tourist facilities, and implement sustainable development principles. These specialists are required to develop strategies for the development of tourist territories, taking into account ecological, social, and cultural aspects.

Where needed: In management structures of the tourism industry, large tour operators, and regional centers for tourism development.

DATA ANALYSTS FOR ECOLOGICAL TOURISM

Necessity: Collect and analyze data on tourist flows, environmental impact, and the effectiveness of sustainable tourism programs. They are necessary for analyzing flow statistics, load, and preferences.

Where needed: In regional tourism management bodies and large tourism companies for decision-making based on statistics.

DESIGNERS FOR CREATING VIRTUAL TOURS

Necessity: Develop interfaces and scenarios for virtual travel, ensuring an interactive experience for users. This need is connected to the growing interest in the virtual world, 3D excursions, and VR routes.

Where needed: In IT companies cooperating with the tourism sector, as well as in innovation development departments in museums and cultural centers.

4. THE FUTURE OF THE AGRO-INDUSTRIAL COMPLEX IN THE ATYRAU REGION

4.1. Expert Opinions

THE FUTURE OF THE AGRO-INDUSTRIAL COMPLEX IN THE ATYRAU REGION

DZHUMAGALIEV UTEMIS BURANBAEVICH
Director of Sole Proprietorship "Dzhumagaliev U.B."

What are the main factors determining the socio-economic development process of your region?

The main factor is the dominant role of the oil and gas industry, which determines income levels, infrastructure, and the investment climate. The second factor is natural resource limitations, such as water shortages, saline soils, and climatic risks. The third factor is the region's geographic location, opening opportunities for aquaculture and logistics. The fourth is the state of human capital potential and migration processes.

What are the most promising areas of activity, work options, and future developments that need to be cultivated in your region?

Aquaculture, greenhouse production, feed production, digital crop farming, automation and robotics, biotechnologies, and agricultural raw material processing. These directions can become drivers of regional development.

What staffing problems do you observe?

Several key staffing problems are clearly visible in the region, hindering industry development. First, graduates of educational institutions often come to enterprises with insufficient practical skills. They lack confident command of equipment, understanding of real technological processes, and work experience in production conditions, so enterprises are forced to spend time and resources on retraining them.

Young specialists often lack the knowledge to work with modern automated systems, sensors, precision farming technologies, recirculating aquaculture systems, and other solutions that are gradually becoming the norm in the regional agro-industry and manufacturing. Limited skills in data analysis, programming, and working with digital tools also impede the implementation of innovations in the real sector.

There remains an acute shortage of specialists in equipment maintenance and operation. Many organizations feel a deficit of technicians, mechanics, engineers, and operators capable of ensuring the stable operation of modern engineering systems and responding quickly to technical problems.

A role is also played by the fact that educational programs often fail to adapt to modern production requirements in time. Curricula are updated slowly, resulting in graduate training that does not always correspond to the current needs of enterprises.

An additional difficulty is the low interest of youth in choosing agrarian and technical specialties. These directions are perceived as less attractive, limiting the inflow of young qualified personnel and exacerbating the existing shortage of specialists.

4.1. Expert Opinions

THE FUTURE OF THE AGRO-INDUSTRIAL COMPLEX IN THE ATYRAU REGION

ZHAMALOV ERNUR KURSANBEKOVICH
Head of "Ecofarm" Sturgeon Fish Farming Plant (Peasant Farm " A-Dana") of the Atyrau Region, Founder of Aquaponics Classrooms

List the strengths of your region at the current stage.

The region has a strong industrial base, high income levels, and a favorable location. Competencies in industrial, ecological, and water spheres have been formed in the region, creating a foundation for the development of processing, logistics, and aquaculture.

What key trends and future technologies do you observe at this time in your region?

Today, Atyrau is seeing the active implementation of digital technologies in key industrial sectors—from the automation of production processes to the expansion of monitoring and resource management systems.

The environmental agenda is also significantly strengthening: attention to water quality, emissions reduction, environmental control, and the implementation of sustainable nature management practices is increasing.

Simultaneously, aquaculture is developing—capacities of fish farms are expanding, and technologies for the reproduction and processing of aquatic bioresources are being modernized.

Additionally, logistics and processing capacities are growing in the region, and infrastructure for storage, transportation, and export of products is strengthening. All this creates prerequisites for the formation of modern industrial clusters and a more sustainable regional economic model.

What factors influence the development of your professional industry?

For the agricultural and fisheries sector, the key factor is water resources. Availability of financing, the level of personnel qualification, climate change, and the introduction of modern technologies are important.

What key moments and potential opportunities are important for the development of the region?

The biggest opportunity is the creation of the Zhayik–Caspian fisheries cluster. Processing, logistics, water resource development, and attracting non-resource investments are also important. There is a real opportunity to fulfill the strategic goal of producing 15,000 tons of fish per year grown in the Atyrau region. This opportunity will allow the return of the status of the "Fish Capital of Kazakhstan" as in former times.

4.1. Expert Opinions

THE FUTURE OF THE AGRO-INDUSTRIAL COMPLEX IN THE ATYRAU REGION

SATTAR NURZHANAR SATTARKYZY
Lecturer in "Agronomy"
Unaybay Kushekov Atyrau Agrarian-Technical College

What threats does the regional leadership need to eliminate in the near future?

The most serious threats are: the water crisis and the shallowing of the Ural River, further degradation and salinization of soils, environmental risks, and the personnel crisis—a shortage of young specialists.

What directions for the transformation of the professional training system would you suggest?

In the professional training system for the "Agronomy" specialty in the Atyrau region, it is necessary to develop several key directions of transformation.

First, updating educational programs. It is important to include modern agrotechnologies, digital agriculture, and monitoring methods using drones and satellites in training, which will allow for the preparation of students and young specialists in accordance with modern requirements.

Second, strengthening practical training. During the learning process, it is extremely important to organize internships at farms, greenhouses, or agro-industrial companies so that students can gain real experience working with crops, soil, and livestock.

Third, programs to increase youth interest in agronomy. Grants, competitions, entrepreneurial projects, and training sessions should be developed to attract young specialists to agriculture and make the industry more attractive.

Fourth, it is necessary to teach agro-service and consulting competencies. It is important not only to master crop production but also to be able to consult farmers, rationally use soil and water resources, and implement environmentally clean production methods.

Fifth, the introduction of a continuous education system. After graduation, specialists should have the opportunity to continue their professional development through seminars, online courses, training, and qualification upgrades.

Overall, updating the personnel training system will allow the Atyrau region to provide the agrarian industry with qualified, practice-oriented, and modern specialists who meet market requirements.

Next question. What knowledge, skills, and abilities are relevant and in demand in your region today?

Today in the Atyrau region, in the field of agronomy, several key skills and knowledge areas are most relevant and in demand.

The ability to apply modern agrotechnologies. This includes mastering digital agriculture technologies, using drones and satellite monitoring, controlling the state of soil and plants, and working with automated systems.

Practical skills and experience. Specialists with real practice in farms, greenhouses, or feed production are in high demand.

Agro-service and managerial abilities. It is important not only to know crop or livestock production but also to be able to advise farmers, organize a farm, plan projects, and correctly establish production processes.

Knowledge in the field of ecological and organic production. Specialists who know how to apply organic fertilizers, minimize the use of chemicals, and implement environmentally clean growing methods are in demand.

In addition, professional communication and the ability to work in a team are also of great importance. An agronomist must possess not only technical knowledge but also the ability to interact effectively with farmers and colleagues.

4.1. Expert Opinions

THE FUTURE OF THE AGRO-INDUSTRIAL COMPLEX IN THE ATYRAU REGION

TAGASHOVA NURSULU ILYASOVNA
Director of "Femida Law Firm" LLP

Please name the negative development trends in your region.

In my opinion, a number of negative trends in the healthcare system are indeed observed in the Atyrau region, and the key one is the **shortage of qualified medical personnel.**

This problem is complex and manifests in several directions. The region experiences a shortage of narrow specialists—anesthesiologists-resuscitators, pediatricians, neonatologists, cardiologists, oncologists, and epidemiologists.

This problem is felt especially acutely in remote districts of the region, where even basic medical services are provided intermittently. Medical school graduates prefer to remain in Almaty, Astana, or other major centers, as the region seems less attractive to them due to working conditions, limited career growth opportunities, and high workloads. Medical workers often move to private clinics or leave the profession entirely due to low motivation, burnout, and uneven workload distribution between institutions. An imbalance between the population size and available infrastructure persists.

Atyrau is one of the regions with high migration dynamics; the population is growing faster than the medical network is developing. This leads to overcrowding in hospitals and polyclinics, especially in the regional center.

Modern healthcare requires **digital skills and mastery of new equipment,** but some specialists do not undergo regular retraining. Because of this, high-tech equipment is often not fully utilized or stands idle. In some villages, there is a shortage even of nursing staff, which reduces the quality of primary health care.

In your opinion, in which industry of your region are business organizations developing most intensively and increasing in number?

The most intensive growth of business organizations in the Atyrau region is observed in the sphere serving the oil sector. These are primarily companies engaged in service maintenance, logistics, equipment supply, industrial safety, and engineering services. Growth is fueled by major projects of TCO, NCOC, and the Atyrau Refinery, which create stable demand for qualified contractors. In addition, the segment of small and medium-sized enterprises working in niches of technical maintenance, IT support, and environmental monitoring is developing. Such a cluster effect makes the oil service sphere the locomotive of the region's entrepreneurial development.

4.1. Expert Opinions

THE FUTURE OF THE AGRO-INDUSTRIAL COMPLEX IN THE ATYRAU REGION

UTEULIEV TASMAGAMBET ARAPAEVICH
Senior Researcher at the Scientific and Production Center for Fisheries

What actual trends and technologies of the future do you observe globally?

In global practice, technologies for sustainable water use, intelligent ecosystem monitoring systems, and digital data analytics on bioresources are actively developing. Methods of artificial reproduction, the use of environmentally clean feeds, and biotechnologies for preserving rare fish species are becoming increasingly in demand. Furthermore, the direction of automation in aquaculture processes is developing, including robotic feeding and water quality monitoring.

Provide an approximate forecast of the state of your region if current trends continue over a 5–10 year horizon.

If current trends persist, then in 5–10 years the region may face a further decrease in the water levels of the Zhayik River, which will lead to limited opportunities for fisheries and a worsening environmental situation. At the same time, the development of aquaculture may partially compensate for the decline in natural fish productivity. The oil and gas sector will continue to remain key, but environmental risks will increase. Therefore, it will be especially important for the region to develop sustainable nature management practices.

In your view, which professional knowledge, skills, and abilities do modern college and HEI educational programs fail to form sufficiently?

The practical part of training is insufficiently developed, particularly skills in working with modern research instruments, hydro-chemical equipment, and fish cultivation technologies. Also, insufficient attention is paid to analytical skills, digital monitoring, and ecological modeling.

What promising professions, specialties, and qualifications currently in demand in your region can you list?

Among promising professions, one can note hydrobiologist engineers, aquaculture specialists, ecological monitoring specialists, and fish farm technicians. Specialists in bioresources, environmental analysts, and laboratory workers engaged in assessing water quality and the state of aquatic ecosystems are also in demand.

4.2. CURRENT STATE OF THE INDUSTRY

The agro-industrial complex (AIC) is one of the key factors for the sustainable socio-economic development of the Atyrau region. Despite the dominant role of the oil and gas sector, the development of the AIC acquires strategic importance from the perspective **of economic diversification, ensuring food security, creating jobs in rural areas, and improving the population's standard of living.** Agriculture and the processing of agricultural products form the basis for the development of small and medium-sized businesses, reducing the region's dependence on food imports and strengthening the domestic market.

According to official data, the agro-industrial complex of the Atyrau region **demonstrates positive dynamics.**

The gross output of agricultural products (services) in the Atyrau region in 2024 reached **124,368.30 million** tenge; however, the share of this sector in the structure of the Gross Regional Product (GRP) remains insignificant, amounting to only 0.8%.

The structure of agriculture is dominated by livestock farming (57.54%) and crop production (about 40%). Less significant sectors include fisheries and aquaculture (1.6%), hunting and trapping (0.03%), as well as forestry and logging (0.003%).

AIC development is constrained by **natural-climatic limitations,** such as aridity, fresh water deficit, and low soil fertility.

One of the critical problems is the **shortage of qualified personnel,** particularly specialists who master modern methods of farming. This problem is exacerbated by the limited number of educational programs focused on new technologies, which lowers the general level of employee competencies, as well as low wages, which make the agrarian sector less attractive and cause labor outflow.

Among systemic challenges, the insufficiency of state support also stands out, as access to subsidies remains limited, and financial instruments are often inaccessible to small and medium-sized farms.

Moreover, the region acutely feels the lack of modern infrastructure for processing agricultural products, which leads to a low depth of raw material processing and dependence on imports.

Nevertheless, the industry possesses potential for development, which can be realized through the **introduction of modern technologies**, including the use of automated management systems, modern irrigation methods, and the development of greenhouse complexes to compensate for the region's natural limitations.

A key direction is **digitalization**, including the application of smart farm management systems, soil condition sensors, and satellite monitoring.

The development of livestock and fish processing is also viewed as a way to increase product value-added and create new jobs.

In the long term, the AIC can become a sustainable and technologically advanced sector of the economy. This requires active state participation aimed at modernizing enterprises, developing subsidy systems, ensuring accessible financing, and improving the quality of professional training.

Provided that processing infrastructure is strengthened and modern agrotechnologies are introduced, the industry is capable of occupying a more prominent place in the regional economy and becoming an important factor in increasing the population's well-being.

4.3. TRENDS

1 trend **Increasing area of degraded and saline lands:**

The growth of land areas unsuitable for agriculture is linked to climate change, improper irrigation, and soil depletion. This leads to reduced yields and requires the implementation of soil restoration technologies, modernization of irrigation systems, and a transition to sustainable farming methods.

2 trend **Increased development of extraction and production in the Atyrau region:**

Active development of the industrial sector, including oil extraction and the construction of production facilities, increases the burden on the environment and agricultural lands. This leads to a reduction in areas for agrarian production and requires the improvement of environmental control mechanisms and rational use of land resources.

3 trend **Reduction of water resources in the Atyrau region:**

Decreased availability of fresh water is associated with droughts, growth in industrial water consumption, and lowering river levels. This causes difficulties in irrigation, reduces production volumes, and requires the introduction of water-saving technologies, drip irrigation, and optimization of water use in agriculture.

4 trend **Increase in agricultural product processing:**

Growing interest in creating processing capacities helps increase the value-added of products and reduce dependence on imports. However, this requires equipment modernization, personnel training, and the expansion of storage and logistics infrastructure.

5 trend **Rising environmental awareness:**

Халық пен өндірушілер өнімнің экологиялық таза болуына және тұрақты шаруашылық жүргізу әдістеріне көбірек назар аударады. Бұл экологиялық өнімге сұранысты арттырады және экологиялық стандарттарды енгізуді ынталандырады, бірақ сонымен бірге жаңа технологиялар мен персоналды оқытуды қажет етеді.

6 trend **Increase in demand for local products:**

Жергілікті өндірушілердің өнімдеріне қызығушылықтың артуы тұтынушылардың аймақтық экономиканы қолдауға және жаңа өнімдерді алуға деген талғамымен байланысты. Бұл фермерлерді өнім ассортиментін және өндіріс көлемін ұлғайтуға ынталандырады, бірақ сапаны жақсарту және жергілікті өнімнің брендингін дамыту қажет.

7 trend **Increased interest in selection specialties:**

Климаттық өзгерістер мен ауруларға төзімді жаңа өсімдіктер мен жануар тұқымдарына қажеттілік селекция мамандарына сұранысты арттырады. Бұл кадрларды даярлау үшін білім беру бағдарламалары, зертханалар және ғылыми орталықтар құру қажеттілігін туындатады.

8 trend **Increasing fish production and aquaculture development:**

The growth of aquaculture is linked to increased demand for fish products and favorable regional conditions. However, this requires the creation of modern fish farms, the introduction of feeding and quality control technologies, and the training of qualified specialists.

9 trend **Declining youth interest in agrarian specialties:**

The low attractiveness of agrarian professions, caused by wage levels and a lack of modern educational programs, leads to a shortage of young personnel. This requires raising the status of agrarian professions, modernizing education, and creating conditions for career growth in the industry.

10 trend **Increased investment in feed production for small and medium farms:**

Due to growing demand for quality feed, farmers receive opportunities to expand production. However, this requires the development of technologies for growing feed crops, modernization of machinery, and state support

11 trend **Increasing automation of agriculture:**

The introduction of modern technologies—robotic machinery, sensors, drones, and digital management systems—increases production efficiency. This reduces the need for manual labor but requires training specialists capable of working with digital solutions and maintaining automated systems.

Trend Clusters

- **Technological Cluster:** Digitalization of agriculture, biotechnologies and genetic engineering, vertical farming technologies.
- **Ecological Cluster:** Sustainable agriculture, green energy, ecological farming.
- **Social and Economic Cluster:** Transformation of labor resources, supply chains and food security, personalized food products.

4.4. THREATS

- **Crop loss due to unfavorable conditions.**
- **Competition from entrepreneurs in neighboring agricultural regions.**
- **Rising resource prices due to increased demand, intensifying competition.**
- **Reduction of Atyrau's water resources threatens all living organisms.**
- **Losses due to climate change and natural disasters.**
- **Negative impact on the environment, intensified competition, and water shortage.**
- **Possible rise in meat prices due to high demand.**
- **Stocking water bodies with hybrid farms (risk of genetic pollution).**
- **Low-quality products.**
- **declining interest of youth in agrarian specialties.**
- **Replacement of humans by technologies and rising cost of entry into the industry.**

4.5. OPPORTUNITIES

- **Growth of funding and investment** to solve yield problems.
- **Growth of local production** reduces product prices.
- **Introduction of water-saving** technologies and rational water use.
- **Use of highly productive** plant varieties and animal breeds.
- **Application of new technologies** (water conservation, new varieties), yield growth.
- **Access to fresh, high-quality,** and environmentally clean meat products.
- **Development of genetic** engineering and obtaining grants for research.
- **Production growth for farmers,** cost reduction for consumers, profit increase for entrepreneurs.
- **Growth of local feed production,** reduction of dependence on imports, strengthening of food security.

4.6. VISION OF THE FUTURE

By 2050, the agrarian sector of the Atyrau region will become a high-tech, sustainable, and fully adaptive system. Facing water deficits, soil salinity, and climatic challenges, the region has created a new architecture of agro-production combining digital technologies, bioengineering, ecological practices, and automation.

The reduction of water resources led to the construction of a comprehensive water sustainability system. Every liter of water is controlled via digital water balance maps. Intelligent water distribution stations, predictive AI models, and technical water reuse systems are in operation.

Fields are divided into digital agro-zones with their own "passports": salinity, microbiota, structure, yield forecast. Autonomous tractors, agro-drones, AI control, and the selection of salt- and drought-resistant varieties allow for the efficient cultivation of even previously degraded plots. Microbiological consortia restore soils, while precision irrigation minimizes water usage.

Livestock farms are equipped with biosensors, automated feeding systems, smart milking complexes, and AI disease diagnostics. Every animal organism is monitored in real-time. Farms operate with high energy efficiency, minimal emissions, and full product quality control.

Recirculating Aquaculture Systems (RAS), genetic centers for aqua-biotechnologies, and sustainable fish farming factories make the region one of the leaders of the Caspian macro-region. Fish are produced with minimal water consumption, year-round, and with a high level of quality control.

Processing has become the core of the agrarian economy. Mini-factories process meat, milk, grain, fish, and vegetables, creating high value-added products. All products are fully traceable via QR passports: from field to shelf. Regional brands gain recognition nationwide.

Plant and animal genetics centers create varieties and breeds resistant to climatic risks. Biotechnological feed production, microbiological preparations, and biostimulants strengthen the resilience of agro-systems.

The agrarian sector becomes a prestigious sphere for youth. New digital professions, high incomes, project-based learning, agro-startups, and technological farms make the industry modern, innovative, and competitive. Jobs become high-tech and safe.

The state implements a new water-agrarian policy, supporting small and medium-sized businesses and scientific research.

Environmental standards, waste minimization, carbon footprint reduction, green energy, and organic production—all elements of sustainable development are integrated into economic activity.

By 2050, the agro-industrial complex of the Atyrau region is a high-tech, sustainable, adaptive system based on digitalization, ecology, biotechnologies, and the prudent use of water resources. The region becomes a model of successful agrarian development under conditions of limited natural resources.

4.7 NEW PROFESSIONS

The development of the agro-industrial complex in the Atyrau region, despite natural-climatic limitations, requires the introduction of digital technologies, biotechnologies, and automation. These trends form a demand for completely new specialties necessary for building a high-tech, adaptive, and sustainable agro-system.

1. AQUAPONIST

Horizon of Appearance: In the next 3-5 years

Description: A specialist creating and managing aquaponic systems in which fish and plants are grown simultaneously. They control water quality, regulate fish feeding, monitor plant conditions, and ensure the stability of the entire closed ecosystem.

Necessary Skills: Combination of knowledge in hydrobiology, plant science, and engineering; water quality control, fish feeding regulation, monitoring plant conditions, ensuring stability of the closed ecosystem.

2. AGRO-IT SPECIALIST

Horizon of Appearance: In the next 3-5 years

Description: A professional integrating digital technologies into agricultural production processes and ensuring the digital infrastructure of the agricultural enterprise. They develop digital platforms, create software, and automate greenhouses, irrigation systems, and farm management.

