

# **Development of science and innovation activity at Azerbaijan Technical University STRATEGY**

## **1. GENERAL PROVISION**

On October 24, 2013, the President of the Republic of Azerbaijan approved the "State Strategy for the Development of Education in the Republic of Azerbaijan". This document outlines the creation of a new educational system, environment, and mechanism based on knowledge economy. It also lays out the necessary actions to be implemented at all stages and levels of education to form human capital.

The factor mentioned above was widely discussed in the Strategic Road Map for the national economy of the Republic of Azerbaijan, which was approved by the President of the Republic of Azerbaijan on December 6, 2016. According to this document, specialists who have received higher education actively participate in managing the state and companies, creating more value, and improving economic growth and labor productivity. Higher education must be integrated into the global education space to meet the demand for skilled personnel and adapt to the requirements of the knowledge-based economy. According to recent studies, Azerbaijan is facing challenges in terms of its economic competitiveness and

sustainable development in the long run due to low levels of technical expertise. The current trends in technical education have shifted significantly, requiring technical higher schools to adopt new approaches and educational methods. With the advent of the fourth industrial revolution and rapid advancements in digital technology, technical universities have an important role to play in preparing specialists equipped with the skills necessary to meet the demands of the modern age.

## **2. RESEARCH AND INNOVATIVE DEVELOPMENT**

One of the key opportunities for technical universities is the ability to conduct real research and implement projects to solve industry and service sector problems. One of the main challenges in the world is to have universities in the industry and ensure university-industry cooperation. This challenge manifests itself more prominently in the CDIO approach to engineering education, and AzTU is determined to join these challenges and meet the necessary steps in this direction. AzTU has spent the past year identifying the university's key areas of scientific focus and establishing faculties and departments aligned with those areas. Moving forward, the primary objective should be to direct the research efforts of students, particularly those pursuing advanced degrees, toward addressing real-world problems and meeting industry demands.

This will enable the creation of specialized scientific products that meet the challenges of the modern world.

The integration of IT and technology at AzTU can drive significant development. Therefore, AzTU Education should focus on Digital Transformations. It is possible to strengthen specializations and interdisciplinary research, connect the research with the educational process, and bring them to a single platform to solve larger-scale problems. High technologies would accompany the implementation of startup ideas.

2.1. The various fields of science and technology represented at AzTU allow for the establishment of an international scientific journal covering general science and research fields, which includes these fields and aims for recognition in the international world. Since 2010, AzTU employees have published 1,901 scientific articles in high-impact international journals. Over the past 5 years, AzTU employees have published a total of 1033 scientific works. Out of these, 218 were published in journals included in the Web of Science database, and 238 were published in journals included in the Scopus database. In total, 770 of these scientific works were published in reputable scientific journals included in the databases of Web of Science, Thomson Reuters, Scopus, and others.

If we consider the publication of scientific articles as a measure of scientific-innovative activity, then it is evident that AzTU has significant potential for growth in this field. One of these opportunities may be to ensure the publication of a scientific and technical journal that combines several fields and to achieve the entry of this journal into international bases in the next 5 years.

As an example, AzTU has the necessary potential to ensure the publication of the INTERNATIONAL JOURNAL OF MATERIAL SCIENCE AND ENERGY.

Efforts should be made to improve the quality of scientific journals that are currently being published by AzTU. In particular, measures should be taken to facilitate the publication of some scientific articles in English. Additionally, work should be done to publish journals in electronic format and to create web pages for journals, allowing articles to be sent for foreign evaluation. It is important to approach these tasks systematically and ensure that they are completed.

To enhance the credibility of scientific research, organizing highly-rated international scientific conferences is crucial. To achieve our goals, we believe that organizing traditional International Scientific Conferences in various fields is a crucial step. These conferences should be attended by influential scientists in their respective fields. Furthermore, we should publish selected conference materials as special issues of international journals established at

AzTU and include them in international databases. These measures will help us to achieve our objectives effectively. Improving AzTU's international ranking can be achieved through scientific measures. The research work carried out at AzTU can pave the way for activities in at least three different directions:

1. Oriented in mechanics, machine building, metallurgy, and material science
2. Automation, electrical engineering, telecommunications, radio engineering oriented
3. Innovative economy and management-oriented

Collaborating with experts, it is important to decide on the appropriate names for traditional international conferences in various fields and make the required arrangements for their organization. These scientific events can be organized jointly by multiple countries, especially universities and relevant industries in Germany and Turkey.

Personnel training can be improved while also increasing the appeal of universities and graduates in the labor market. To achieve this, it is important to take serious steps toward establishing and implementing research projects that focus on solving practical problems at AzTU. This will help to realize the existing opportunities for growth and development within the university.

For this purpose, it may be appropriate to carry out the following works at AzTU as a strategy:

1. Establishing habits of setting issues aimed at solving real scientific and technical problems and ensuring their solution.
2. Develop a short and long-term plan for creating a startup ecosystem and technopark that can handle new challenges.

They are taking advantage of intra-university integration by creating opportunities for innovative work and writing joint scientific articles for internationally indexed journals.

4. Development of a serious action plan for the development of university-industry cooperation.

5. To increase the possibilities of the creation of innovative technologies of specialized departments that are more related to industry and production, to strengthen the joint activity with ICT departments of the university, and to constantly keep the involvement of graduate students in the focus of this work.