Necessary Skills: Programming skills, system analysis, understanding of agro-biological processes; software creation, automation of greenhouses/irrigation systems/farm management; analysis of data from sensors, drones, and satellites.

3. AGRONOMIST DATA ANALYST

Horizon of Appearance: In the next 3-5 years

Description: A specialist using digital tools (drones, sensors, satellite imagery, big data) to monitor soil conditions, plants, and yields. They analyze climatic and agrochemical indicators, build forecasts, identify risks, and propose optimal technological solutions.

Necessary Skills: Analysis of climatic and agrochemical indicators, forecasting, risk identification; proposal of optimal technological solutions; increasing efficiency through precision farming.

4.7 NEW PROFESSIONS

4. AGROSYSTEM HYDRO-NAVIGATOR ENGINEER

Horizon of Appearance: In the next 5-6 years.

Description: A specialist managing the water resources of the agro-sector based on AI, digital water balance maps, and climate models. They design water distribution schemes, create water use scenarios for the long term, control the water efficiency of each field, and manage water reuse systems.

Necessary Skills: Designing water distribution schemes; creating water use scenarios for 10–20 years; controlling field water efficiency; modeling droughts and proposing adaptation measures.

5. DIGITAL FARM VETERINARIAN

Horizon of Appearance: In the next 3-5 years.

Description: A professional who applies modern digital technologies to control animal health. They work with biosensors, automated feeding systems, predictive diagnostic programs, and animal behavior monitoring.

Necessary Skills: Working with biosensors, automated feeding systems, predictive diagnostic programs, and animal behavior monitoring; analyzing herd status data, identifying early signs of diseases.

6. HYDROGEN ENERGY ENGINEER

Horizon of Appearance: In the next 5-6 years.

Description: A professional developing technologies for the production, storage, and use of hydrogen in the energy systems of agricultural enterprises. They engage in equipment design, the implementation of hydrogen installations, and the reduction of harmful emissions.

Necessary Skills: Equipment design; implementation of hydrogen installations; energy system efficiency analysis; reduction of harmful emissions.

4.7 NEW PROFESSIONS

7. BREEDER-GENETICIST

Horizon of Appearance: In the next 5-6 years.

Description: A specialist in genetic and biotechnological methods for improving plants and animals. They use genomic research and bioinformatics to create highly productive varieties and breeds resistant to climate change, salinization, and drought.

Necessary Skills: Use of genomic research, marker-assisted selection, bioinformatics; analysis of large genetic databases; creation of high-yielding, salt- and drought-resistant varieties.

8. ENGINEER FOR ELECTRIC TRACTORS AND AGRICULTURAL MACHINERY

Horizon of Appearance: In the next 5-6 years.

Description: A specialist specializing in the maintenance, diagnostics, and tuning of electric tractors and autonomous agricultural machinery. They work with electric motors, battery packs, and navigation systems.

Necessary Skills: Working with electric motors, battery packs, navigation systems, and software; providing technical support; increasing machine energy efficiency.

9. SMART GREENHOUSE OPERATOR / GREENHOUSE CLIMATE OPERATOR

Horizon of Appearance: In the next 3-5 years.

Description: A specialist managing digital microclimate systems in greenhouses, regulating temperature, humidity, ventilation, lighting, and CO_2 levels. They analyze plant conditions and maintain optimal growth conditions.

Necessary Skills: Management of climatic systems, IoT sensors; sensor control, plant condition analysis, maintaining optimal growth conditions.

4.8. TRANSFORMING PROFESSIONS

The transformation of traditional professions in the AIC occurs under the influence of digitalization, automation, and biotechnologies. Specialists are shifting focus from routine tasks to analytics, control, and expert interpretation of digital data.

1. AGRONOMIST (TRADITIONAL) → DIGITAL FARMING SPECIALIST

Transformation Horizon: In the next 1-3 years.

Description: A digital farming specialist using data from drones, GPS navigation, satellites, and soil sensors to analyze large data sets. They forecast yields, identify disease risks, and optimize resource use by implementing precision farming.

Necessity of Transformation: Implementation of precision farming, use of digital technologies (drones, satellites, sensors), and the need to analyze big data.

Competency Acquisition: Management of smart greenhouses, working with GPS navigation, satellites, soil sensors, and climatic systems, big data analysis and yield forecasting, implementation of precision farming.

2. ZOOTECHNICIAN → DIGITAL LIVESTOCK MANAGER

Transformation Horizon: In the next 1-3 years.

Description: A digital livestock manager working with animal biosensors, automatic feeding systems, and predictive diagnostic programs. They manage databases, track biometric indicators, forecast productivity, and formulate rations using digital calculators.

Necessity of Transformation: Implementation of digital livestock farming, use of biosensors, automatic feeding systems, and predictive diagnostics.

Competency Acquisition: Working with biosensors, managing automatic feeding systems, analyzing biometric indicators, using predictive disease diagnostic programs.

3. TRACTOR DRIVER → OPERATOR OF AUTONOMOUS AND GPS-NAVIGATION MACHINERY

Transformation Horizon: In the next 1-3 years.

Description: An operator managing machines with autopilot systems, motion control sensors, and satellite communication. They monitor unit operation parameters, track operation accuracy, and can remotely control machinery via a tablet.

Necessity of Transformation: Implementation of autonomous and GPS-navigation machinery, replacement of traditional tractors.

Competency Acquisition: Management of machines with autopilot systems and satellite communication, monitoring of unit operation parameters, working with electronics, software, and digital field maps, remote machinery control.

4.8. TRANSFORMING PROFESSIONS

4. VETERINARIAN → DIGITAL VETERINARY SPECIALIST

Transformation Horizon: In the next 1-3 years.

Description: A digital veterinary specialist working with automatic diagnostic tools, sensory health monitoring systems, and early disease detection programs. They conduct remote herd monitoring and use artificial intelligence for diagnostics.

Necessity of Transformation: Implementation of digital veterinary medicine, use of sensory systems and AI for diagnostics.

Competency Acquisition: Working with automatic diagnostic tools, using biometric bracelets and thermal imagers, remote herd monitoring, real-time data analysis, using AI for diagnostics.

5. FEED MILL WORKER → AUTOMATED FEED LINE OPERATOR

Transformation Horizon: In the next 1-3 years.

Description: An operator working with computerized feed mixing systems, humidity and temperature sensors, and automatic raw material loaders. The profession requires equipment management and quality control of the finished product.

Necessity of Transformation: Transition to automated feed production lines.

Competency Acquisition: Working with computerized mixing systems, monitoring humidity and temperature sensors, managing automatic loaders, ensuring uninterrupted feed production.

4.8. TRANSFORMING PROFESSIONS

6. TRADITIONAL TRACTOR MECHANIC → OPERATOR AND MAINTENANCE ENGINEER OF "SMART" AGRICULTURAL MACHINERY

Transformation Horizon: In the next 1-3 years.

Description: An engineer maintaining autonomous tractors, GPS navigation systems, telematics, and digital diagnostic systems. They control machine software and optimize field operation processes.

Necessity of Transformation: Implementation of "smart" agricultural machinery (autonomous tractors, GPS, telematics).

Competency Acquisition: Maintenance of autonomous tractors, working with GPS navigation and digital diagnostics, controlling machine software, optimizing field operations.

7. MANUAL GREENHOUSE WORKER → HIGH-TECH GREENHOUSE COMPLEX OPERATOR

Transformation Horizon: In the next 1-3 years.

Description: An operator managing climate systems, LED lighting, hydroponics, automatic irrigation, and IoT sensors in a "smart" greenhouse. They analyze microclimate parameters and make changes for maximum crop productivity.

Necessity of Transformation: Greenhouses are becoming "smart" with automatic climate and irrigation.

Competency Acquisition: Management of climatic systems, LED lighting, hydroponics, working with IoT sensors, analysis of microclimate parameters.

4.9. DISAPPEARING PROFESSIONS

The disappearance of a number of traditional professions in the AIC is due to full automation and the replacement of manual labor with digital and robotic systems.

MILKER

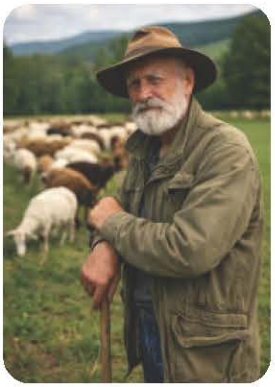
Horizon of Disappearance: In the next 3–5 years.

Reason for Disappearance: A profession that previously required manual work with animals (milking, care) is disappearing due to full automation. Humans are moving to new positions requiring equipment management skills (robotic farm operators).

TRACTOR DRIVER ON OLD TRACTORS / OPERATOR OF OUTDATED TRACTORS

Horizon of Disappearance: In the next 3–5 years.

Reason for Disappearance: Traditional tractors without electronics and GPS are being replaced by modern machines equipped with autopilot, sensors, and digital panels. The traditional profession of a tractor driver is disappearing and transforming into an operator of high-tech agricultural machinery.



SHEPHERD

Horizon of Disappearance: In the next 3–5 years.

Reason for Disappearance: The profession is disappearing as herds are equipped with **sensors, trackers, and smart collars,** and movement is controlled via monitoring systems. Shepherds are retraining as operators of digital animal observation systems.

FIELD SCOUT / AGRONOMIST-OBSERVER

Horizon of Disappearance: In the next 3–5 years.

Reason for Disappearance: The profession is becoming obsolete as its functions (personal field inspection, visual check, and manual recording of soil conditions) are replaced by **drones, satellite imagery, soil sensors, and big data.** It transforms into a digital agronomist or agro-analyst.

4.10. CRITICALLY SCARCE PROFESSIONS

In the Agro-Industrial Complex of the Atyrau region, there is an acute shortage of qualified personnel, especially those mastering modern farming methods. Scarce specialties are critically important for the implementation of digital solutions, precision farming, and ensuring the region's water sustainability.

AGRO-IT SPECIALIST

Necessity: Ensures the digital infrastructure of the agricultural enterprise, implements monitoring systems, manages sensors, digital field maps, and IoT equipment integration. Critical for farms transitioning to precision farming.

Where needed: In large and medium-sized agricultural enterprises, as well as in companies engaged in the development and implementation of agrotechnologies.

AGRONOMIST DATA ANALYST

Necessity: Conducts analysis of large arrays of field data (humidity, NDVI, soil condition, climate), builds yield forecasts, identifies risks, and creates recommendations based on AI models. One of the key "new agrarian" specialties.

Where needed: In agro-holdings, research centers, and consulting companies for precision farming.

PRECISION FARMING SPECIALIST

Necessity: Configures and manages systems for precision application of fertilizers, seeds, and Plant Protection Products (PPP); responsible for the correctness of cartograms, autopilots, drones, and field sensors. High demand due to farms transitioning to digital methods.

Where needed: In all farms implementing precision farming technologies.

ENGINEER FOR INTELLIGENT AGRICULTURAL MACHINERY

Necessity: Operates and maintains autonomous tractors, electric tractors, robotic units, positioning systems, and autopilots. Demand is growing due to the introduction of autonomous machinery in the region.

Where needed: In Machine-Tractor Stations, service centers, and large agro-farms.

ENGINEER FOR AGRICULTURAL ROBOTIZATION

Necessity: Designs and maintains robotic lines in livestock farming, greenhouses, and processing: milking robots, automatic feeding complexes, food robotic lines. Especially in demand in large farms and processing.

Where needed: In dairy and livestock complexes, greenhouse farms, and mini-processing plants.

4.10. CRITICALLY SCARCE PROFESSIONS

OPERATOR OF ROBOTIC FOOD LINES

Necessity: Works with automated production modules at plants processing milk, meat, fish, and vegetables. Acute shortage amidst the growth of processing mini-factories.

Where needed: At enterprises processing agricultural products and fish (mini-factories).

ENGINEER FOR FARM AUTOMATION

Necessity: Configures automatic management systems for microclimate, irrigation, feeding, and processing. Needed for those enterprises switching to full digital automation.

Where needed: In large farms, greenhouse and livestock complexes.

AGRO-DRONE OPERATOR

Necessity: Controls Unmanned Aerial Vehicles (UAVs) for spraying, crop monitoring, fertilizer application, and plant protection. High demand as drones actively replace traditional machinery.

Where needed: In service companies providing precision farming services and large agro-farms.

GREENHOUSE CLIMATE CONTROL SPECIALIST / SMART GREENHOUSE OPERATOR

Necessity: Manages digital systems regulating temperature, humidity, CO2, and light. Guarantees stability and predictability of yields in modern greenhouse complexes. Shortage of personnel, especially in new greenhouse projects in the region.

Where needed: In regional greenhouse complexes.

DIGITAL FARM VETERINARIAN

Necessity: Uses biosensors, RFID tags, animal health monitoring systems, and diagnostic AI tools. Outdated traditional skills no longer cover the needs of modern farms.

Where needed: In livestock farms transitioning to "smart livestock farming" models.

4.10. CRITICALLY SCARCE PROFESSIONS

BREEDER-GENETICIST

Necessity: Creates new high-yielding, salt- and drought-resistant varieties, works with genetic lines of plants and animals. Critically important for regions with soil degradation and salinization.

Where needed: In research centers, genetic laboratories, and seed farms.

AQUAPONIST / SPECIALIST IN RECIRCULATING AQUACULTURE SYSTEMS (RAS)

Necessity: Manages systems of combined fish and plant cultivation (aquaponics) and provides technological support for new generation fish farming systems. Included in the top 3 most in-demand professions in the Atyrau region due to soil and water resource deficits.

Where needed: n fish farms, aquaculture complexes, and centers for aquaponics development.

5. FUTURE OF THE MANUFACTURING INDUSTRY IN ATYRAU REGION

5.1. Expert Opinions

FUTURE OF THE MANUFACTURING INDUSTRY IN ATYRAU REGION

ADILOVA SALTANAT RASHIDOVNA
General Director of LLP «Atyrauneftemash»

What are the main factors determining the socio-economic development of your region that you can name?

The Atyrau Region is traditionally one of the key drivers of Kazakhstan's economy. Its socio-economic development is determined by a combination of natural, industrial, and human factors.

Firstly, the presence of rich oil and gas reserves remains the primary source of economic growth.

Secondly, the development of industrial infrastructure and active support for domestic mechanical engineering, service, and construction companies create additional jobs and increase the level of production localization.

The third important factor is the socially oriented state policy: the implementation of programs for housing construction, development of social infrastructure, modernization of healthcare and education significantly improves the quality of life of the population.

In addition, the region's geographical location—at the intersection of international transport routes—plays a significant role, contributing to the development of logistics and foreign economic relations.

What factors influencing the development of your professional industry can you name?

The development of the region's mechanical engineering industry is influenced by several key factors.

Foremost is the high demand from oil and gas companies, which stimulates production and equipment modernization.

Technological renewal, the introduction of innovations, and the improvement of product quality standards are of great importance.

State support for industry, the development of local content, and the training of qualified personnel also play a crucial role.

Furthermore, the industry is affected by the economic situation and the investment climate in the region, which determine the scale and stability of production projects.

In your opinion, which professional knowledge, skills, and abilities are insufficiently developed in modern college and university educational programs?

In my view, modern college and university educational programs insufficiently develop the following professional knowledge, skills, and abilities:

1. Practical skills in working with modern equipment and technologies—students often receive more theoretical knowledge than hands-on experience with real industrial systems.
2. Competencies in digitalization and automation—the ability to work with modern software products, production management systems, and industrial robots is not developed in all programs.
3. Skills in interdisciplinary interaction and teamwork—insufficient attention is paid to project-based activities, collaborative work in teams, and solving complex practical tasks.
4. Problem-solving mindset and the ability to innovate—students rarely encounter tasks requiring independent solution-seeking and implementation of improvements.
5. Skills in safe and environmentally responsible work practices—issues of occupational safety, industrial safety, and rational resource use are not always deeply integrated into curricula.

Strengthening these areas will enable graduates to be better prepared for the demands of modern industry and more in-demand specialists in the labor market.

5.1. Expert Opinions

FUTURE OF THE MANUFACTURING INDUSTRY IN ATYRAU REGION

In your opinion, what threats exist that the leadership of your region will need to address promptly in the near future?

Among the threats requiring prompt resolution in the near future are the risk of slowing economic growth due to raw material dependency. There are also environmental risks—ongoing environmental pollution, including of the Caspian Sea, which could lead to deterioration in public health. Without timely modernization, there is a risk of infrastructure and utility system wear. In addition, labor shortages and the outflow of specialists may limit the development of mechanical engineering and service enterprises.

Identify the key highlights and potential opportunities that should be prioritized for the development of your region.

Key opportunities include economic diversification, including the expansion of non-raw material sectors such as mechanical engineering, petrochemicals, and agricultural processing. Emphasis should be placed on developing industrial mechanical engineering and the petrochemical cluster. An important aspect is the introduction of Industry 4.0 technologies, automation, artificial intelligence, and digital twins to improve efficiency. Ecological modernization of industry and the development of the region's transport and logistics potential are also critical, potentially turning it into a major hub.

What knowledge, skills, and abilities are currently relevant and in demand in your region?

Today, technical and engineering competencies (welding, installation, repair of oil and gas equipment) are in demand in the region. There is high demand for specialists skilled in digital design and modeling (AutoCAD, SolidWorks). Competencies in automation and electronics (PLC, SCADA, industrial robots), as well as knowledge in energy efficiency and environmental safety, are relevant. Skills in technical maintenance and diagnostics (vibration diagnostics, predictive maintenance) and digital and analytical skills (Big Data) are also sought after.

AUELBEKOV ALMAS GALYMOVICH
General Director of LLP «Qansat Energy»

5.1. Expert Opinions

FUTURE OF THE MANUFACTURING INDUSTRY IN ATYRAU REGION

ASHIMOV DAMIR AGYLANOVICH
Project Director
LLP «Kazakhstan Petrochemical Industries Inc.»

List the strengths of your region at the current stage.

Rich mineral and raw material base. Developed oil and gas and processing complex. High level of investment. Favorable geographical location. Qualified personnel and industrial culture. Support from the state and major companies. Development of industrial mechanical engineering and service industries.

In which industry of your region are staffing problems most acutely felt?

Mechanical Engineering and Metal Processing. This industry experiences a serious shortage of qualified skilled trades workers—turners, millers, welders, fitter-assemblers, CNC machine adjusters, and industrial equipment operators. The lack of specialists limits the pace of development of local production and enterprise modernization.

Oil and Gas Sector and Industrial Services. Despite high employment levels, the industry faces a shortage of automation engineers, technologists, equipment repair and diagnostics specialists, as well as skilled technicians.

Construction Industry. With the development of infrastructure and housing projects, there is a shortage of engineering and technical specialists, builders, electricians, welders, and designers.

IT Sector and Digital Technologies. With the growth of industrial and management digitalization processes, there is an increasing need for programmers, system administrators, cybersecurity specialists, and data processing experts.

Educational and Engineering-Technical Specialties. There is a shortage of young technical discipline instructors and practitioner-trainers, which slows the renewal of industry human resource potential.

Environmental and Energy Sectors. With increasing requirements for environmental safety and energy efficiency, there is a need for ecologists, sustainable development engineers, and renewable energy specialists.

What promising professions, specialties, and qualifications already in demand in your region can you list?

Mechanical Engineers and Designers of Oil and Gas Equipment. Specialists capable of designing, calculating, and improving equipment for extraction, transportation, and processing of oil and gas—pumps, compressors, reducers, drilling rigs, etc.—are in demand.

Manufacturing Technologists. Specialists proficient in modern metal processing methods, assembly of units, quality control, and optimization of production processes are required.

Automation and Mechatronics Engineers. As enterprises transition to digital systems and "smart" manufacturing, specialists in PLC, SCADA, industrial robots, sensors, and remote monitoring systems are needed.

Equipment Maintenance and Diagnostics Engineers. Professionals skilled in vibration diagnostics, non-destructive testing, balancing, and predictive equipment condition analysis are in demand.

Energy and Energy Conservation Specialists. Greater attention is paid to reducing energy consumption and improving technological process efficiency, increasing the need for energy engineers.

Ecologists and Industrial Safety Engineers. With tightening environmental requirements and safety standards, demand is growing for specialists capable of monitoring emissions, ensuring compliance with norms, and developing environmental protection measures.

Welders, Turners, Millers, CNC Machine Operators. Skilled trades remain the foundation of the production sector. Qualified specialists capable of working with modern installations and programmed control are particularly in demand.

Digital Technology Engineers and Industrial IT Specialists. Programmers and engineers implementing Industry 4.0, digital twins, 3D printing, and remote equipment monitoring systems are sought after.

Logistics and Supply Chain Management Specialists. With the growth of industrial production, there is an increased need for professionals capable of efficiently organizing supplies, storage, and transportation of equipment and materials.

Project Managers and Production Management Specialists. Personnel skilled in planning production resources, implementing Lean Manufacturing, ERP systems, and lean production methods are in demand.

5.1. Expert Opinions

FUTURE OF THE MANUFACTURING INDUSTRY IN ATYRAU REGION

NURMYSHEV ASYLBECK ZHORABEKOVICH
Director of APEC Petrotechnic Higher College

In your opinion, in which industry of your region are business organizations developing most intensively and increasing in number?

The most dynamically developing business sectors in the Atyrau Region:

• Oilfield services and auxiliary services: Atyrau is the oil and gas center of Kazakhstan. Therefore, oil and gas companies, service organizations, and equipment suppliers are developing most rapidly.

• Construction and infrastructure sector: Population growth and the need for new housing, roads, and social facilities drive the dynamic development of construction companies.

• Trade and retail market: Individual entrepreneurs, supermarkets, and household appliances and clothing stores are growing year by year.

• Transport and logistics services: Oil exports, Caspian transportation, and regional freight turnover growth contribute to the expansion of logistics companies.

• Hotel and service sector: The flow of employees, shift workers, and tourists accelerates the development of the hotel business.

• Light industry and small industrial enterprises: Atyrau is developing the production of chemical and construction materials, with an increasing number of small plants.

In conclusion, the most dynamically developing sectors in Atyrau are oilfield services, construction, trade, logistics, and hospitality.

What current global trends and future technologies do you observe?

Current global trends and future technologies:

1. Artificial intelligence (AI) and automation:

• Generative AI, robotization, autonomous driving, AI solutions in medicine and education.

2. Biotechnology and genetic engineering:

• CRISPR, artificial organs, longevity technologies, precision medicine.

3. Renewable energy sources and green technologies:

• Solar, wind, hydrogen energy, carbon reduction technologies.

4. Web 3.0 and digitalization

• Blockchain, cryptocurrency, digital identity, Metaverse technologies.

5. Quantum technologies:

• Quantum computers, quantum cryptography, new modeling methods.

6. Internet of Things (IoT) and Smart City:

• Smart homes, smart city infrastructure, automated transport systems.

7. Space technologies:

• Private companies entering space, Moon landing projects, space tourism, Starlink.

8. AR, VR, and mixed reality:

• AR/VR devices, training, medicine, virtual production solutions.

9. Cybersecurity:

• Data protection, AI attack defense systems, digital security.

10. Logistics and transport technologies:

• Drone delivery, autonomous trucks, Hyperloop systems.

What most promising areas of activity, work options, and further development can you name that need to be developed in your region?

The most promising areas of activity to be developed in the Atyrau Region and for further development:

1. Oil and gas services

Engineering, production safety, equipment maintenance, logistics, and warehouse services.

2. Renewable energy sources

Wind and solar energy projects, hydrogen energy, ecological energy.

3. Chemical and petrochemical industry

Production of polymers, plastics, construction materials, and chemical reagents.

4. Logistics and transport services

Freight transportation, warehouse centers, multimodal hubs, drone delivery technologies.

5. Construction and infrastructure

Housing construction, road construction, engineering networks, and energy-efficient structures.

6. IT and digital technologies

Programming, IoT, SCADA, BIM modeling, cybersecurity, and development of digital services.

7. Ecology and environmental protection

Environmental monitoring, purification systems, waste management, Caspian ecosystem protection.

8. Service sector

Hotel business, public catering, household services, online marketplace services.

9. Education and specialist training

IT centers, technical specialist training, STEM education.

10. Agro-industrial sector

Irrigated agriculture, greenhouse farming, increasing local food production.

5.1. Expert Opinions

FUTURE OF THE MANUFACTURING INDUSTRY IN ATYRAU REGION

Name the negative trends in the development of your region?

Increase in the number of fast-food establishments

What key trends and future technologies do you currently see in your region?

In the region, key trends and technologies such as robotics and automation are observed.

If current trends persist, what forecasts can you make for the state of your region in approximately 5-10 years?

Gross regional product will increase by 2-3%

What current staffing problems arise in your workplace?

The main current problem is the skills gap between educational institutions and production enterprises.

What directions for transformation can you propose in the system of professional training?

Dual education

SHARGABAYEVA AKBOBEK SAGYNBAIKYZY
Director of the Industrial Development Department, Department of Entrepreneurship and Industrial Development

5.2. CURRENT STATE OF THE INDUSTRY

Current Situation of the Manufacturing Industry in Atyrau Region

The manufacturing industry in Atyrau Region, despite the dominance of the raw materials sector, is a key tool for diversifying the regional economy.

Today, the structure of the region's GRP is characterized by a high share of industry (49.5%), with the mining sector accounting for about 43.7%, while manufacturing accounts for only around 4.6%. The region's share in the country's manufacturing output is also low (4.4%), underscoring its current role against the backdrop of the powerful mining sector (43.6%).

The processing sector is represented by enterprises in various fields, including mechanical engineering, metal processing, chemical industry, food production, and the manufacture of components for oil and gas companies. The development of this industry is critically important, as it creates sustainable jobs and ensures the production of value-added products. Enterprises receive support through the development of industrial zones and special economic zones that provide access to infrastructure and tax benefits.

Despite positive trends, the industry faces a number of systemic constraints:

1. Labor shortage: The region experiences an acute shortage of qualified skilled trades and engineering-technical specialists, as young people prefer the higher-paid oil and gas sector.

2. Wear and tear of fixed assets: A significant portion of capacity operates on aging and obsolete equipment installed 20–30 years ago, reducing productivity and product competitiveness.

3. Financing and import dependency: Enterprises are constrained by high lending rates and a lack of long-term modernization instruments. At the same time, many types of raw materials and components are imported, increasing costs and dependency on external supplies.

4. Low level of digitalization: Most enterprises are only at the initial stage of digital transformation, reducing the efficiency of production processes.

At the same time, the manufacturing industry has significant growth potential: State programs, preferential loans, and the participation of major oil and gas companies in localization projects open opportunities for technical renewal. The introduction of digital technologies—ERP, MES systems, robotization, and predictive analytics—is supported by the state and corporate partners, which will increase productivity and reduce costs.

In addition, an industrial cluster uniting mechanical engineering and chemical production is gradually forming, enhancing economic resilience.

The manufacturing industry in Atyrau Region is at a stage of active structural renewal. Its comprehensive modernization and strengthening of human resource potential through the creation of competency centers and dual education can transform the industry into a key element of sustainable regional economic development.

Proper industrial policy and support for enterprises from the state and large businesses can transform the industry into one of the drivers of regional economic development.

5.3. TRENDS

1 trend **Growth in localization of production for the oil and gas sector.**

Atyrau Region is the center of the oil and gas industry, so enterprises are increasingly focused on producing equipment, components, and services to replace imports. This strengthens demand for mechanical engineering, metal processing, and repair industries.

2 trend **Digitalization of production processes. The**

The introduction of automated control systems, IIoT sensors, digital twins, and ERP/MES platforms is becoming a key trend among enterprises aiming to improve efficiency and reduce costs.

3 trend **Shift toward high value-added products**

Enterprises are moving from simple operations (cutting, welding, assembly) to more complex ones—producing units and finished products. This increases requirements for workforce qualifications and stimulates modernization.

4 trend **Equipment modernization and transition to energy-efficient technologies.**

Much of the equipment at enterprises is worn out, making infrastructure renewal a critical growth factor. In parallel, modern energy-efficient solutions and industrial safety systems are being introduced.

5 trend **Development of industrial zones and clusters.**

The creation of industrial zones allows enterprises to access ready infrastructure, communications, and benefits. This stimulates the emergence of production clusters, particularly in oil services and mechanical engineering.

6 trend **Integration of automation and robotization.**

The use of robotic complexes is growing, especially in metal processing, packaging, and assembly. This gradually reduces the need for manual labor and increases productivity.

7 trend **Greening of production processes (ESG trend).**

Enterprises are introducing filtration systems, waste processing, technologies to reduce emissions and energy consumption. Secondary raw material processing, including plastics and industrial waste, is developing.

8 trend **Increasing requirements for product quality and certification.**

To enter the market for major oil and gas projects, enterprises must comply with international standards (API, ISO, ASME). This requires the implementation of quality management systems and professional staff training.

9 trend **Redistribution of the labor market.**

Due to high competition with the oil and gas sector, manufacturing enterprises experience shortages of workers and engineers. In response, emphasis is increasing on dual education, corporate training, and enhancing the status of skilled trades.

10 trend **Strengthening cooperation between SMEs and large enterprises.**

Major companies (TCO, NCOC, ANPZ) are increasingly involving local enterprises in equipment production, repair, and service work. This creates new niches for small and medium-sized businesses in the processing sector.

11 trend **Expansion of polymer and chemical product processing.**

The presence of major petrochemical projects (Atyrau Refinery, Atyrau Petrochemical Park) stimulates the production of plastics, chemicals, packaging, and polymer products.

12 trend **Strengthening the role of human capital**

The transition from mechanized to digital production requires new competencies: automation engineers, CNC operators, digital system specialists, and data analysts.

Trend Clusters:

- **Technological Cluster:** Implementation of automation and robotization systems for production lines, process digitalization through ERP/MES systems and IIoT sensors, use of predictive analytics and equipment digital twins, growth in additive technologies (3D printing of parts and components), transition to energy-efficient technologies and modernization of old capacities, development of petrochemicals and deep polymer processing.
- **Environmental Cluster:** Transition to clean technologies, reduction of emissions and energy efficiency, development of industrial waste and plastics processing, strengthening of environmental standards requirements, product certification, environmental monitoring and production safety technologies, implementation of the "circular industry" concept—secondary material use.
- **Social and Economic Cluster:** Localization of production for the oil and gas sector (equipment, parts, services), formation of industrial and oil service clusters, development of industrial zones in Atyrau providing infrastructure for SMEs, growth in demand for high value-added products, expansion of secondary raw material processing within ESG initiatives, strengthening cooperation between major companies (TCO, NCOC, ANPZ) and small businesses

5.4. THREATS

- High dependency on imported equipment and components:

Any disruptions in international supplies lead to production halts and increased product costs.

- Competition with the oil and gas sector for personnel:

Young specialists prefer the oil and gas sector due to higher salaries, leading to shortages of skilled trades and engineering personnel in manufacturing.

- Outdated production assets:

A significant portion of equipment is obsolete and physically deteriorated, reducing efficiency and increasing accident risks.

- Low degree of automation: Many productions operate manually, leading to high defect rates, low productivity, and dependency on human factors

- Limited access to investments:

High loan interest rates and short payback periods hinder enterprise modernization.

- Environmental and regulatory risks:

Strengthening safety and environmental requirements increases enterprise costs.

- Risks of instability in supply chains:

The region depends on external logistics routes, making production vulnerable to external factors.

5.5. OPPORTUNITIES

-Localization of production for oil and gas giants (TCO, NCOC, ANPZ):
Major projects stimulate the creation of plants for producing components, metal structures, equipment, and services.

-Development of industrial zones:
Ready infrastructure lowers entry barriers for new enterprises and supports small and medium-sized business development.

-Access to state support measures:
Programs for subsidizing leasing, preferential lending, and investment compensation create conditions for production modernization.

-Introduction of digital technologies and robotization:
This enables enterprises to reduce costs, improve quality, and ensure production stability.

-Development of secondary raw material and waste processing:
The ESG agenda and growing interest in eco-friendly solutions open new niches.

-Growth in demand for local producers:
Major companies are interested in reducing imports and focusing on local plants.

-Collaboration with educational institutions:
Creation of training grounds, dual programs, and corporate training centers ensure a steady flow of personnel.

5.6. VISION OF THE FUTURE

The manufacturing industry in Atyrau Region in the future represents a high-tech, sustainable, and digital production ecosystem. A new generation of enterprises operates on the basis of automation, robotization, intelligent control systems, digital twins, and predictive equipment maintenance.

Industrial sites become flexible: they can quickly reconfigure production to meet the needs of the oil and gas industry, mechanical engineering, construction, and petrochemicals. Localized component production reduces import dependency and forms domestic supply chains.

Workers of the future are specialists of a new type: digital system operators, automation engineers, data analysts, industrial safety specialists, robotics experts, and additive technology professionals.

The region strengthens its position as a center for petrochemicals and oil services, while also becoming an attractive hub for investments in mechanical engineering, metal processing, and equipment production. The implementation of ESG standards makes production more environmentally friendly, reduces emissions, and improves resource use efficiency.

5.7. NEW PROFESSIONS

1. AUTOMATED LINE OPERATOR

Emergence Horizon: In the next 1-3 years

Description: Monitoring robotic and autonomous lines, as well as troubleshooting failures in artificial intelligence (AI) systems..

Required Skills: Management of robotic systems, AI failure diagnostics, work with MES systems, PLC, HMI, basic understanding of AI diagnostics.

2. ROBOTIC SERVICE TECHNICIAN

Emergence Horizon: In the next 1-3 years

Description: Configuring sensor software, programming manipulators, and maintaining robotic systems.

Required Skills: Sensor and transducer configuration, manipulator programming, work with digital instrumentation, performance monitoring, sensor system setup

3. 3D PRINTING AND WELDING ENGINEER

Emergence Horizon: In the next 1-3 years

Description: Preparing 3D models, printing on 3D machines, maintenance and repair of additive equipment. Required for producing high-precision parts.

Required Skills: 3D modeling (CAD/CAE), work with additive technologies, materials science, 3D printer setup, print quality control.

4. INDUSTRIAL DATA SPECIALIST

Emergence Horizon: In the next 1-3 years

Description: Collects and analyzes data from sensors, machines, and robots to optimize production.

Required Skills: Programming (Python, SQL), big data analysis, machine learning, data visualization, work with IoT sensors.

5.7. NEW PROFESSIONS

5. SMART OPERATOR

Emergence Horizon: In the next 1-3 years

Description: Collects and analyzes real-time data on machines and robots, as well as monitoring production processes.

Required Skills: Knowledge of technological processes, work with IoT equipment, real-time system monitoring, basic data analytics.

6. GREEN TECHNOLOGY ENGINEER

Emergence Horizon: In the next 1-3 years

Description: Implementing energy-saving technologies, waste management, ESG control and reporting. Driven by the trend of production greening (ESG trend).

Required Skills: Environmental auditing, energy efficiency management, AI emission diagnostics, sustainable design, knowledge of ESG standards, project management.

7. QUALITY AND INTERNATIONAL PRODUCT CERTIFICATION ENGINEER

Emergence Horizon: In the next 1-3 years

Description: Ensuring product compliance with international standards (ISO, API, ASME), required for enterprises to enter foreign markets and participate in major tenders.

Required Skills: Knowledge of international quality standards (ISO 9001, API, ASME), quality management systems, auditing and certification, project management.

8. ADDITIVE TECHNOLOGY OPERATOR (3D PRINTING)

Emergence Horizon: In the next 1-3 years

Description: Professional manufacturing parts and forms using 3D printers.

Required Skills: Work with 3D printers, model preparation for printing, knowledge of materials for additive manufacturing, quality control, basic 3D modeling.

5.7. NEW PROFESSIONS

9. DIGITAL SERVICE AND AI ENGINEER

Emergence Horizon: In the next 3–5 years.

Description: Manages production through digital twins and conducts AI analysis of production processes.

Required Skills: Creation and management of digital twins, AI analytics, programming (Python, R), process modeling, machine learning.

10. VR/AR TECHNOLOGY ENGINEER

Emergence Horizon: In the next 3–5 years.

Description: Engaged in 3D modeling, creating VR simulations for equipment maintenance, and developing AR instructions for workers

Required Skills: VR/AR design and development, digital twin creation, 3D modeling, technical simulation development, programming.

11. AI TECHNOLOGY PROJECT MANAGER

Emergence Horizon: In the next 3–5 years.

Description: Planning and implementing AI projects in production, process optimization, and management of digital teams.

Required Skills: Project management (Agile, Scrum), understanding of AI technologies, analytical skills, digital competencies, communication and leadership.

12. NANOTECHNOLOGY ENGINEER

Emergence Horizon: In the next 3–5 years.

Description: Creating, implementing, and supporting nanomaterials and nanotechnologies in production, driven by the shift toward high value-added products.

Required Skills: Materials science, nanophysics and nanochemistry, laboratory skills, safety in working with nanomaterials, AI modeling.

5.8. TRANSFORMING PROFESSIONS

1. DRIVER → AUTONOMOUS TRANSPORT MODULE SUPERVISOR-OPERATOR

Transformation Horizon: In the next 3–5 years.

Reason for Change: Automation of logistics, introduction of unmanned transport and drones, shifting from manual control to monitoring and remote management.

Acquired Competencies: Work with autonomous transport module (ATM) software, digital system monitoring, basics of cybersecurity, remote control and dispatching, telematics data analysis

2. MACHINE OPERATOR (MILLER, TURNER) → ADDITIVE AND SUBTRACTIVE SYSTEM PROGRAMMER-OPERATOR

Transformation Horizon: In the next 1–3 years.

Reason for Change: Active use of CNC machines, robotic equipment, and additive technologies (3D printing).

Acquired Competencies: G-code and trajectory programming; Digital modeling (CAD/CAM); Work with machine digital twins; Robot operation optimization; Predictive equipment diagnostics; Work with composite materials.

3. PAINTER → ROBOTIC PAINTING CHAMBER OPERATOR

Transformation Horizon: Short-term (1–3 years).

Reason for Change: Introduction of automatic painting chambers, robotic manipulators, new paint materials, and compliance with environmental standards.

Acquired Competencies: Programming of robot manipulators; Control of coating thickness and uniformity using digital sensors; Knowledge of nanostructured paint chemistry; Automated chamber parameter setup; Compliance with environmental standards (ESG).

4. SANDBLASTER → AUTOMATED SURFACE TREATMENT TECHNICIAN

Transformation Horizon: In the next 1–3 years.

Reason for Change: Robotization and automation of surface treatment, enabling control of automated cabins, remote monitoring, and improved working conditions.

Acquired Competencies: Programming of robotic manipulators; Pressure and abrasive material parameter setup; Equipment monitoring through digital systems; Remote process control; Work with automated dust removal systems.

5.8. TRANSFORMING PROFESSIONS

5. WELDER → WELDER WITH ROBOTIZATION ELEMENTS

Transformation Horizon: in the next 1–3 years.

Reason for Change: Introduction of robotic welding systems for complex and repetitive operations and higher weld quality requirements for the oil and gas sector.

Acquired Competencies: Basic programming of welding robots; Welding trajectory setup; Work with automatic quality control systems; Knowledge of international standards (API, ASME); Digital process documentation.

6. PROCESS ENGINEER → DIGITAL MANUFACTURING ARCHITECT

Transformation Horizon: in the next 3–5 years.

Reason for Change: Transition from paper technical maps and manual calculations to digital design using PLM systems and AI process optimization.

Acquired Competencies: Work with PLM systems (Siemens Teamcenter, PTC Windchill); Big data analysis; Digital design (CAD/CAE/CAM); Creation of digital process maps; AI process optimization; Data integration across departments.

7. OCCUPATIONAL SAFETY ENGINEER → PREDICTIVE INDUSTRIAL SAFETY ANALYST (HSE DATA ANALYST)

Transformation Horizon: in the next 3–5 years.

Reason for Change: Introduction of sensors, AI monitoring, and video analytics for remote control of work areas.

Acquired Competencies: Work with video analytics software; Sensor and IoT device setup; Data analysis for incident prediction; Remote control via drones and cameras; Development of digital safety protocols; Predictive risk modeling.

5.9. DISAPPEARING PROFESSIONS

TIMEKEEPER

Disappearance Horizon: In the next 3–5 years.

Reason for Disappearance: Automation of working time tracking using digital systems and AI.

TRANSLATORS

Disappearance Horizon: In the next 3–5 years.

Reason for Disappearance: : Use of AI translators and automated translation systems

TRADITIONAL DISPATCHERS

Disappearance Horizon: In the next 3–5 years.

Reason for Disappearance: Replacement by digital dispatching centers automating monitoring and task distribution functions.

FITTER-MECHANICS WITHOUT DIGITAL COMPETENCIES

Disappearance Horizon: In the next 3–5 years.

Reason for Disappearance: Predictive diagnostics and robots reduce the need for manual repairs, while requiring skills in maintaining automated systems.

LOW-LEVEL OPERATORS (PERFORMING ROUTINE TASKS)

Disappearance Horizon: In the next 3–5 years.

Reason for Disappearance: Full automation of production processes and robotization.

LABORATORY TECHNICIANS WITHOUT ANALYTICS SKILLS

Disappearance Horizon: In the next 3–5 years.

Reason for Disappearance: Replacement by automatic analyzers and digital laboratories.

WELDERS (FOR STANDARD OPERATIONS)

Disappearance Horizon: In the next 3–5 years.

Reason for Disappearance: Introduction of robotic welding complexes and metal 3D printing for repetitive and complex operations.

5.10. CRITICALLY SCARCE PROFESSIONS

WELDER

Necessity: Extremely in demand in the region, as filling one vacancy can take up to a month. Required for oxy-fuel, semi-automatic, and structural welding. The acute shortage is exacerbated by competition with the oil and gas sector.

Where Needed: Large and medium-sized industrial enterprises, oil and gas services, mechanical engineering.

FITTER-MECHANIC / EQUIPMENT ADJUSTER TECHNICIAN

Necessity: Needed for maintenance and repair of equipment, machines, as well as control, setup, and servicing of production lines. The shortage is linked to qualified personnel moving to the oil and gas sector.

Where Needed: Industrial enterprises, oil and gas services, mechanical engineering, as well as for technical maintenance, repair, and equipment installation.

MACHINE OPERATOR / MACHINIST

Necessity: Required for metal processing, work on CNC, lathe, and milling machines. Needed to ensure high product quality.

Where Needed: Mechanical engineering and metal processing enterprises.

ELECTRICAL FITTER / ELECTRICIAN

Necessity: Required for installation, setup, and maintenance of electrical equipment, as well as electrical and thermal energy supply for industrial facilities.

Where Needed: Industrial facilities, enterprises engaged in technical maintenance, repair, and equipment installation.

DIGITAL SYSTEMS AND AUTOMATION SPECIALISTS

Necessity: Engineers in IIoT, ERP/MES, and digital twins are needed, determining technological sustainability of enterprises during the transition to cyber-physical systems and Industry 4.0 requirements.

Where Needed: Industrial enterprises aiming for process digitalization and implementation of automated control systems.

5.10. CRITICALLY SCARCE PROFESSIONS

DATA ANALYSTS / INDUSTRIAL ANALYTICS ENGINEERS

Necessity: Needed for processing and analyzing data from sensors and systems to optimize production processes. Required for predictive equipment analytics.

Where Needed: KLarge industrial enterprises and R&D departments.

MID-LEVEL ENGINEERING AND TECHNICAL PERSONNEL

Necessity: Foremen, supervisors, and maintenance and repair specialists are required. There is an acute shortage of qualified engineering-technical specialists, as young people choose the oil and gas sector.

Where Needed: Industrial enterprises providing repair, maintenance, and equipment installation.

6. FUTURE OF THE FOOD INDUSTRY IN THE ATYRAU REGION

6.1. Expert Opinion

FUTURE OF THE FOOD INDUSTRY IN THE ATYRAU REGION

BORANOVA AKMARAL ALGADAYKYZY
Chief Specialist, Department of Fisheries
State Institution "Department of Agriculture and Land Relations of the Atyrau Region"

1. List the strengths of your region at the current stage.

In my opinion, the strengths of the Atyrau Region at the current stage are its high potential in the oil and gas sector, advantageous geographical location, qualified personnel, developed infrastructure, and high investment attractiveness. The strengths of the Atyrau Region in the fishing industry lie in its unique natural resources (the Caspian Sea and the Zhaiyk/Ural River), developed infrastructure, the presence of experienced enterprises, export opportunities, and state support.

2. What key trends and technologies of the future do you currently observe in your region?

In the Atyrau Region, the fishing industry is seeing the development of aquaculture and recirculating aquaculture systems (RAS), as well as the implementation of digital monitoring and the robotization of processing. Attention is also being paid to sustainable fishing and eco-friendly feeds.

3. What directions for transformation in the professional training system would you propose?

To transform the professional personnel training system, it is important to adapt curricula to specific production requirements, introduce digital and distance learning technologies, utilize international experience, and implement practice-oriented education. For the fishing industry, it is crucial to develop specialized education and training-production centers so that students acquire practical skills.

6.1. Expert Opinion

FUTURE OF THE FOOD INDUSTRY IN THE ATYRAU REGION

YERZHANOV KUANDYK KUANYSHULY
Director, Atyrau College of Service

1. What are the main factors determining the process of socio-economic development in your region?

The main factors determining the socio-economic development of the Atyrau Region in the food industry are the availability of a raw material base, including developed livestock farming, fisheries, and vegetable growing. A significant role is played by the existing processing infrastructure, represented by enterprises undergoing modernization and introducing modern technologies. An important factor is the region's logistical potential, including proximity to Russia, export opportunities via the Caspian Sea, and the presence of international highways.

2. What current trends and technologies of the future do you observe globally?

The future of public catering is being shaped by key trends such as the development of healthy eating, automation and the emergence of robotic kitchens, digitalization and the expansion of online services, as well as increased attention to eco-friendliness and sustainable development, the proliferation of plant-based and alternative products, and the development of delivery services and virtual kitchens.

3. In which industry of your region are problems with staffing felt most acutely?

The problem of staffing is felt most acutely in the sphere of public catering and service industries, including hotel business, tourism, hairdressing and cosmetology, as well as restaurant service.

6.1. Expert Opinion

FUTURE OF THE FOOD INDUSTRY IN THE ATYRAU REGION

Determine an approximate forecast for the state of your region if current trends continue over a 5–10 year horizon.

If current trends continue, the region's economy will gradually diversify, the agricultural sector will strengthen, and digital services will expand; however, the shortage of personnel and environmental problems will remain significant.

What knowledge, skills, and abilities are relevant and in demand today in your region?

The most in-demand skills are technical competencies, IT skills, environmental management, logistics, and analytical and engineering skills.

ZINULLIN MEREKE MUKHSYEVICH
Head of the City Department of Entrepreneurship and Agriculture Atyrau City

6.1. Expert Opinion

FUTURE OF THE FOOD INDUSTRY IN THE ATYRAU REGION

What factors influencing the development of your professional industry can you name?

The development of the industry is influenced by the availability of raw materials, the introduction of new technologies, sanitary standards, state support, the quality of personnel training, and demand in the domestic market.

What are the most promising areas of activity, work options, and further development that need to be developed in your region?

It is necessary to develop meat and milk processing, fish processing, production of organic products, biotechnology, warehouse logistics, and the digitalization of production processes.

What promising professions, specialties, and qualifications that are in demand in your region right now can you list?

There is a demand for engineers in eco-technologies and sustainable production, engineers in automation and digitalization of food production, agronomist-technologists, logistics specialists, and biotechnologists in aquaculture and fish processing.

IZBULOVA ARAYLYM MADIKHATOVNA
Lecturer, O. Kushekov Atyrau Agrarian-Technical College

6.1. Expert Opinion

FUTURE OF THE FOOD INDUSTRY IN THE ATYRAU REGION

1. In your opinion, what threats exist that the leadership of your region will need to eliminate in a timely manner in the near future?

The main threats are related to the deterioration of the ecological state of the Caspian Sea, dropping water levels, pollution of water resources, and illegal fishing. Additionally, it is necessary to strengthen product quality control and ensure the modernization of processing enterprises.

2. What are the most promising areas of activity, work options, and further development that need to be developed in your region?

Promising areas include: deep processing of fish (fillets, canned goods, culinary semi-finished products), development of fishing tourism, production of feed for aquaculture, implementation of digital fishery management systems, and the development of cold chain logistics centers.

MENYAYLO SERGEY SERGEYEVICH
Deputy Chairman, Production Cooperative "Rakush"

6.1. Expert Opinion

FUTURE OF THE FOOD INDUSTRY IN THE ATYRAU REGION

1. In your opinion, in which industry of your region are business organizations developing most intensively and increasing in number?

Many are now trying their hand at fish reproduction (RAS) and pond construction, but they do not fully understand the colossal effort and investment required to realize these ideas. The confectionery sector (bread, cakes, muffins, etc.) is developing very dynamically.

2. What current staffing problems are observed in the industry where you work?

In our case, there is a shortage of the following specialists: open-field agronomists for growing vegetables, fodder for livestock, fish, and poultry; greenhouse agronomists; horticulturists for growing apples, grapes, etc.; machine operators; fish breeders; food industry technologists; dairy workers; and shepherds.

NURSHIEV ADILBEK KABESOVICH
Manager, Peasant Farm "Zhumagalieva N.M."

6.1. Expert Opinion

FUTURE OF THE FOOD INDUSTRY IN THE ATYRAU REGION

UTEPOVA KARLYGASH KHIZATULLAEVNA
Director, "Abylai-Khan" LLP

1. Name the negative trends in the development of your region.

Negative trends in the development of the Atyrau Region include high dependence on the oil and gas sector, environmental problems, insufficient economic diversification, freshwater deficit, labor market imbalance, and socio-economic inequality between the city and rural districts.

2. Identify the key points and potential opportunities that should be relied upon for the development of your region.

For the development of the food industry in the Atyrau Region, the key points and opportunities are:

- Raw material resources – availability of agricultural and fish products for processing.
- Investments and technologies – introduction of modern equipment and production automation.
- Logistics and export – development of transport infrastructure and access to external markets.
- Personnel and education – training of qualified specialists in the food industry.
- Innovation and high value-added products – development of organic, processed, and functional products. Focusing on these areas will increase the region's competitiveness and create new jobs.

3. In your opinion, what professional knowledge, skills, and abilities do modern college and university educational programs fail to form sufficiently?

Modern educational programs in the Atyrau Region insufficiently form students' skills in working with modern equipment, product quality and safety management, innovative processing methods, digital literacy, and entrepreneurial competencies in the food industry.

6.2. CURRENT STATE OF THE INDUSTRY

The food industry of the Atyrau Region is characterized as being in a start-up or moderately developed stage, possessing potential but limited by the dominance of the petrochemical industry in the regional economy.

According to available statistical data, food production in the Atyrau Region amounts to approximately 6,389.4 million tenge. Despite this volume, the share of the manufacturing industry, which includes the food sector, remains low in the total volume of regional industry.

The share of the food industry in the Gross Regional Product (GRP) is assessed as low, which is characteristic of regions where raw material industries predominate. Nevertheless, the food industry is included among the key directions for new investment projects in the region.

Major systemic problems limiting the growth of the industry include:

1. Low share of the sector in the total volume of industry.
2. Problems with infrastructure, logistics, and technological equipment of enterprises.
3. Shortage of qualified personnel, as well as incomplete realization of export potential.

Analysis of educational programs in regional universities and colleges confirms the fact that educational institutions only partially cover the personnel needs of the food industry. Personnel training in specialized areas is limited and represented by isolated educational programs, lacking a wide range of specializations focused on modern processing technologies, quality control, automation, and production process management in the food sector.

In the context of the region's food industry growth and modernization, this situation creates a gap between employer demands and the capabilities of the vocational and higher education system. This indicates the need to expand and update educational programs, strengthen practice-oriented training, and foster closer interaction between educational organizations and food industry enterprises.

Prospects for growth and modernization of the industry are linked to attracting investment to create more powerful processing enterprises producing high value-added products.

There is an opportunity to develop exports due to the region's geographical location (Western Kazakhstan) to supply neighboring markets.

Critically important measures include the introduction of modern quality standards (HACCP, traceability) and the development of cooperation between agricultural producers and food enterprises under the "farm–factory–market" scheme.

In the long term (2035–2040), the goal is to transform the food industry into a diversified cluster for the processing of agricultural and seafood products, oriented towards export and the domestic market, characterized by vertical integration, a high level of processing, and its own line of brands (e.g., Halal, Organic).

Thus, despite the currently low share in industrial volume, the industry has all the prerequisites for sustainable growth, subject to effective modernization and government policy.

6.3. TRENDS

1 trend **Personnel shortage in the food industry:**

The industry faces a shortage of qualified specialists, linked to low wages and limited professional training opportunities. This necessitates the development of modern educational programs and increasing the attractiveness of blue-collar professions in food production. A key direction is the training and retention of competent personnel, modernization of curricula in food technologies, and the development of dual education systems and production internships at enterprises

2 trend **Decline in the quality of personnel training:**

The educational system shows a decline in the level of specialist training for the food industry in the Atyrau Region. The main reason is the insufficient adaptation of educational programs and teaching methods to modern requirements and technological changes in the industry.

3 trend **Lack of investment and state support:**

Despite implemented state support measures, the industry continues to lack subsidies for modernization and technical re-equipment. Stimulating the development of the food industry requires creating more favorable conditions for investors—providing tax breaks and developing production and transport infrastructure. A promising direction is the expansion of partnership projects with the National Chamber of Entrepreneurs, financial institutions, and international organizations.

4 trend **Growing demand for healthy food and convenient formats:**

In the Atyrau Region, there is an increasing consumer interest in healthy eating, snacks, and small-portion meals. According to data from Kursiv Media Kazakhstan, the share of urban residents regularly consuming snacks reached about 49% in 2024. According to forecasts by StrategyHelix, the snack market will grow at a compound annual growth rate (CAGR) of about 9.6% until 2030. This trend opens new opportunities for local manufacturers to create packaged, convenient, and functional products with added consumer value. Formation of "Made in Atyrau" brands. Increase in the share of eco-friendly, farm, and functional food products.

5 trend **Development of aquaculture and fish processing:**

The Atyrau Region is seeing active growth in fisheries and fish product production, accompanied by the expansion of fish farms, processing workshops, and export capacities. Given the region's advantageous location on the Caspian Sea coast and proximity to fish resources, the development of fish processing and aquaculture is becoming particularly relevant. Promising directions include the production of fish meal, aquaculture feeds, and frozen and packaged products, which will increase the added value of products and strengthen the region's position in domestic and foreign markets.

6 trend **Development of technology and production automation:**

The dairy, meat, and fish processing sectors are actively introducing modern technologies, including production process automation, ultrafiltration, and innovative packaging solutions (foodexpo.kz). At the same time, issues of sustainable development, waste reduction, and the implementation of eco-friendly production practices are becoming increasingly significant. For the Atyrau Region, the introduction of modern production lines and sustainable technologies can ensure regional enterprises a competitive advantage in domestic and foreign markets.

7 trend **Transition from a raw material to a processing economy:**

The Atyrau Region demonstrates potential for the development of deep processing enterprises for meat, milk, fish, grain, and melon crops. Creating modern production lines for filling, packaging, preservation, and the release of semi-finished products will increase the added value of products, reduce dependence on raw material exports, and strengthen the region's competitiveness in domestic and foreign markets.

8 trend **Sustainable development and eco-technologies:**

In the food industry of the Atyrau Region, attention to sustainable development and the introduction of eco-friendly technologies is growing. Key directions are waste reduction, processing of by-products, and water reuse. Bioenergy and "green" production projects are developing, and there is growing demand for secondary raw material processing. Increasing the volume of waste and agricultural by-product processing requires creating new production capacities and modernizing infrastructure, contributing to increased efficiency and environmental safety of the industry.

9 trend **Development of cold chain logistics and storage infrastructure:**

To ensure the quality and preservation of food products in the Atyrau Region, the development of modern cold chain logistics is important. Key directions are the creation of a network of refrigerated warehouses and logistics centers, as well as the introduction of modern transport solutions that allow maintaining optimal conditions for product storage and transportation. This will increase supply chain efficiency and reduce product losses.

10 trend **Expansion of export directions:**

The Atyrau Region has the potential to enter external markets, including countries of the Caspian region, Central Asia, and the Middle East. Successful product promotion requires certification according to international quality and safety standards such as ISO, HACCP, and Halal. This will strengthen the position of regional manufacturers in foreign markets and increase consumer trust in the products.

11 trend **Development of scientific and technological cooperation:**

For the development of the food industry in the Atyrau Region, it is important to create food innovation laboratories at universities and research institutes. A significant direction is supporting startups and implementing solutions in the field of foodtech, which accelerates innovation, increases production efficiency, and develops competitive products on the market.

12 trend **Strengthening food security and regional self-sufficiency:**

An important direction for the development of the food industry in the Atyrau Region is increasing the share of local products in retail trade and public procurement. The development of short supply chains between agricultural producers and end consumers contributes to strengthening the region's food security, reducing logistics costs, and increasing the availability of quality products for the population.

13 trend **Rising prices and declining processing profitability:**

Rising prices for raw agricultural products are accompanied by a fall in the real value of processed products, which negatively affects the income of farmers and processors.

14 trend **Increase in fish farming production and the need to form a proprietary fishery base:**

This reflects the region's growing need to develop aquaculture as a sustainable source of food security and economic growth. Creating a proprietary production base in the fishery sector will reduce dependence on external supplies, stabilize production volumes, and ensure product quality control. It also opens opportunities for introducing modern technologies for breeding, selection, feeding, and monitoring the state of aquatic bioresources. Developing aquaculture infrastructure will be a factor in attracting investment, expanding entrepreneurial initiatives, and increasing the region's export potential.

15 trend **Scaling up fish feed production:**

The growth in fish product production volumes requires the formation of a sustainable feed base. Increasing the scale of specialized fish feed production is a key condition for increasing the productivity of aquaculture farms and ensuring industry stability. Developing proprietary feed production allows reducing dependence on imported components, lowering product costs, and increasing control over feed quality and composition. Furthermore, introducing modern technologies in feed formulation and production (high-protein mixtures, biological additives, optimized formulas) helps accelerate fish growth, reduce diseases, and increase process eco-friendliness. This direction opens new opportunities for developing related industries, stimulating local business, and forming a fully closed cycle in the region's aquaculture sector.

16 trend **Strengthening standardization requirements:**

Tightening requirements in the field of standardization is becoming a key factor in improving product quality and safety. This is driven by growing demands from consumers, partners, and regulators, as well as the need to comply with international norms to enter foreign markets. Raising the level of standardization involves introducing modern systems for quality control, certification, traceability, and documentation of production processes. For industry enterprises, this means the need to modernize equipment, update technological regulations, train personnel, and transition to more transparent quality management procedures. In the long term, compliance with higher standards helps build consumer trust, grow product competitiveness, and reduce risks associated with non-compliance with market and regulatory requirements.

17 trend **Improving brand quality, advertising, and packaging (trend towards minimalism):**

The modern market places higher demands on the visual identity and communication materials of manufacturers. The trend towards minimalism in branding, advertising, and packaging reflects a desire for simplicity, clarity, and functionality. Clients increasingly choose products that have a clean, neat design, easily readable information, and eco-friendly packaging. Improving brand and packaging quality is a strategic tool for building consumer trust, increasing product recognition, and forming a positive company image. A minimalist approach allows focusing on key product characteristics, emphasizing quality and naturalness, as well as optimizing costs for packaging materials. For industry enterprises, implementing such standards means working on updating corporate style, improving the quality of visual materials, and transitioning to more modern and eco-friendly packaging solutions. This contributes to the growth of product competitiveness in both domestic and foreign markets.

Trend Clusters of the Atyrau Region Food Industry:

- **Personnel-Educational Cluster:** Shortage of qualified specialists, decline in training quality, modernization of educational programs, dual education, and internships.
- **Investment-Economic Cluster:** Investment attractiveness, state support, tax incentives, infrastructure development, partnership projects with NCE, banks, and international organizations.
- **Consumer and Product Cluster:** Growing demand for healthy and functional food, snacks, packaged products, "Made in Atyrau" brands.
- **Technological and Production Cluster:** Automation and innovation, ultrafiltration, modern packaging lines, transition from raw material to processing format, aquaculture, and fish processing.
- **Environmental Cluster:** Sustainable development, eco-technologies, waste processing, bioenergy, "green" production, infrastructure modernization.
- **Logistics and Export Cluster:** Cold chain logistics, modern transport solutions, expansion of export directions, ISO, HACCP, Halal certification.
- **Scientific-Technological Cluster:** Food innovation laboratories, startup support, implementation of foodtech solutions.
- **Food Security and Economic Cluster:** Short supply chains, increasing the share of local products, rising raw material prices, declining processing profitability, imbalance between demand for specialists and their quantity/quality.

6.4. THREATS

HR Risks:

Shortage of qualified specialists and declining training quality, mismatch of educational programs with modern industry requirements; low worker incomes continue to drive labor migration to other industries.

Economic Risks:

Rising raw material prices alongside falling processing profitability, imbalance between demand for specialists and their quantity/quality.

Infrastructure Limitations:

Shortage of cold chain logistics and warehouse capacities, limited opportunities for modernization and re-equipment of enterprises.

Regulatory and Market Barriers:

Lack of subsidies and state support for modernization, necessity of product certification for entering export markets.

Shallowing of the Zhaiyk River and Caspian Sea:

Represents a serious strategic threat to the region, directly affecting ecological stability, agriculture, the fishing industry, and water supply. Reducing levels of the Zhaiyk River and the Caspian Sea lead to a reduction in aquatic bioresources, deterioration of spawning conditions, and a decrease in the natural food base, which negatively affects fishery and aquaculture volumes.

Land Degradation due to Climate Change:

Represents a serious long-term threat to food security and sustainable development of the region. Rising temperatures, reduced precipitation, frequent droughts, and changing soil structures negatively affect land fertility, reduce crop yields, and increase costs for maintaining agricultural production.

Non-compliance of Agricultural Products with Established Standards:

Represents a significant threat to the sustainable development of the industry. This problem leads to reduced product competitiveness, limits opportunities for entering new markets, and increases risks of rejection by partners and processing enterprises.

Growing Competition and Declining Product Quality:

Intensifying competition in the industry without proper quality control creates a significant threat to the sustainable development of enterprises. In an effort to reduce costs and retain market position, some manufacturers may cut spending on raw materials, technologies, and quality control, leading to deteriorating product characteristics and loss of consumer trust.

Logistical and Infrastructural Threats:

Insufficiently developed transport and processing infrastructure represents a serious threat to the food industry of the Atyrau Region. Limitations in product transportation and storage lead to increased losses, reduced quality, and a reduction in available sales markets. This is particularly relevant for perishable products, raw materials for processing, and export deliveries. A shortage of refrigerated warehouses, modern transport vehicles, and effective logistics chains limits enterprises' ability to scale production and react quickly to demand changes.

6.5. OPPORTUNITIES

Development of Human Potential:

Modernization and opening of new educational programs, introduction of dual education and internships, raising the status of blue-collar professions in the industry.

Investment and State Support:

Creating favorable conditions for investors: tax incentives, partnership with NCE, banks, and international organizations.

Product and Consumer:

Growing demand for healthy, functional, and convenient food. Opportunity to create local "Made in Atyrau" brands.

Technology and Production:

Automation, innovation, ultrafiltration, modern packaging lines, transition from a raw material to a processing economy format (milk, meat, fish, grain, melons), development of aquaculture and fish processing.

Sustainable Development and Eco-technologies:

Implementation of projects for waste processing, water reuse, introduction of bioenergy and "green" technologies makes the industry more competitive and environmentally safe.

Logistics and Export:

Creation of a network of refrigerated warehouses and transport solutions, expansion of export directions (Caspian region, Central Asia, Middle East) with international ISO, HACCP, Halal certification.

Scientific-Technological Cooperation:

Food innovation laboratories, support for startups, and implementation of foodtech solutions.

Increasing Food Security and Regional Self-Sufficiency:

Increasing the share of local products and developing short supply chains between agricultural producers and consumers ensure the stability of the regional food market.

Development of Aquaculture and Fish Processing:

Favorable location in the Ural-Caspian basin opens broad prospects for creating modern fish farms, processing, and exporting seafood. Production of fish meal, feed, and frozen products can become a driver of regional economic growth.

Transition to Deep Processing of Agricultural Raw Materials:

Development of enterprises for processing meat, milk, fish, grain, and melon crops with the release of finished and packaged products increases added value and helps reduce dependence on raw material exports.

Introduction of Automation and Digitalization Technologies:

Use of robotic systems, sensors, artificial intelligence, and foodtech solutions allows increasing productivity, reducing costs, and improving quality control.

Development of Cold Chain Logistics and Storage Infrastructure:

Creating a network of refrigerated warehouses, transport hubs, and logistics centers will preserve product quality, reduce losses, and ensure stability of supplies to domestic and foreign markets.

Expansion of Export Directions:

Entering markets of the Caspian region, Central Asia, and the Middle East with product certification according to international standards (ISO, HACCP, Halal) creates new revenue sources and enhances the region's reputation as an export hub.

Scientific-Technological Cooperation and Innovation:

Creating food innovation laboratories, startup incubators, and research centers at universities stimulates the introduction of advanced technologies and new products.

Development of SMEs in Processing and Packaging:

Support for small enterprises engaged in processing agricultural products and producing local brands contributes to economic diversification and increased employment.

6.5. OPPORTUNITIES

Dredging and Restoration of Water Resources:

Developing dredging works and measures to restore water resources is a strategic direction for ensuring the sustainable functioning of the food industry and aquaculture in the region. Restoration of water resources contributes to increasing ecological stability, reduces risks of raw material and product losses, and creates prerequisites for developing modern water use technologies and effective management of aquatic bioresources.

Production of Cheap Local Feeds:

Growth in the production of inexpensive feeds for animals and fish reflects a desire to reduce production costs and ensure the availability of a feed base for aquaculture and agriculture. Developing the production of inexpensive but high-quality feeds creates potential for increasing industry stability, expanding product assortment, and strengthening competitiveness in domestic and foreign markets.

Subsidies and Concessional Lending:

Developing a system of subsidies and concessional lending is an important tool for state support of the food industry. These measures stimulate production modernization, the introduction of new technologies, expansion of raw material processing, and improvement of product quality. For enterprises, this creates opportunities to reduce the financial burden when investing in equipment, infrastructure construction, and launching innovative projects. Furthermore, access to concessional financing increases industry competitiveness, helps attract investment, and stimulates the development of small and medium-sized enterprises.

Promotion of Healthy Eating:

Promoting healthy eating stimulates manufacturers to introduce modern processing technologies, use natural raw materials, reduce sugar, salt, and preservative content, and develop functional products. For the industry, this opens opportunities to expand the assortment, enter new market segments, and increase consumer loyalty.

6.6. VISION OF THE FUTURE

In the future, the food industry of the Atyrau Region will become an innovative, eco-friendly, and export-oriented sector of the economy. Highly qualified specialists, trained under modern educational programs with elements of dual education and internships, fully satisfy the industry's needs. Professions in the food industry acquire prestige and attractiveness for youth.

Enterprises are equipped with automated and digitalized lines for processing meat, milk, fish, and melon crops. Foodtech solutions, ultrafiltration, and innovative packaging technologies are actively implemented. Aquaculture and fish processing are developed, along with the production of frozen and packaged products with high added value.

Eco-friendliness and sustainable development become the key principles of the industry's operation. Waste is processed, water is reused, and bioenergy and "green" production processes are introduced. This ensures a minimal ecological footprint and high efficiency.

The share of local products in retail and public procurement exceeds 70–80%, and short supply chains directly link agricultural producers and consumers, ensuring freshness and availability of products. Consumers have a wide choice of healthy, functional, and convenient food, including snacks, semi-finished products, organic, and farm products. Local "Made in Atyrau" brands are in demand in domestic and foreign markets.

A network of modern refrigerated warehouses and logistics centers is developed, ensuring product preservation and timely delivery. Export activity is actively conducted to markets in the Caspian region, Central Asia, and the Middle East, complying with international ISO, HACCP, and Halal standards.

Scientific-technological cooperation between universities, research institutes, and enterprises accelerates the introduction of innovations. Food innovation laboratories, support for startups, and digital solutions increase production efficiency and product competitiveness.

Economic stability is ensured by balanced prices for raw materials and processed products, infrastructure development, and investment support. The regional food industry becomes stable, highly profitable, and capable of competing in national and international markets.

6.7. NEW PROFESSIONS

New professions in the food industry are driven by trends in digitalization, automation, growing demand for functional food, and the need to comply with international standards and environmental requirements.

1. TECHNOLOGIST OF FUNCTIONAL AND HEALTHY PRODUCTS

Time Horizon: In the next 1–3 years

Description: Development and production of functional, organic, and convenient food products, including snacks and semi-finished products.

Necessary Skills: Food production technology, biochemistry, HACCP quality standards, recipe development, and innovation

2. ENGINEER FOR AUTOMATION AND DIGITALIZATION OF FOOD PRODUCTION

Time Horizon: In the next 1–3 years

Description: Implementation and operation of automated lines, digital control systems, and foodtech technologies.

Necessary Skills: : Automation (PLC, SCADA), industrial robotics, digital twins, equipment diagnostics

3. DATA SPECIALIST (DATA ENGINEER)

Time Horizon: In the next 1–3 years

Description: Engaged in analyzing data structure, developing storage schemes and data organization, and ensuring data availability through digital systems. Designs and optimizes databases, develops effective solutions for processing and storing large volumes of information.

Necessary Skills: Databases, Big Data, data analytics, programming (Python, SQL), data storage systems.

4. ROBOTICS SYSTEMS DESIGN ENGINEER

Time Horizon: In the next 1–3 years

Description: Design, creation, and implementation of robotic and automated systems, development of concepts and technical solutions for new robots and intelligent mechanisms.

Necessary Skills: Technical knowledge, programming, systems thinking, robotics, systems integration.

6.7. NEW PROFESSIONS

5. INDUSTRIAL CYBERSECURITY SPECIALIST

Time Horizon: In the next 1–3 years

Description: Ensures protection of digital objects, industrial systems, and corporate networks from cyberattacks; monitors and analyzes network activity.

Necessary Skills: Cybersecurity, network technologies, threat monitoring, incident response, protection of industrial systems.

6. DIGITAL PRODUCTION OPERATOR

Time Horizon: In the next 1–3 years

Description: Management and control of digital and automated production systems, setup, launch, and monitoring of equipment. Participates in creating digital twins and managing digital objects.

Necessary Skills: Working with digital control systems, equipment monitoring, digital twins, basic programming.

7. ENGINEER IN ECO-TECHNOLOGIES AND SUSTAINABLE PRODUCTION

Time Horizon: In the next 1–3 years

Description: Waste processing, water reuse, bioenergy, implementation of "green" production processes.

Necessary Skills: Environmental management, recycling, ISO 14001, ESG approaches.

8. BIOTECHNOLOGIST IN AQUACULTURE AND FISH PROCESSING

Time Horizon: In the next 1–3 years

Description: Fish breeding, production of feed, frozen, and packaged seafood products considering environmental and export standards.

Necessary Skills: Biotechnology, sanitary standards, aquaculture management.

9. EXPERT IN LOGISTICS AND FOOD EXPORT

Time Horizon: In the next 1–3 years

Description: Management of cold chain logistics, supply chains, and exports in compliance with ISO, HACCP, and Halal.

Necessary Skills: Logistics, certification, international standards, export regulation.

6.7. NEW PROFESSIONS

10. MANAGER OF FOODTECH AND R&D SOLUTIONS

Time Horizon: In the next 1–3 years

Description: Research, startup development, and implementation of innovative technological solutions in the food industry.

Necessary Skills: Project management, innovation management, foodtech, marketing.

11. PACKAGING AND PRESERVATION DESIGN ENGINEER

Time Horizon: In the next 1–3 years

Description: Development of innovative and eco-friendly packaging, including biodegradable and multifunctional types of packaging to extend shelf life.

Necessary Skills: : Materials science, engineering design, 3D modeling.

12. EQUIPMENT REPAIR MASTER (TECHNICAL MAINTENANCE)

Time Horizon: In the next 1–3 years

Description: Specialist engaged in diagnostics, repair, and technical maintenance of machines and equipment in the food industry.

Necessary Skills: Technical skills, electromechanics and safety, organizational skills.

6.8. TRANSFORMING PROFESSIONS

1. FOOD PRODUCTION TECHNOLOGIST → TECHNOLOGIST OF FUNCTIONAL AND HEALTHY PRODUCTS

Transformation Horizon: In the next 1–3 years.

Reason for Change: Growing demand for healthy and functional food and the need to develop value-added products.

New Skills Required: Development of functional products, organic products, healthy eating, innovative recipes.

2. FOOD SAFETY SPECIALIST → DIGITAL QUALITY MANAGER

Transformation Horizon: In the next 1–3 years.

Reason for Change: Modernization of approaches to ensuring food safety through the introduction of advanced digital technologies. Includes the use of big data analytics, automated monitoring systems, and blockchain technologies.

New Skills Required: Big data analytics, automated monitoring systems, blockchain technologies, digital quality control platforms.

3. MECHANICAL ENGINEER → ENGINEER FOR AUTOMATION AND DIGITALIZATION OF PRODUCTION

Transformation Horizon: In the next 1–3 years.

Reason for Change: Automation and digitalization of production, requiring mechanical engineers to have skills in working with automated lines and foodtech solutions.

New Skills Required: Automation (PLC, SCADA), digital control systems, foodtech solutions, IT integration.

4. ENVIRONMENTAL INSPECTOR → SPECIALIST IN SUSTAINABLE AND "GREEN" TECHNOLOGIES

Transformation Horizon: In the next 1–3 years.

Reason for Change: Growing requirements for eco-friendliness, implementation of sustainable production practices, waste processing, bioenergy.

New Skills Required: Sustainable production practices, waste processing, bioenergy, ESG standards, green technologies.

6.8. TRANSFORMING PROFESSIONS

5. LOGISTICIAN → SPECIALIST IN COLD CHAIN LOGISTICS AND SUPPLY CHAIN MANAGEMENT

Transformation Horizon: In the next 1–3 years.

Reason for Change: Requirements for the preservation of perishable products and exports, necessity of introducing modern transport solutions and managing international chains.

New Skills Required: Cold chain logistics, international standards (ISO, HACCP, Halal), export supply management, modern transport solutions.

6. FISH PROCESSOR → BIOTECHNOLOGIST IN AQUACULTURE AND FISH PROCESSING

Transformation Horizon: In the next 1–3 years.

Reason for Change: Development of aquaculture and fish processing in the region, requiring specialists with knowledge in managing modern farms and feed development.

New Skills Required: Biotechnology, aquaculture management, feed development, environmental and export standards.

7. MARKETER → SPECIALIST IN PROMOTION OF HEALTHY AND FUNCTIONAL FOOD

Transformation Horizon: In the next 1–3 years.

Reason for Change: Growing demand for healthy eating, functional products, and the need to promote local brands.

New Skills Required: Promotion of local brands, demand analysis for functional products, export marketing, digital marketing.

8. LABORATORY CHEMIST, MICROBIOLOGIST → AUTOMATED LABORATORY OPERATOR (LAB TECH ANALYST)

Transformation Horizon: In the next 1–3 years.

Reason for Change: Automation and digitalization of laboratory processes, requiring skills in working with automatic analyzers and digital platforms

New Skills Required: Automatic analyzers, robotic sample preparation systems, digital monitoring platforms, data analytics.

6.8. TRANSFORMING PROFESSIONS

9. RESEARCHER → RESEARCHER IN FOODTECH AND TECHNOLOGICAL INNOVATIONS

Transformation Horizon: In the next 3–5 years.

Reason for Change: Growing interest in foodtech, laboratory research, development of innovative products, and work with startups.

New Skills Required: Foodtech technologies, innovative products, working with startups, laboratory innovations.

10. PRODUCTION MANAGER → MANAGER OF FOOD SECURITY AND ECONOMIC SUSTAINABILITY

Transformation Horizon: In the next 3–5 years.

Reason for Change: Increased requirements for food security, management of short supply chains, and the need to monitor prices and profitability.

New Skills Required: Supply chain management, food security, price and profitability monitoring, regional economy.

6.9. DISAPPEARING PROFESSIONS

In the food industry, 12 traditional professions will disappear in the next 3–5 years due **to automation of production processes** and **displacement of manual labor.**

1. MANUAL PROCESSING LINE OPERATOR

Disappearance Horizon: In the next 3–5 years.

Reason for Disappearance: Automation of production processes and introduction of modern automated lines.

2. CLASSIC TECHNOLOGIST WITHOUT FOODTECH KNOWLEDGE

Disappearance Horizon: In the next 3–5 years.

Reason for Disappearance: The healthy food and innovative product market requires new competencies, and such technologists do not use digital control systems or functional products.

3. MANUAL PRODUCT PACKER

Disappearance Horizon: In the next 3–5 years.

Reason for Disappearance: Replacement by automated packaging lines, ultrafiltration, and robotic solutions.

4. UNSKILLED LABORERS IN RAW MATERIAL PRODUCTION (RAW MATERIAL ECONOMY FORMAT)

Disappearance Horizon: In the next 3–5 years.

Reason for Disappearance: The industry's transition to a deep processing format and the production of semi-finished and packaged products.

5. CLASSIC LOGISTICIAN WITHOUT COLD CHAIN AND SUPPLY CHAIN MANAGEMENT SKILLS

Disappearance Horizon: In the next 3–5 years.

Reason for Disappearance: Necessity to ensure product preservation (cold chain logistics), compliance with international standards and export requirements.

6. ENVIRONMENTAL INSPECTOR WITHOUT SUSTAINABLE DEVELOPMENT AND ECO-TECH SKILLS

Disappearance Horizon: In the next 3–5 years.

Reason for Disappearance: Growing requirements for sustainable development; such specialists are not involved in waste processing, bioenergy, or the implementation of "green" technologies.

7. TRADITIONAL MARKETER WITHOUT SPECIALIZATION IN FUNCTIONAL PRODUCTS AND EXPORT

Disappearance Horizon: In the next 3–5 years.

Reason for Disappearance: Marketers working only with mass or local products without a focus on healthy eating, functional products, and export markets are becoming less in demand.

6.9. DISAPPEARING PROFESSIONS

8. SORTER

Disappearance Horizon: In the next 3–5 years.

Reason for Disappearance: Automation of sorting processes and reduced need for manual labor.

9. LOADER/MOVER

Disappearance Horizon: In the next 3–5 years.

Reason for Disappearance: Development of logistics technologies, robotic systems, and automatic conveyors.

10. BAKER

Disappearance Horizon: In the next 3–5 years.

Reason for Disappearance: Development of new technologies, the need for more specialized knowledge, and professionalization of production processes in the baking industry.

11. COSTING TECHNOLOGIST

Disappearance Horizon: In the next 3–5 years.

Reason for Disappearance: Automation of costing technologist functions, shifting requirements towards analytics and digital tools.

12. CONFECTIONER-DECORATOR

Disappearance Horizon: In the next 3–5 years.

Reason for Disappearance: Automation and use of modern decorating technologies replacing manual artistic work in mass production.

6.10. CRITICALLY SCARCE PROFESSIONS

The education system of the Atyrau Region demonstrates a **critical gap** between industry needs and the supply of specialists: **86% of necessary educational programs are missing.**

TECHNOLOGIST OF FUNCTIONAL AND HEALTHY PRODUCTS

Reason for Demand: Growing demand for healthy eating, functional products, and export supplies. There is an acute shortage of programs on functional product technology in the region.

Key Skills: Food production technology, biochemistry, HACCP quality standards, recipe development, and innovation.

ENGINEER FOR AUTOMATION AND DIGITALIZATION OF FOOD PRODUCTION

Reason for Demand: Digital transformation of enterprises and reduction of manual labor share. Specialized courses on food production automation and working with digital twins are missing.

Key Skills: Automation (PLC, SCADA), industrial robotics, digital twins, equipment diagnostics.

BIOTECHNOLOGIST IN AQUACULTURE AND FISH PROCESSING

Reason for Demand: Active development of the fish cluster in the Atyrau Region and export orientation. The region requires its own base for fishing, feed production, and fish processing

Key Skills: Biotechnology, sanitary standards, aquaculture management.

EXPERT IN LOGISTICS AND FOOD EXPORT (COLD CHAIN SPECIALIST)

Reason for Demand: Growth in exports of processed products, necessity to comply with international standards (ISO, HACCP, Halal), and acute shortage of refrigerated logistics and warehouse capacities in the region.

Key Skills: Logistics, certification, international standards, export regulation.

ENGINEER IN ECO-TECHNOLOGIES AND SUSTAINABLE PRODUCTION / ENVIRONMENTAL AUDITOR

Reason for Demand: Growing requirements for production eco-friendliness and regional sustainable development (ESG trend). Needed for implementing waste processing systems, bioenergy, and "green" technologies.

Key Skills: Environmental management, recycling, ISO 14001, ESG approaches.

6.10. CRITICALLY SCARCE PROFESSIONS

MID-LEVEL ENGINEERING AND TECHNICAL PERSONNEL (FOREMEN/MASTERS, OPERATORS, TECHNICIAN-TECHNOLOGISTS)

Reason for Demand: (technician-technologists, production line operators, foremen). For key directions (meat processing, dairy production, fish processing), programs in colleges are completely absent, creating a gap between engineers and workers without a qualified intermediate link..

Where Needed: All processing enterprises, especially in meat processing, dairy production, and fish processing.

MANAGER FOR DEEP PROCESSING OF RAW MATERIALS

Reason for Demand: Necessity to transition from a raw material economy to a processing model and increase added value. The situation is critical with a complete absence of specialist training for the processing and preservation of vegetables and fruits, as well as the production of flour and cereal products.

Key Skills: Food production technology, processing economics, quality management.

7. FUTURE OF THE IT INDUSTRY AND DIGITALIZATION OF THE ATYRAU REGION

7.1. Expert Opinions

FUTURE OF THE IT INDUSTRY AND DIGITALIZATION OF THE ATYRAU REGION

BAGITOVA KALAMKAS BAGITOVNA
PhD, Head of the "Informatics" Department
Kh. Dosmukhamedov Atyrau University (Atyrau)

What are the main factors determining the process of socio-economic development in your region that you can name?

The modern socio-economic development of the Atyrau region can be characterized as dynamic. The region remains a vital center of the oil and gas industry, which ensures stable economic growth. Simultaneously, infrastructure, education, and healthcare are developing, and small and medium-sized businesses are being supported. However, challenges remain regarding dependence on the oil sector, environmental safety, and the need for further modernization of industry and social infrastructure.

What are the most promising areas of activity, work options, and future development that you can name which need to be developed in your region?

The IT sphere, engineering specialties, services, and artisan production are promising. These areas possess high growth potential and create new jobs, forming the basis for economic diversification and reducing dependence on the raw materials sector. It is also important to develop educational projects and startups, which creates an innovative ecosystem in the region.

What actual problems in workforce supply are observed in the industry where you work?

In the IT sphere today, there is an acute shortage of university lecturers. Highly qualified specialists often prefer to work in private companies with higher salaries and dynamic projects rather than in the academic environment. At the same time, universities are actively developing practical directions: hackathons, student projects, startup initiatives, and international sports programming competitions are held to help students acquire relevant skills.

What directions for transformation in the professional training system could you propose?

If I had one wish, I would direct it towards eliminating the **gap between the educational system and real industry needs**. This would allow for the creation of a system where every graduate is ready for real professional challenges, knows how to work with modern technologies, and actively participates in innovative projects.

Imagine you have one wish that will be used. For which problem in the educational sphere would you decide to use this wish?

If I had one wish, I would direct it towards eliminating the gap between the educational system and real industry needs. Currently, there is a lack of practice-oriented knowledge and skills required by modern specialists. My wish would allow for the creation of an educational system where every graduate is ready for real professional challenges, knows how to work with modern technologies, and actively participates in innovative projects.

7.1. Expert Opinions

FUTURE OF THE IT INDUSTRY AND DIGITALIZATION OF THE ATYRAU REGION

GILAZHOV MEIRBEK FARABIEVICH
Head of Deep Oil Refining Production, "ANPZ" LLP

In your opinion, what threats exist that the leadership of your region will need to eliminate in a timely manner in the near future?

Possible threats requiring a timely response include fluctuations in global energy markets, as the region is actively tied to the oil and gas industry. A threat is posed by the increased load on infrastructure caused by rapid industrial development and population growth. With the development of digitalization, the need to protect information systems and increase the technological resilience of key enterprises and government services (technological challenges and digital security) increases. It is also important to prevent a deficit of qualified personnel and environmental risks during active industrial growth.

What promising professions, specialties, and qualifications that are in demand in your region right now can you list?

Promising and in-demand professions in the oil refining industry include: Oil Refining Technologist / Oil & Gas Technologist; Engineering (design engineers, constructors); Automation and I&C Specialists (PLC programmers, SCADA specialists); **IT specialists** (developers, data engineers); Sustainable Development and "Green" Energy Specialists (ESG, ecologists); Robotics Engineers; and MRO Specialists (Maintenance, Repair, and Operations).

What directions for transformation in the professional training system could you propose?

It is necessary to transform the personnel training system by focusing efforts on the following:

- Strengthening practice-oriented training: Increasing practical skills on real equipment or simulators, including digital twins of units.
- Digitalization and education: Using online courses, interactive platforms, and distance learning systems to master new technologies.
- Mentorship and internships: Creating a system of mentors from among experienced specialists.
- Systematic professional development: Regular training on new standards, technologies, and safety requirements.
- Cooperation with educational institutions: Developing partnerships for the joint creation of training programs.
- Development of new competencies: Introducing skills in working with automated systems, data analytics, digital tools, and environmental standards.

7.1. Expert Opinions

FUTURE OF THE IT INDUSTRY AND DIGITALIZATION OF THE ATYRAU REGION

DYUSENOV UTEBAY KABZHILELOVICH
Project Management Consultant,
"Tengizchevroil" LLP (Atyrau)

In your opinion, in which industry of your region are business organizations developing most intensively and increasing in number?

Small and medium-sized businesses are growing most actively, especially in the service sector, construction, and artisan production. These directions possess flexibility and a low entry barrier, making them a natural driver of employment and development. Small business adapts fastest to changes and forms a sustainable economy, creating new jobs.

What factors influencing the development of your professional industry can you name?

In the oil and gas sector, key factors remain the investment climate, labor market transformation, and requirements for local content. Digital platforms—SAP, Microsoft 365, and others—are becoming the basis for increasing productivity and process integration. Investor confidence and the quality of dialogue with the state determine the long-term sustainability of the industry. The new generation of employees demands flexibility and modern working conditions, which forms a new model of human capital management.

Identify the key moments and potential opportunities that should be bet on for the development of your region

For the development of the Atyrau region, key is the transition from a raw material economic model to a diversified one, in which digital technologies, education, and small business play a leading role. Developing human capital and digital competencies, including forming an IT education ecosystem and training specialists in programming, data analysis, and cybersecurity, will allow for integration into global technological chains and ensure international competitiveness. No less significant is support for small and medium-sized businesses capable of adapting quickly, creating new niches, and reducing the regional economy's dependence on fluctuations in global oil prices. The third key moment is the modernization of transport, utility, and digital infrastructure, including the creation of logistics hubs and data centers, which requires a combination of state programs and private initiatives. Finally, the region must bet on environmental sustainability and international cooperation, solving problems of the Caspian Sea's shallowing and implementing environmental standards, which will increase its attractiveness for investors. Thus, the strategic resilience of the Atyrau region is ensured by the development of digital competencies, SME support, infrastructure modernization, and environmental sustainability.

Determine an approximate forecast of the state of your region if current trends continue over a horizon of 5–10 years.

If current trends continue, the region will remain a strategic center of the oil and gas and chemical industries but will face challenges of diversification and ecology. At the same time, the development of IT education and digital technologies will help mitigate these risks. In 5–10 years, Atyrau could become a center of digital competencies and innovation, which will require systemic work and strategic planning.

7.1. Expert Opinions

FUTURE OF THE IT INDUSTRY AND DIGITALIZATION OF THE ATYRAU REGION

IMANGALI KUANYSH
Commercial Director, Norsec Delta Projects LLP

What are the main factors determining the process of socio-economic development in your region that you can name?

The main driver of development remains the **Oil & Gas industry.** Projects such as Tengiz and Kashagan form the region's economy. Additionally, the region is located strategically advantageously: proximity to Russia and access to the Caspian Sea open opportunities for logistics. Population growth is also important, as specialists arrive in the region, services develop, and new businesses appear.

Name the negative trends in the development of your region.

The first trend is high dependence on oil. The second is the high cost of living; Atyrau remains one of the most expensive cities in the country. The third is the ecological situation: the Ural delta is shallowing, the Caspian is receding, and the river is silting up, causing the river port to be virtually non-operational. And the fourth is a **personnel deficit**, especially of technical specialists.

What knowledge, abilities, and skills are relevant and in demand today in your region?

Today, digital competencies, engineering knowledge, and project management skills are most in demand. The ability to work with data, analytics, and cloud platforms is gaining increasing importance. Knowledge of the English language and the ability to integrate into international projects are becoming critical. Soft skills are valued—the ability to work in a team, communicate, adapt to changes, and demonstrate leadership qualities.

What key trends and technologies of the future do you observe at this time in your region?

Active implementation of automation at oilfields is observed in the region. Companies are updating IT infrastructure and implementing monitoring and data protection systems. Demand for cybersecurity specialists is also growing. Meanwhile, development in logistics has stalled due to problems with the river port.

In which industry of your region are problems with workforce supply felt most acutely?

The greatest personnel deficit is felt among automation engineers, electricians, and mechanics. There is also a critical shortage of IT specialists (especially network engineers and security experts) and qualified workers (welders, assemblers). A shortage of project managers is felt.

7.1. Expert Opinions

FUTURE OF THE IT INDUSTRY AND DIGITALIZATION OF THE ATYRAU REGION

KARZHAUOV RAFIL GABITOVICH
Director of the Branch of the Autonomous Cluster Fund "Park of Innovative Technologies" for Atyrau City (Atyrau Hub)

List the strengths of your region at the modern stage

The main strength of the region in the context of digitalization is the presence of large industrial clients who need modern IT solutions, which forms a stable market for developers and service companies. Atyrau Hub acts as a key concentration point for the technological community, hosting hackathons and programs that give youth practical skills in programming, development, AI, and IT entrepreneurship.

In your opinion, which professional knowledge, abilities, and skills do modern college and university educational programs form insufficiently?

Skills in working with Linux, networks, containerization, cloud platforms, and CI/CD are insufficiently developed. Practical courses on cybersecurity, data analysis and visualization, IoT, and industrial digital systems are poorly represented. There is also a lack of systemic work with technical English, without which it is difficult to grow in the IT sphere.

What promising professions, specialties, and qualifications that are in demand in your region right now can you list?

The following IT professions are promising and already in demand: IT Support and Helpdesk, System and Network Engineer, Cybersecurity Engineer, IoT Engineer, Data Analyst and Engineer, DevOps Engineer, Software Developer, Artificial Intelligence Specialist. Separately, there is a growing request for specialists in the integration and maintenance of smart devices and digital access systems.

What factors influencing the development of your professional industry can you name?

Three key factors influence IT development in the region: the industry's request for digitalization (creating demand for specialists), state policy on developing technoparks and hubs, and the presence of local educational programs in IT directions. Atyrau Hub plays the role of a link between business, startups, and educational organizations.

What actual trends and technologies of the future do you observe in the world?

From an IT perspective, actual global trends are primarily artificial intelligence, big data, the Internet of Things, cloud technologies, and cybersecurity. More and more processes in the world are being automated, and decisions are made based on data analytics. Digital platforms are becoming the basis for interaction between business and clients. These trends determine requirements for specialist competencies and form new professions.

7.2. CURRENT STATE OF THE INDUSTRY

Digitalization and the development of the IT industry in the Atyrau region are becoming critical elements of economic modernization. Despite the dominance of the oil and gas industry, digital technologies are gradually taking a key role in increasing productivity, improving management, and ensuring environmental and industrial safety. However, the process of digital transformation is accompanied by a number of significant challenges.

One of the main problems remains the shortage of qualified IT specialists. The region feels a deficit of personnel in the fields of cybersecurity, data analysis, AI development, industrial automation, and corporate system support. The limited number of educational programs and the migration of specialists to more attractive markets exacerbate this gap. The mismatch between the needs of oil and gas enterprises and the capabilities of the current personnel training system is particularly noticeable.

In addition to the personnel issue, the region faces infrastructural limitations. Despite the development of internet networks and the appearance of data centers, access to high-speed internet remains unstable in a number of districts. This hampers the implementation of online services, cloud solutions, IoT systems, and predictive analytics tools. Many problems also exist in the corporate sector—outdated equipment, weak cyber protection, lack of digital standards, and insufficient system integration.

Nevertheless, digitalization opens up significant opportunities for the region. Oil and gas companies are actively implementing digital twin technologies, robotization, environmental monitoring systems, unmanned solutions, and analytical platforms. These initiatives allow for increased production safety, reduced costs, and an improved environmental situation. Parallel to this, the Smart City direction is developing: transport monitoring, digitalization of utility services, environmental sensors, and automation of urban process management.

Digital transformation stimulates the emergence of new professions: specialists in digital ecology, robotization, VR simulators, ESG analytics, predictive equipment maintenance, Smart City engineers, etc. This creates new jobs and expands opportunities for youth in the region.

In the future, digitalization could become one of the key factors in the economic diversification of the Atyrau region, reducing its dependence on oil and gas. Provided that educational programs are developed, infrastructure is modernized, and IT business is supported, the region can create a fully-fledged IT cluster and increase its competitiveness at the national level.

Thus, despite existing difficulties, the digital sector of the Atyrau region possesses significant potential. With competent state and corporate policy, it is capable of becoming a driver of innovation, sustainable development, and improved quality of life for the population.

7.3. TRENDS

1 trend **Increase in population's digital data**

The growth in the amount of personal data in digital systems intensifies the need for protection and regulation of information storage. This creates risks of leaks and requires the implementation of stricter cybersecurity standards.

2 trend **Increase in digital bullying**

The expansion of online communications leads to a growth in negative manifestations on the network, including threats and pressure on users. This requires the development of digital culture, preventive programs, and cybersecurity measures to protect youth.

3 trend **Increase in the AI industry**

The active implementation of artificial intelligence leads to the transformation of production processes, automation, and the emergence of new jobs. At the same time, the need for specialists in data, model training, and AI solution implementation grows.

4 trend **Increase in the population's fear of using digital technologies**

Part of the population fears technologies due to a lack of knowledge, cyber threats, and distrust of digital services. This slows down the implementation of e-gov solutions and requires an increase in digital literacy.

5 trend **Increase in the diversification of online courses (micro-qualifications)**

More short educational programs are appearing, allowing for the rapid acquisition of new skills. This intensifies competition in the labor market and helps people adapt quickly to the requirements of the digital economy.

6 trend **Increase in the use of VR technologies and virtual enterprise tours**

VR is becoming a tool for training, industrial safety, and career guidance, allowing real processes to be simulated without risk. This improves the quality of personnel training for industry and education.

7 trend **Increase in demand for IoT technologies and infrastructure**

Enterprises are increasingly implementing sensors, automation, and monitoring systems to increase efficiency. This contributes to the development of smart infrastructure and requires the scaling of communication networks.

8 trend **Growth in demand for digital business management platforms**

Companies are switching to automated accounting systems, CRM, and ERP to optimize processes. This increases management transparency and reduces operational costs.

9 trend **Increase in the number of mobile apps in trade and marketing**

Businesses are actively using apps for sales, delivery, and communication with clients. This intensifies competition in the e-commerce sphere and increases the need for mobile developers.

10 trend **Increase in the use of digital medicine and medical services**

Online consultations, telemedicine, and digital patient records are becoming more common. This increases the availability of medical services and reduces the load on regional clinics.

11 trend **Increase in cyberattacks and data leaks**

The growth of digitalization leads to an increase in attempts at hacking, phishing, and penetration into corporate systems. This requires strengthening the protection of critical infrastructure and training cybersecurity specialists.

12 trend **Increase in demand for green technologies**

Companies strive to reduce their carbon footprint by implementing more eco-friendly IT solutions and energy-saving technologies. This stimulates the development of new digital tools for resource monitoring and management.

13 trend **Increase in demand for remote work**

Employers are increasingly adopting hybrid and remote formats to attract workers from outside the region. This increases the need for digital platforms, communication services, and secure communication channels.

Clusters of trends:

- **Technological Cluster:** Artificial intelligence and industrial automation, Development of IoT infrastructure and sensors for "Smart City", Expansion of VR/AR technologies for training and operational safety.
- **Ecological Cluster:** *Digital environmental monitoring (air, water, soil), Growth in demand for green and energy-efficient digital technologies, Use of IoT and analytics to prevent environmental risks.*
- **Social and Economic Cluster:** Growth of population's digital data and intensification of cyber risks, Increase in remote employment and need for digital skills, Diversification of online learning and expansion of micro-qualifications.

7.4. THREATS

1. Growth of cyberattacks and data leaks

The increase in digital data intensifies risks of hacking, phishing, and leaks threatening government bodies, oil & gas, and the population.

2. Deficit of qualified IT staff

The region cannot keep pace with the need for specialists in AI, IoT, cybersecurity, and data analysis, which slows down digitalization.

3. Distrust and low digital literacy of the population

Part of the residents are afraid to use online services, which limits the growth of digital services and e-gov.

4. Outdated infrastructure and lack of modern equipment

Weak internet coverage, lack of climate-resilient devices, and limited data center capacities create risks of failures.

5. Social digital risks: bullying, fraud, psychological pressure

The growth of online activity intensifies threats for teenagers, vulnerable groups, and social network users.

7.5. OPPORTUNITIES

1. Formation of a regional IT cluster and proprietary digital solutions

Growth in demand for AI, IoT, and digital platforms stimulates the development of startups, hubs, and local developers.

2. Development of digital security systems and creation of SOC centers

Rising threats create demand for cyber specialists, anti-fraud solutions, and monitoring of critical infrastructure.

3. Digitalization of medicine and expansion of telemedicine services

Increases the availability of medical assistance, especially in remote districts of the Atyrau region.

4. Implementation of Smart City and digital industry (IoT, digital twins, robotization)

Increases safety, reduces costs, and makes urban infrastructure more resilient and efficient.

5. Expansion of micro-qualifications, online education, and VR simulators

Allows for the rapid preparation of in-demand personnel for oil & gas, industry, and IT, reducing the personnel deficit.

Future of digitalization in the Atyrau region: resilience, security, and technological growth

7.6. VISION OF THE FUTURE

The future of digitalization in the Atyrau region is formed around the deep implementation of artificial intelligence, total cybersecurity, and the transition to fully electronic interaction between the population, business, and the state. In this future, the region becomes one of the country's digital leaders, where most processes are automated, and decisions are made based on data analysis and predictive models. Artificial intelligence ensures protection against the majority of cyber threats, preventing up to 95% of attacks and making the digital environment significantly safer for every user.

One of the key changes will be the high digital literacy of the population. Residents of the region will confidently use electronic services, and cases of cyber fraud will decrease thanks to mass educational work, automated protection systems, and embedded digital ethics. Online services will become completely transparent, high-quality, and accessible: residents will be able to verify the authenticity of goods via AR/VR technologies, process documents remotely, and receive services without unnecessary visits to organizations. All professions not requiring physical presence will gradually transition to hybrid or fully remote formats, making work processes more flexible and convenient.

A central role in the future will be played by digital data and information storage infrastructure. All confidential data of the population, business, and government bodies will be stored in protected domestic data centers, ensuring a high level of security and autonomy from external threats. Medical infrastructure will be fully integrated with IoT and bio-data: sensors, detectors, and wearable devices will automatically collect health indicators, form primary conclusions, and direct patients to the necessary specialist, who will already see the picture online and prescribe treatment.

The environmental component will also improve significantly thanks to digital technologies. Waste recycling plants and smart recycling sorting systems will reduce landfill volumes, and the transition to alternative energy sources will reduce the load on the environment. High-hazard production facilities will be fully equipped with contactless IoT surveillance—drones, sensors, Wi-Fi detectors—which will minimize risks for employees and ensure continuous control over the condition of equipment and processes.

Furthermore, a single digital platform will appear in Kazakhstan allowing for the acquisition of all types of documents, certifications, and confirmations of competencies recognized by international standards. This will allow any resident of the region to easily confirm their skills and get hired by world-class companies. The educational system will be closely linked with digital technologies: AR/VR tours of enterprises, production operation simulators, and flexible online courses will help youth quickly adapt to new market requirements and form relevant, practical skills.

7.7. NEW PROFESSIONS

New professions in the sphere of IT and digitalization are emerging under the influence of total digital transformation of the economy, growth of the AI industry, increase in cyberattacks, and the necessity of implementing Smart City solutions.

1. AI CYBERSECURITY ENGINEER

Horizon of appearance: in the next 1–3 years

Description: Develops and manages AI algorithms to protect networks, data, and geoinformation systems.

Necessary skills: Management of AI algorithms; Protection of networks, data, and geoinformation systems.

2. IT ARCHITECT

Horizon of appearance: in the next 1–3 years

Description: Designs the architecture of equipment, software, networks, clouds, and security systems of an organization in the context of the digital transformation of the economy.

Necessary skills: Designing equipment, software, networks, clouds, and security systems.

3. INDUSTRIAL DIGITAL SECURITY ARCHITECT

Horizon of appearance: in the next 1–3 years

Description: Creates defense strategies for industrial systems, SCADA, and IoT infrastructure, which is critical for protecting critical infrastructure.

Necessary skills: Creation of defense strategies; Protection of industrial systems, SCADA, and IoT infrastructure.

4. AI MODEL TRAINING SPECIALIST

Horizon of appearance: in the next 1–3 years

Description: Prepares data, trains, and tests AI models for industrial and service tasks, including forecasting in the oil and gas industry.

Necessary skills: Data preparation; Training and testing AI models; Working with AI models for industrial and service tasks.

7.7. NEW PROFESSIONS

5. AI PROMPT ENGINEER

Horizon of appearance: in the next 1–3 years

Description: Formulates precise queries to AI models to obtain optimal results and increase efficiency.

Necessary skills: Working with AI models; Formulating precise queries to obtain optimal results.

6. IT SOFTWARE INTEGRATOR

Horizon of appearance: in the next 1–3 years

Description: Implements software solutions and configures interaction between new and existing corporate systems.

Necessary skills: Software implementation; Configuring system interaction between new and existing systems.

7. CYBER FORENSICS SPECIALIST

Horizon of appearance: in the next 1–3 years

Description: Identifies digital crimes and fraud, develops algorithms for their prevention.

Necessary skills: Identification of digital crimes; Development of algorithms for fraud prevention.

8. EQUIPMENT PREDICTIVE ANALYTICS SPECIALIST

Horizon of appearance: in the next 1–3 years

Description: Analyzes equipment data and predicts possible malfunctions to prevent downtime at industrial facilities.

Necessary skills: Analyzes equipment data and predicts possible malfunctions to prevent downtime at industrial facilities..

9. DIGITAL TWIN OPERATOR

Horizon of appearance: in the next 1–3 years

Description: Manages digital models of objects and processes for forecasting and optimizing production, which is actively applied in the oil and gas industry.

Necessary skills: Management of digital models; Forecasting and optimization of production.

7.7. NEW PROFESSIONS

10. IOT SOFTWARE DEVELOPMENT ENGINEER

Horizon of appearance: In the next 1–3 years

Description: Develops software for managing and integrating IoT equipment and sensors into industrial and urban systems.

Necessary skills: Software development; System integration; Management and integration of IoT equipment.

11. AR/VR DEVELOPER

Horizon of appearance: In the next 1–3 years

Description: Creates software and hardware for augmented and virtual reality, including VR simulators for hazardous industries.

Necessary skills: AR/VR software; Creation of software and hardware for augmented and virtual reality.

12. SPECIALIST IN DEVELOPING VR SIMULATORS FOR HAZARDOUS INDUSTRIES

Horizon of appearance: In the next 1–3 years

Description: Models emergency situations and creates VR simulators for training personnel in hazardous industries.

Necessary skills: VR simulation; Modeling of accidents; Creation of VR simulators for personnel training.

13. INDUSTRIAL PROCESS ROBOTIZATION ENGINEER

Horizon of appearance: In the next 1–3 years

Description: Designs and implements industrial robots and automated lines in industry.

Necessary skills: Design and implementation of robots; Implementation of industrial robots and automated lines.

14. SMART CITY SYSTEMS IMPLEMENTATION ENGINEER

Horizon of appearance: In the next 1–3 years

Description: Develops and implements digital solutions for urban management and infrastructure within the framework of Smart City development.

Necessary skills: Development and implementation of digital solutions; Implementation of smart urban systems for city management and infrastructure.

7.7. NEW PROFESSIONS

15. ENERGY DIGITALIZATION SPECIALIST

Horizon of appearance: in the next 1–3 years

Description: Implements digital energy management technologies and optimizes energy consumption using Smart Grid.

Necessary skills: Digital energy management; Optimization of energy consumption using Smart Grid.

16. AI ECOLOGIST-ANALYST

Horizon of appearance: in the next 1–3 years

Description: Analyzes environmental data using AI, forms forecasts and reports on ecosystems

Necessary skills: Environmental analysis; Working with AI; Formation of forecasts and reports on ecosystems.

17. CRISIS MANAGER / PROBLEM MANAGER

Horizon of appearance: in the next 1–3 years

Description: Analyzes and resolves crisis and complex situations in the company, preventing operational failures.

Necessary skills: Analysis of crisis situations; Prevention of failures; Resolution of complex situations in the company.

18. PROGRAM MANAGER

Horizon of appearance: in the next 1–3 years

Description: Manages projects and programs of digital transformation, ensuring interaction between business and IT teams.

Necessary skills: Management of projects and programs of digital transformation; Interaction between business and IT teams.

19. EQUIPMENT 3D MODELING SPECIALIST

Horizon of appearance: in the next 1–3 years

Description: Creates 3D models of parts and devices digitally and on 3D printers for production and prototyping.

Necessary skills: Creation of 3D models; Working with 3D printers

7.7. NEW PROFESSIONS

20. IOT HARDWARE DEVELOPER

Horizon of appearance: In the next 1–3 years

Description: Designs and creates the hardware of smart devices and sensors required for the digitalization of industry and urban infrastructure.

Necessary skills: Integration of IT solutions; Working with medical data; Improving diagnostics using IT.

21. IT DIAGNOSTICIAN IN MEDICINE (MEDTECH)

Horizon of appearance: In the next 1–3 years

Description: Integrates IT solutions with medical equipment and data to improve diagnostics.

Necessary skills: ntegration of IT solutions; Working with medical data; Improving diagnostics using IT.

7.8. TRANSFORMING PROFESSIONS

Professions in IT and related spheres are not disappearing but are changing their functional scope under the influence of AI, robotization, and the implementation of digital platforms.

1. ACCOUNTANT → FINANCIAL ANALYST AND AUTOMATION CONTROLLER

Horizon of transformation: In the next 1–3 years.

Description: The accountant transforms into an analyst who controls automated accounting processes, assesses financial risks, and works with digital systems (1C, SAP, cloud services).

Necessity of transformation: Widespread implementation of AI and cloud services replaces a large part of routine operations and accounting.

Acquisition of competence: Transformation into an analyst; Control of automated processes; Assessment of financial risks.

2. TEACHER (PEDAGOGUE, MENTOR, TUTOR) → TEACHER/MENTOR WORKING WITH AI

Horizon of transformation: In the next 1–3 years.

Description: The role of the teacher shifts from the main source of knowledge to a mentor. They use digital tools and AI to support the student's individual educational trajectories.

Necessity of transformation: Artificial intelligence, online platforms, and robotic systems are changing the classical teaching process by automating the delivery of basic information.

Acquisition of competence: Working with digital tools; Supporting individual learning trajectories; Strengthening the role of a mentor.

3. OPERATOR (CALL CENTERS, DISPATCHER, RECEPTION) → OPERATOR/ DISPATCHER FOR COMPLEX REQUESTS

Horizon of transformation: In the next 1–3 years.

Description: The specialist concentrates on handling complex, non-standard requests, operational control, and managing digital service channels.

Necessity of transformation: Robotization, chatbots, and automated systems reduce the need for performing routine operator tasks.

Acquisition of competence: Handling complex requests; Operational control; Management of digital service channels.

7.8. TRANSFORMING PROFESSIONS

4. GENERAL PRACTITIONER → TREATMENT COORDINATOR AND AI DIAGNOSTICS

Horizon of transformation: In the next 1–3 years.

Description: The doctor concentrates on interpreting data received from digital devices and AI diagnostic systems, fulfilling the role of a treatment coordinator

Necessity of transformation: Telemedicine, AI diagnostics, and robotic systems are changing the format of interaction with the patient and direct diagnosis.

Acquisition of competence: Interpretation of data received from digital devices and AI; Role of treatment coordinator.

5. POLICE, TRAFFIC POLICE → DIGITAL LAW ENFORCEMENT SPECIALIST

Horizon of transformation: In the next 1–3 years.

Necessity of transformation: The officer works with digital databases, analytics, and automated tools (video surveillance, IoT systems) for recording violations and control.

Necessity of transformation: Digitalization, video surveillance, and IoT systems are changing classical methods of control and law enforcement.

Acquisition of competence: Working with digital databases; Analytics; Working with automated tools for recording violations.

6. LAWYER → LAWYER-EXPERT IN INTERPRETING AI CONCLUSIONS

Horizon of transformation: In the next 1–3 years.

Description: The lawyer engages in the expert resolution of legal tasks and the interpretation of AI algorithm conclusions, focusing on non-standard cases.

Necessity of transformation: AI algorithms perform routine searches for precedents, drafting of standard documents, and risk analysis

Acquisition of competence: Expertise in interpreting AI conclusions; Resolution of non-standard legal tasks.

7.8. TRANSFORMING PROFESSIONS

7. HR SPECIALIST → HR STRATEGIST AND DATA ANALYST

Horizon of transformation: In the next 1–3 years.

Description: The HR specialist focuses on talent strategy, data analysis, and building digital communication with employees and candidates.

Necessity of transformation: AI recruitment systems, automated funnels, and online candidate assessment are changing the process of routine recruitment.

Acquisition of competence: Role of talent strategist; Data analysis; Building digital communication.

8. MARKETER → MARKETER-STRATEGIST AND DATA ANALYST

Horizon of transformation: In the next 1–3 years.

Description: The marketer focuses on strategy development, working with data, and creative solutions that AI cannot replace.

Necessity of transformation: Generative designs, AI copywriting, and ML analytics automate a significant part of routine marketing.

Acquisition of competence: Generative designs, AI copywriting, and ML analytics automate a significant part of routine marketing.

9. JOURNALIST → JOURNALIST-ANALYST

Horizon of transformation: In the next 1–3 years.

Description: The journalist switches to analytics, investigations, and working with unique information sources.

Necessity of transformation: AI generates news, creates transcripts, and conducts auto-fact-checking, automating routine content generation.

Acquisition of competence: Switching to analytics, investigations; Working with unique sources.

10. ARCHITECT → ARCHITECT-CURATOR OF DIGITAL MODELS

Horizon of transformation: In the next 1–3 years.

Description: The architect curates digital models (BIM) and controls project compliance with requirements and aesthetics using VR design.

Necessity of transformation: Generative design, VR design, and BIM models automate the stages of drafting and routine design.

Acquisition of competence: Curating digital models; Controlling project compliance.

7.8. TRANSFORMING PROFESSIONS

11. LOGISTICIAN → LOGISTICIAN-ANALYST OF AUTOMATED CHAINS

Horizon of transformation: In the next 1–3 years.

Description: The logistician works with monitoring systems, analyzes data, and controls automated supply chains, including IoT tracking and AI route optimization.e.

Necessity of transformation: IoT tracking, autonomous delivery, and AI route optimization are changing logistics management.

Acquisition of competence: Working with monitoring systems; Data analysis; Control of automated supply chains.

12. OCCUPATIONAL SAFETY SPECIALIST → DIGITAL LABOR SAFETY ANALYST

Horizon of transformation: In the next 1–3 years.

Description: The specialist analyzes safety data and manages digital risks using IoT sensors and automated monitoring systems.

Necessity of transformation: IoT sensors, automated monitoring systems, and cameras replace part of physical inspection tasks.

Acquisition of competence: Analysis of safety data; Management of digital risks.

7.9. DISAPPEARING PROFESSIONS

1. CIVIL AND MILITARY PILOTS

Horizon of disappearance: In the next 3–5 years.

Reason for disappearance: Development of unmanned aerial vehicles (UAVs), AI navigation, and remote control reduces the need for pilots.

2. TAXI DISPATCHERS

Horizon of disappearance: In the next 3–5 years.

Reason for disappearance: Functions are completely replaced by routing algorithms and automatic order distribution systems.

3. CALL CENTER OPERATORS

Horizon of disappearance: In the next 3–5 years.

Reason for disappearance: AI systems and voice robots handle the majority of standard requests, automating routine service.

4. CASHIERS / JUNIOR ACCOUNTANTS

Horizon of disappearance: In the next 3–5 years.

Reason for disappearance: Functions are replaced by self-checkout counters, online payments, and automated accounting systems.

5. COURIERS

Horizon of disappearance: In the next 3–5 years.

Reason for disappearance: Threat of replacement by autonomous drones and delivery robots.

7.10. CRITICALLY SCARCE PROFESSIONS

CYBERSECURITY (AI CYBERSECURITY ENGINEER, DIGITAL SECURITY ARCHITECT, CYBER FORENSICS SPECIALIST)

Necessity: Extremely necessary for protecting critical infrastructure, industrial systems (SCADA), and IoT infrastructure, as well as for countering the growing number of cyberattacks and data leaks.

Where needed: Large oil and gas enterprises, IT centers, holdings engaged in monitoring, and government bodies (for protecting critical infrastructure).

DATA ANALYSIS AND AI DEVELOPMENT (PREDICTIVE ANALYTICS SPECIALIST, AI PROMPT ENGINEER, AI MODEL TRAINING SPECIALIST)

Necessity: Required for analyzing equipment data and predicting malfunctions (predictive analytics), forecasting in the oil and gas industry, as well as for resource optimization and downtime prevention. AI developments are necessary for automation, diagnostics, and anomaly recognition in industrial equipment

Where needed: Oil and gas industry, industrial enterprises, service companies, R&D departments, and software development companies.

INDUSTRIAL AUTOMATION AND IOT (INDUSTRIAL PROCESS ROBOTIZATION ENGINEER, IOT DEVELOPERS)

Necessity: Required for the operation and maintenance of robotic lines and automated control systems, as well as for the development and integration of IoT equipment into industrial and urban systems.

Where needed: Oil and gas companies, industrial enterprises implementing robotization and Smart City, as well as service centers..

VR/AR TECHNOLOGIES AND DIGITAL TWINS (VR SIMULATOR DEVELOPMENT SPECIALIST, DIGITAL TWIN OPERATOR)

Necessity: Necessary for creating VR simulators and trainers for safe personnel training in emergency situations, which is critically important for industrial safety, as well as for managing digital models of objects and processes for forecasting and optimizing production.

Where needed: Hazardous production facilities (oil and gas sector), training centers, industrial enterprises.

SMART CITY SYSTEMS IMPLEMENTATION ENGINEER

Necessity: ENecessary for the development and implementation of digital solutions for urban management and infrastructure (monitoring of transport, utility services), which is a priority for the region.

Where needed: Government bodies, utility services, infrastructure companies developing Smart City.

8. EDUNAVIGATOR.KZ – CAREER GUIDANCE FOR PROFESSIONS OF THE FUTURE

Career guidance contributes to the effective management and distribution of labor resources, which ultimately increases the efficiency of their use. There are a number of researchers within the CIS and beyond whose works represent various theoretical approaches to career guidance issues and allow for tracking the evolution and development of career guidance as a separate scientific sphere.

In the development of career guidance, it is also necessary to separately consider the theoretical findings of international scholars, many of whom form the methodological basis of modern career guidance techniques and tools worldwide.

John Holland developed a model of vocational choice based on six personality types (Realistic, Investigative, Artistic, Social, Enterprising, Conventional). His theory emphasizes the importance of matching personal qualities with the requirements of the professional environment.

Myers-Briggs and MBTI: A personality typology based on the works of C.G. Jung, used in career guidance to understand a person's predisposition to certain types of professional activity. Frank Parsons, the founder of scientific career guidance, identified three main elements of a successful career choice: knowledge of one's abilities, understanding of the profession's requirements, and decision-making skills.

This list of researchers is not exhaustive and is merely cited as examples of the most prominent representatives to form a general idea of career guidance as a scientific sphere and a priority direction of the "Mamandygym-bolashagym" program.

This section presents the results of professional diagnostics in the Atyrau Region, in which 10,239 high school students from 101 schools across all cities and districts of the region participated.

Distribution of students by district

The study involved 69.7% of children from schools in Atyrau city, 14.3% from the Zhylyoi district, 4.5% from the Kurmangazy district, 4% from the Makat district, 2% (209) from the Isatai district, 2% from the Inder district, 1.9% from the Kyzylkoga district, and 1.6% from the Makhambet district.

Professional diagnostics were conducted in the form of testing on the specialized EduNavigator platform. The testing lasts 30 minutes and includes questions, the answers to which provide the following opportunities:

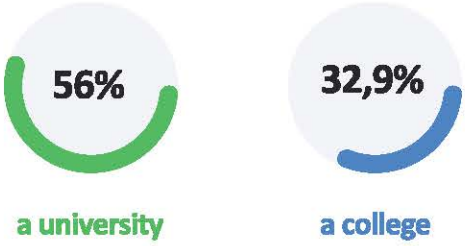
- **familiarization** with various professional directions;
- **conducting** self-testing and analysis to identify personal qualities and predispositions;
- **forming** one's own view of a future career.

Below are the results of the professional diagnostics and surveys, which revealed the key preferences and needs of the region's schoolchildren in the field of professional self-determination, as well as recommendations for improving the effectiveness of career guidance work in the Atyrau Region.

8.1. INTERESTS OF SCHOOLCHILDREN IN FUTURE PROFESSIONS

Educational Trajectories and Locations

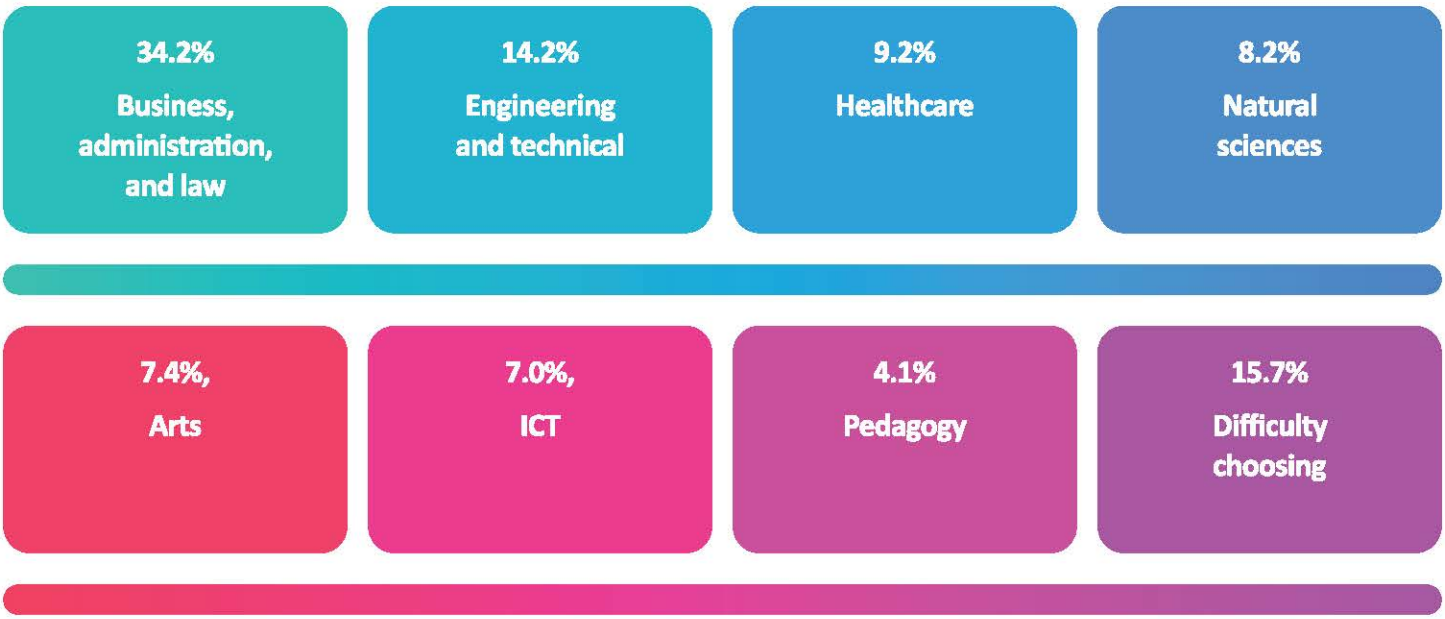
he majority of students plan to continue their education after school, with **50.3%** intending to enter a university and **32.9%** planning to attend a college



Regarding the location of study, **44.1%** of schoolchildren are considering studying in another region, **20.7%** intend to remain in the region, and **18.2%** plan to go to another country

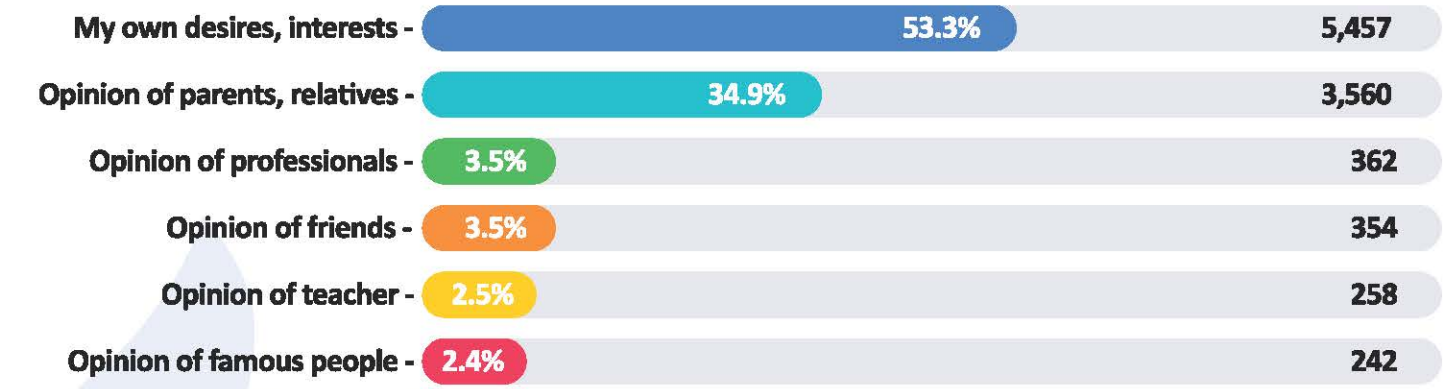
Preferences by Economic Sectors

Business, administration, and law interest **34.2%** of students, engineering and technical directions were chosen by **14.2%** of respondents, healthcare by **9.2%,** natural sciences by **8.2%,** arts by **7.4%,** ICT by **7.0%,** pedagogy by **4.1%,** and **15.7%** of schoolchildren had difficulty choosing .

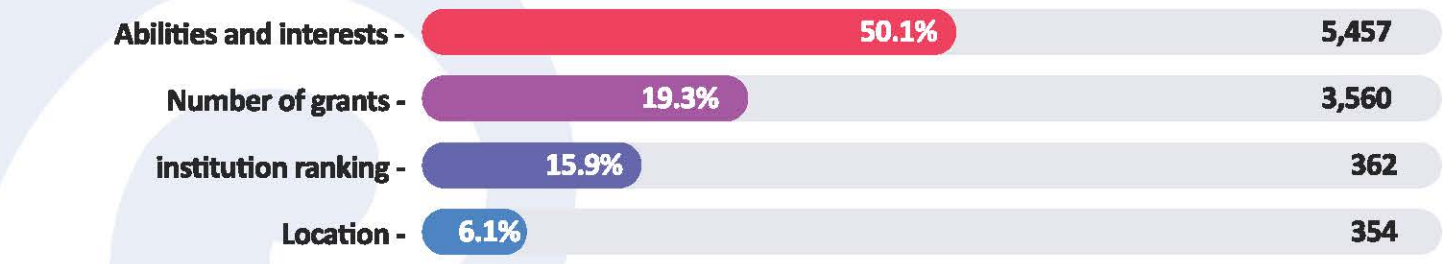


Selection Criteria and Influencing Factors

When choosing a profession, the majority of schoolchildren rely on their own desires and interests – 5,457 **(53.3%)**. The opinion of parents is important for 3,560 students **(34.8%).** The opinion of professionals is considered by **3.5%,** friends by **3.5%,** teachers by **2.5%,** and famous people by **2.4%** of respondents (Figure 5).



• Abilities and interests are the key criteria for choosing a specialty: this was the answer of 5,125 schoolchildren **(50.1%)**. The number of grants is important for 1,975 **(19.3%)**, and the rating of the educational institution for 1,629 students **(15.9%)**. Location plays a role for **6.1%** of respondents (Figure 6).



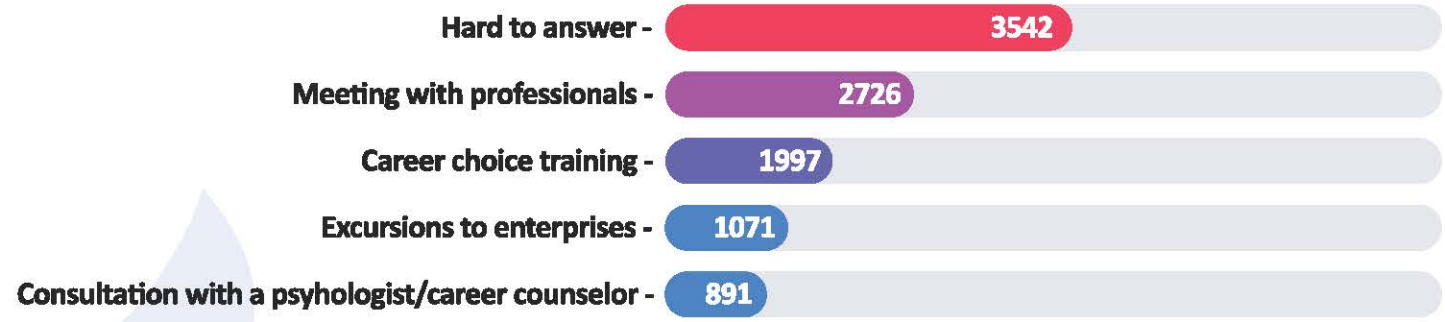
• From the perspective of preparation for the Unified National Testing (ENT), humanities subjects are the most popular **(39.9%)**, followed by natural sciences **(35.1%)**.

Needs for Information and Knowledge

• Results show that **28.9%** of schoolchildren have not yet chosen a future profession.

• In the context of knowledge about their future profession, information about professions popular in the market is most in demand – 2,074 students **(20.3%)**. Questions about existing professions interest 1,661 schoolchildren **(16.2%)**, self-assessment of abilities – 1,398 **(13.7%)**, choice of profession – 1,206 **(11.8%)**, labor content – 1,107 **(10.8%)**, and professional qualities – 1,052 students **(10.3%)**. Information about salaries interests 875 **(8.6%)**, and places of study – 860 respondents **(8.3%)**.

• The most attractive forms of career guidance events are meetings with representatives of professions **(26.7%)** and training sessions **(19.5%)** .

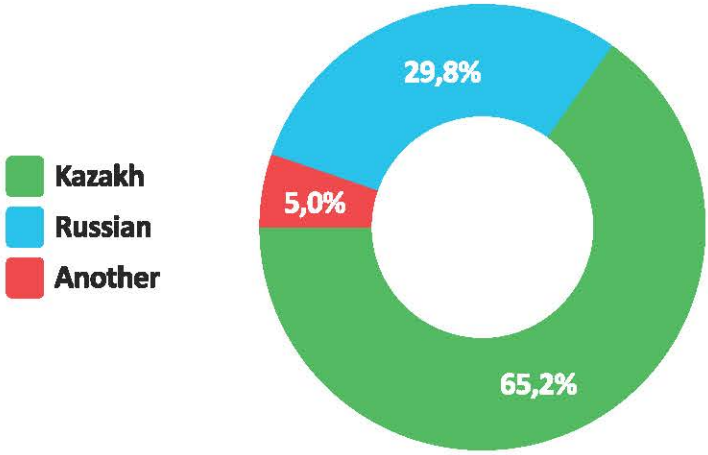


• To search for career guidance information, schoolchildren most often use the internet **(37.5%)** and career guidance tests **(21.0%)**.

8.2 General Recommendations

It is recommended to build a differentiated model of career guidance for schools in rural areas. Additionally, it is recommended to strengthen interdepartmental interaction and expand practical forms of student involvement. This will increase the effectiveness of career guidance work in the region.

The majority of schoolchildren study in the Kazakh language – **65.2%**, in Russian – **29.8%**, and about **5.0%** indicated another language of instruction (Figure 9). In this regard, it is important for schools to ensure equal access to career guidance materials in both languages.



To improve the effectiveness of career guidance work in the Atyrau Region, a comprehensive and systemic approach is important, including expanding the participation of employers, developing vocational trials, and forming an up-to-date database of professions.

At the level of the Education Department and Schools:

• It is necessary to **expand interaction with regional enterprises**, attracting their representatives as masters of industrial training in specialized classes and involving employers in the creation of technical elective courses.

• It is recommended to **provide additional support to rural schools** by organizing mobile career guidance sessions and mobile laboratories, taking into account differences in resources.

• Schools should **strengthen partnerships with Universities, colleges, and enterprises** to conduct excursions, lectures, and research projects.

• It is important to **actively promote STEM directions and pedagogical programs** by organizing meetings with specialists and vocational trials. To support interest in technical specialties, it is recommended to develop clubs and projects in STEM areas, introducing practice-oriented forms of learning.

• It is necessary to **expand the participation of educators and the professional community** by implementing mentorship programs and strengthening work with parents.

In the process of Career Guidance:

• It is necessary to form comprehensive career information content, including profession cards, educational routes, and up-to-date labor market data.

• It is recommended to use proven digital resources, such as the EduNavigator platform, which provides detailed testing based on international methodologies and current information about professions and educational trajectories.

• Within the framework of working with the region-forming industry (extraction and processing), it is recommended to organize visits to enterprises and plants, as well as career meetings and master classes with current employees of leading companies (TCO, NCOC), which helps form a realistic view of professions.

• It is important to form and systematically update the current registry of professions in demand in the regional labor market and help students match their interests with the requirements of the professions.

The application of modern digital tools, such as the EduNavigator platform, plays a key role, allowing schoolchildren to correlate their own interests and abilities with the characteristics of professional activity and make an informed choice.

9. WHERE TO TRAIN FOR FUTURE PROFESSIONS IN THE REGION?

9.1. LIST OF RECOMMENDED EDUCATIONAL PROGRAMS IN REGIONAL UNIVERSITIES

Universities in the Atyrau region (Safi Utebayev Atyrau University of Oil and Gas, Almaty Management University Branch) implement Bachelor's, Master's, and Doctoral (PhD) programs covering key technical, digital, agricultural, and service directions.

Institution	Code and Name of Educational Program (EP)
TOURISM	
Kh. Dosmukhamedov Atyrau University	**BACHELOR'S DEGREE:** 6B11101 Tourism and Service
Almaty Management University (AlmaU) Branch	**BACHELOR'S DEGREE:** 6B11188 Tourism and Event Management
AGRO-INDUSTRIAL COMPLEX	
Kh. Dosmukhamedov Atyrau University	**BACHELOR'S DEGREE:** 6B08401 Ichthyology and Fisheries 5B080400 Fisheries and Industrial Fishing 6B05202 Eco-analytics
MANUFACTURING INDUSTRY	
Kh. Dosmukhamedov Atyrau University	**BACHELOR'S DEGREE:** 6B07501 - Standardization, Metrology and Certification **MASTER'S DEGREE:** 7M07501 - Standardization, Metrology and Certification
Safi Utebayev Atyrau University of Oil and Gas	**BACHELOR'S DEGREE:** **Machine Building and Metalworking (6 programs):** B07102 - Transport, Transport Engineering and Technologies (Automotive Transport) 6B07102 - Technological Machines and Equipment (Oil and Gas Field Machinery and Equipment) 6B07102 - Technological Machines and Equipment (Petrochemical Production Machinery and Equipment) 6B07102 - Technological Machines and Equipment (Oil and Gas Pumping Complex Machinery and Equipment) 6B07102 - Marine Engineering and Technologies (Operation of Ship Power Plants) 6B07102 - Marine Engineering and Technologies (Offshore Oil and Gas Structures) **Electrical Engineering and Automation (5 programs):** 6B07101 - Automation and Production Control 6B07101 - Electric Power Engineering (Power Supply) 6B07101 - Electric Power Engineering (Electric Drive and Automation of Technological Processes) 6B07101 - Automation and Control (Automation and Informatization in Control Systems) 6B07101 - Automation and Control (Automation of Technological Processes and Productions) **Construction (3 programs):** 6B07301 - Construction (Technology of Industrial and Civil Construction) 6B07301 - Construction (Construction of Oil and Gas Pipelines and Storage Facilities) 6B07301 - Geodesy and Cartography **Information Technologies for Production (3 programs):** 6B06301 - Information Security 6B06201 - Information Systems 6B06101 - Computing Engineering and Software
	MASTER'S DEGREE: 7M07103 - Automation and Production Control 7M07103 - Automation and Production Control
	DOCTORAL STUDIES (PhD): D07201 - Petroleum Engineering (PhD, 3 years)
FOOD INDUSTRY	
Safi Utebayev Atyrau University of Oil and Gas	**BACHELOR'S DEGREE:** 6B07201 - "Food Products Technology" with specializations in the technology of meat, fish, and dairy products;

	5B080400 - "Fisheries and Industrial Fishing," training technologists for meat processing plants, dairy plants, fish processing enterprises, and fish farms.
Kh. Dosmukhamedov Atyrau University	**BACHELOR'S DEGREE:** 6B08401 - "Ichthyology and Fisheries"
IT AND DIGITALIZATION	
Safi Utebayev Atyrau University of Oil and Gas	**BACHELOR'S DEGREE:** 6B06201 Infocommunication Systems and Networks 6B06101 Information Systems in the Oil and Gas Industry 6B06102 Computer Control Systems and Robotics 6B06301 Information Security 6B06104 Business Analysis in Information and Communication Technologies
	MASTER'S DEGREE: 7M04107 Information Technologies (EMBA)
Kh. Dosmukhamedov Atyrau University	**BACHELOR'S DEGREE:** 6B06101 Applied Informatics in Design 6B06102 Business Analytics and IT Project Management 6B06103 Systems and Networks Administration
	MASTER'S DEGREE: 7M06101 Business Informatics. Study duration: 2 years 7M06104 Applied Informatics in Design 7M06114 Applied Informatics in Design (1 year) 7M06105 Software Engineering

9.2. LIST OF RECOMMENDED EDUCATIONAL PROGRAMS IN REGIONAL COLLEGES

Regional colleges (TVET institutions) train workforce cadres and technicians in machine building, automation, the IT sector, fisheries, and the service industry.

TOURISM

1) Caspian Multidisciplinary Higher College
10150100 Tourism (Tourism Manager, Guide)
2) Atyrau Service College
0507000 Organization of Hotel Service (Supervisor, Administrator)

AGRO-INDUSTRIAL COMPLEX

1) Unaybay Kushekov Atyrau Agrarian-Technical College
08110700 Fisheries (Fish Breeder Technician)
07161600 Agricultural Mechanization (Tractor Driver-Machinist)
2) Caspian Multidisciplinary Higher College
08410100 Veterinary Medicine (Veterinary Technician)

MANUFACTURING INDUSTRY:

Colleges in Atyrau City:
1) Atyrau Innovation College "Parasat":
07140100 – "Automation and Control of Technological Processes (by profile)" (Electromechanical Technician).
2) Caspian Multidisciplinary Higher College:
07151100 – "Operation and Maintenance of Machines and Equipment (by industry)" (Mechanical Technician).
07140100 – "Automation and Control of Technological Processes (by profile)" (Electromechanical Technician).
3) Atyrau College of Transport and Communications:
07150500 – "Welding (by type)" (Mechanical Technician, Electric and Gas Welder).
07150700 – "Hoisting Machines and Transporters" (Crane Operator (by type)).
07161300 – "Maintenance, Repair, and Operation of Motor Transport" (Car Repair Locksmith, Automotive Electrical Equipment Electrician, Mechanical Technician).

07130700 – "Maintenance, Repair, and Operation of Electromechanical Equipment (by type and industry)" (Electromechanical Technician).

4) Unaybay Kushekov Atyrau Agrarian-Technical College:

07150900 – "Installation and Operation of Refrigeration-Compressor Machines and Units" (Mechanical Technician).

07140100 – "Automation and Control of Technological Processes (by profile)" (Electromechanical Technician).

07161600 – "Agricultural Mechanization" (Tractor Driver-Machinist of Agricultural Production).

07161300 – "Maintenance, Repair, and Operation of Motor Transport" (Mechanical Technician, Automotive Electrical Equipment Electrician).

5) Private Institution "Atyrau Higher Multidisciplinary College 'Bolashak'"

No specialties related to the manufacturing industry were found in the sources (only education, medicine, accounting, and service).

6) Atyrau Service College:

07230100 – "Garment Production and Clothing Design" (Seamstress).

7) Atyrau College of Energy and Construction (KGKP "Atyrau College of Energy and Construction")

07150500 – "Welding (by type)" (Mechanical Technician, Electric and Gas Welder).

07150700 – "Hoisting Machines and Transporters" (Crane Operator (by type)).

07220100 – "Production of Building Products and Structures" (Master of Manufacturing and Installation of Metal-Plastic Products, Technician-Technologist).

8) Atyrau Industrial College

"Welding (by type)."

"Hoisting Machines and Transporters."

"Installation and Operation of Engineering Systems for Housing and Communal Services Facilities."

9) S. Mukashev Atyrau Polytechnic Higher College:

07151100 – "Operation and Maintenance of Machines and Equipment (by industry)" (Mechanical Technician).

07140100 – "Technological Processes of Automation and Control" (Electromechanical Technician).

07140200 – "Mechatronics" (Applied Bachelor of Mechatronics).

07130700 – "Maintenance, Repair, and Operation of Electromechanical Equipment" (Electromechanical Technician).

Colleges in the Region (Districts):

1) Zhylyoi Technological College of Oil and Gas named after Safi Utebayev:

07150500 – "Welding (by types)" (Electric and gas welder, Technician-mechanic).

07140100 – "Automation and control of technological processes (by profile)" (Instrumentation and control locksmith, Technician-electromechanic).

07161300 – "Maintenance, repair and operation of motor transport" (Car repair locksmith, Technician-mechanic).

07150600 – "Locksmithing (by industries and types)" (Repair locksmith, Instrument locksmith).

2) Inder Multidisciplinary College of Agriculture:

07150500 – "Welding (by types)" (Electric and gas welder).

07161300 – "Maintenance, repair and operation of motor transport" (Car repair locksmith).
07161600 – "Agricultural mechanization" (Agricultural production tractor driver-machinist, Master of agricultural machinery repair).

3) KGKP "Kurmangazy Agrarian-Technical College"

07150500 – "Welding (by types)" (Electric and gas welder).
07161300 – "Maintenance, repair and operation of motor transport" (Car repair locksmith, Master of motor transport repair).
07161600 – "Agricultural mechanization" (Repair locksmith, Master of agricultural machinery repair, Tractor driver-machinist).

4) Makat Technological College of Oil and Gas:

07150300 – "Lathe work (by types)" (Turner).
07150500 – "Welding (by types)" (Electric and gas welder).
07230100 – "Garment production and clothing modeling" (Tailor).
07130700 – "Maintenance, repair and operation of electromechanical equipment (by types and industries)" (Electrical equipment installer).
07140100 – "Automation and control of technological processes (by profile)" (Instrumentation and control locksmith).
07150600 – "Locksmithing (by industries and types)" (Repair locksmith).
07151100 – "Operation and maintenance of machines and equipment (by industries)" (Technician-mechanic, Equipment adjuster).

5) Makhambet Multidisciplinary Agricultural College:

07150500 – "Welding (by types)" (Electric and gas welder).
07161600 – "Agricultural mechanization" (Agricultural production tractor driver, Master of agricultural machinery repair).

FOOD INDUSTRY

1) Atyrau Service College is the only educational institution in Atyrau city training personnel for the food industry in three specialties:

10130300 "Catering Organization" (Pastry Chef-Decorator, Cook, Technologist, and Barman).

10130200 "Organization of Service in Catering" (Head Waiter/Maitre d').

07210300 "Bakery, Pasta, and Confectionery Production" (Baker).

2) Inder Multidisciplinary College of Agriculture is the only college in the region's districts with a program in the food industry and provides training in the specialty:

10130300 "Catering Organization" (Cook).

IT AND DIGITALIZATION

There are 9 colleges in the region offering the following programs: "Programming," "Computing Engineering," "IT," and "Computer Hardware Operator," including:

1) Caspian Multidisciplinary Higher College

06120100 Computing Engineering and Information Networks (Network Administration Technician)

06130100 Software (Software Developer, Web Designer)

2) S. Mukashev Atyrau Polytechnic Higher College

07140200 Mechatronics (Applied Bachelor of Mechatronics)

3) Atyrau Innovation College "Parasat"

07140100 Automation and Control of Technological Processes (Electromechanical Technician)

9.3. LIST OF EDUCATIONAL CENTERS, MASS OPEN ONLINE COURSES, AND OTHER OPPORTUNITIES FOR ACQUIRING FUTURE SKILLS

A list of mass open online courses (MOOCs) hosted on educational platforms that assist in mastering future skills:

ENBEK SKILLS

https://skills.enbek.kz

An educational platform by the Ministry of Labor and Social Protection of Population of the Republic of Kazakhstan, offering online courses on digital, managerial, entrepreneurial, and professional skills. Training is available on both a free and paid basis with the issuance of standard certificates.

EXCELLENT EDUCATIONAL CENTRE

https://excellent-edu.kz

A Kazakhstani educational company implementing professional development and retraining programs for students and faculty of universities and colleges. Courses focus on future professions, digital competencies, project management, and educational design.

BELGIAN EDUCATIONAL COUNCIL

https://www.becouncil.eu

An organization developing international cooperation in the field of education. It provides internship programs, professional development, academic mobility, and the integration of innovative educational and technological solutions.

COURSERA

https://www.coursera.org
An international online platform offering courses, specializations, and professional certificates from leading universities and companies in the following areas: artificial intelligence, data analysis, cybersecurity, programming, business, and project management.

EDX

https://www.edx.org
An educational platform founded by MIT and Harvard, providing courses and MicroMasters and Professional Certificates programs in STEM disciplines, engineering, computer sciences, AI, and data analytics.

UDACITY

https://www.udacity.com
A platform specializing in practice-oriented Nanodegree programs and short-term courses on artificial intelligence, machine learning, data analysis, software development, and digital professions.

FUTURELEARN

https://www.futurelearn.com
An online learning platform from universities and international organizations offering courses on digital skills, sustainable development, healthcare, management, and innovation.

KHAN ACADEMY

https://www.khanacademy.org
A free educational platform for schoolchildren and students, covering mathematics, natural sciences, programming, and the fundamentals of computer science, oriented primarily toward secondary education.

LINKEDIN LEARNING

https://www.linkedin.com/learning
A professional learning platform with courses on digital skills, project management, analytics, leadership, communications, and creative disciplines, integrated with the LinkedIn career profile.

SKILLSHARE

https://www.skillshare.com
An online platform with practical courses on design, marketing, entrepreneurship, multimedia, and creative professions, focused on the development of applied skills.

PLURALSIGHT

https://www.pluralsight.com
A professional IT training platform specializing in programming, cybersecurity, cloud technologies, DevOps, game development, and engineering competencies.

OPENCLASSROOMS

https://www.openclassrooms.com
An educational platform focused on practical training, offering courses and career tracks in web development, UX/UI design, digital marketing, and IT specialties.

CISCO NETWORKING ACADEMY

https://www.netacad.com
An international educational initiative by Cisco, providing courses and certification programs in networking technologies, cybersecurity, IoT, and IT infrastructure.

MICROSOFT (MICROSOFT LEARN)

https://learn.microsoft.com
Microsoft's training and certification platform with courses on Azure cloud solutions, software development, data analysis, artificial intelligence, and IT project management.

GOOGLE (GOOGLE CAREER CERTIFICATES)

https://grow.google
Google educational programs focused on practical skills in data analysis, cloud technologies, IT support, UX design, and digital marketing.

IBM (IBM SKILLSBUILD)

https://www.ibm.com/skills
IBM's training platform offering courses and programs on artificial intelligence, data analysis, cloud technologies, cybersecurity, and digital skills.The AWS educational ecosystem, providing courses and certifications on cloud technologies, solution architecture, DevOps, security, and data management.

AWS (AMAZON WEB SERVICES TRAINING)

https://aws.amazon.com/training
The AWS educational ecosystem, providing courses and certifications on cloud technologies, solution architecture, DevOps, security, and data management.

CONCLUSION

The Regional Card of Personnel Needs of the Atyrau Region demonstrates that the future of the region is inextricably linked with technological renewal, economic diversification, and overcoming high dependence on the oil and gas sector. The region has powerful economic potential and a highly motivated population, 30% of whom are ready to master new professions, predominantly in sectors key to the region's development (industry, agriculture, IT, tourism).

Key Challenges and Problems. Despite the optimism, the study revealed critical personnel gaps that could stall the implementation of investment projects in the region:

1. Personnel shortage and workforce quality: Business critically notes that the workforce does not meet qualification requirements and also records a low level of competence in Programming, Robotics, and AI (Artificial Intelligence). Young people prefer the highly paid oil and gas sphere, creating a shortage of blue-collar and engineering personnel in the manufacturing industry.

2. Education problems: Educators confirm this problem, pointing to poor selection of applicants and low practical orientation of training. College and University curricula often fail to adapt to production requirements in time, failing to develop necessary skills in communication, project management, and digital marketing.

3. Raw material dependence and environmental risks: High dependence on the oil and gas industry makes the economy vulnerable to external shocks. Environmental risks associated with pollution and the shallowing of the Caspian Sea and the Zhayik River pose a serious strategic threat to agriculture and fisheries.

Strategic Recommendations for the Future. To successfully transition to an economy of a new formation and ensure a sustainable future for the Atyrau Region, the following strategic steps are necessary:

1. Continuous and practice-oriented education: A transition to continuous education focused on practical skills and current industry requests is critically important. This includes increasing practical skills on real equipment, implementing dual education, and using VR/AR simulators for hazardous industries.

2. Development of digital competencies and the IT cluster: It is necessary to urgently fill the deficit of IT specialists, especially in the fields of cybersecurity, data analysis, IoT development, and industrial automation. The development of Atyrau Hub and specialized educational programs will help the region become a center for digital competencies and innovation.

3. Investments in diversification and sustainable development: The region needs to actively develop non-resource industries:

- **Tourism:** Bet on eco-tourism (Inder salt lake, lotus fields), industrial tours, and the training of VR/AR guides.
- **Agro-industrial complex (APK):** Development of aquaculture (Zhayik–Caspian fishery cluster), precision farming, and biotechnology, with the training of Agro-IT specialists and Aquaponists.
- **Manufacturing and Food Industry:** Modernization of enterprises, implementation of ESG standards and robotization, as well as the creation of enterprises for deep processing of raw materials (meat, fish, milk), with the training of Automation Engineers and Aquaculture Biotechnologists.

The Regional Card of Personnel Needs is a strategic document that will ensure the Atyrau Region prepares specialists, attracts investment, and improves the quality of life, facilitating the transition from a raw material model to a high-tech, sustainable, and adaptive economy.

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