Creating an environment where knowledge can be shared is crucial and can greatly enhance the effectiveness of large collaborative research efforts. Additionally, it is also considered one of the key factors in determining the international ranking of universities. Therefore, to create an effective knowledge-sharing environment at AzTU for prospective development, it may be appropriate to perform the following activities:

1. Stimulation of the necessary working platform for students and young researchers to come up with ideas and apply them to real life.
2. Creation of intra-university integration for carrying out research.
3. Necessary educational and preparation and execution of the action plan for the organization of educational courses.

### **3.1. University-industry cooperation**

Looking at the historical evolution of technical universities, it can be seen that both teaching and scientific research and project-constructive work have been concentrated in them since their formation. In the latter half of the 20th century, countries like the USA, European nations, Japan, South Korea, and later China, experienced a significant transformation in the way scientific and technical work was carried out. With the rapid advancements in technology, a portion of the scientific and technical work shifted from academic and research institutions to the experimental laboratories of industrial enterprises. This scientific research has enabled companies to compete with technical universities.

To meet the demand for teaching and scientific research, universities sought ways to collaborate with industrial enterprises, as they concluded that the demand for these skills is primarily formed in the labor market. As forms of "university-industry cooperation", direct ordering of industrial enterprises, personnel

training, scientific research, and joint research of universities, and industrial enterprises, the creation of joint production-experimental areas began to be implemented. Today, it is impossible to imagine that the technical universities of the world and the region where the Republic of Azerbaijan is located conduct teaching and research without interaction with industrial enterprises. During the former Soviet Union, Azerbaijan Technical University, a leading technical higher education institution related to the industrial sector of the republic, trained qualified personnel for state industrial enterprises and conducted substantial scientific research by the state's planning policy. After the collapse of the Soviet Union, the decline of state-owned industrial enterprises made it difficult to place trained personnel in the labor market, and the quantity and quality of scientific research decreased. Since the mid-2000s, the growing development of both oil and non-oil sectors in the country has set new challenges for technical higher education institutions:

Without waiting for "demand" from the industrial enterprises that own the labor market, the universities should take the initiative and cooperate with them

- Flexible adaptation of the educational system and methods of conducting scientific research to the achievements of scientific and technical progress in the era of the Information Society, where technologies are rapidly changing

- Development of entrepreneurship-related knowledge skills in universities and obtaining sustainable financial support by providing additional services to the universities themselves.

Despite efforts, Azerbaijan Technical University still faces challenges in university-industry cooperation.

Curriculums and directions of scientific research are still not adapted to the requirements of the ever-changing industries of the country, as well as to the global trends in the field of technical education.

The university has weak business relations with private and state enterprises, leading to delays in joint work implementation, particularly with small and medium-sized businesses.

- Lack of opportunity to use the "CDIO" ("Content" - "Project" - "Working" - "Application") approach, which includes the professional development of individual knowledge and skills of engineers and is used in technical universities.

In addition to the current problems, the University has historically formed academic opportunities related to teaching and scientific research:

- Being the first educational institution established in the field of technical education in the country, the existence of a traditional teaching and scientific research base in important fields such as materials science, metallurgy, energy, transport, logistics, mechanical engineering, radio engineering, and automation.

- The presence of laboratories that allow conducting in-depth scientific research on the mentioned industries
- Having different spheres of professors and medics of sciences, hundreds of associate professors and doctors of philosophy in various fields

In addition to higher education, Baku Technical and Baku State Colleges of Communication and Transport, which have the right to grant sub-bachelor vocational degrees, operating under the University, provide secondary vocational education and sub-bachelor vocational education based on secondary vocational programs

Taking into account the mentioned issues and the existing academic opportunities of the University, the following were defined as strategic goals in this direction for 2020-2030:

- To adapt to the challenges of the country's economy, creating bachelor's and master's theses through experience in public and private enterprises with which the University cooperates
- Strengthening relations with small and medium-sized business entities, training qualified staff for them, and conducting joint scientific research
- Receiving scientific orders from state and private enterprises by expanding the economic activity of university laboratories
- Determination of the "CDIO" approach as the basis of technical education in engineer training

The strategic goals, the work to be done to achieve them, and the corresponding timeline will be presented in the Strategy Implementation Roadmap.

### **3.2. Development of technopark and startup ecosystem**

In the second half of the 20th century, in-depth experiments and scientific works carried out in the industrial enterprises themselves strengthened the competitive environment among them in the field of technologies that encouraged the development of individual and collective entrepreneurial characteristics. Today, the world's biggest technology companies were once founded in homes, small offices, and university rooms. First in the United States, and then in Europe and East Asia, technology companies that evolved around innovative ideas pushed technically oriented universities to focus teaching and research on the development of individual entrepreneurial skills and innovative technologies. Already, universities have begun to create technology parks and start-up centers on their campuses to keep up with the ever-growing technologies and establish cooperation levels with technology companies. It should be noted that during this period, industrial enterprises and technology companies had already created industrial districts and technology parks to carry out joint operations among themselves. Universities, in creating technoparks, innovation, and start-up centers, aimed to create conditions for teachers and students with innovative ideas to work

in these centers, and industrial enterprises to be involved in these centers and conduct scientific research and research together with them. The formation of innovation and startup ecosystems in Azerbaijan started in the mid-2000s. Initially, only private enterprises and individuals were engaged in this field, but in the last ten years, certain legislative documents and programs have been adopted in this field, the Innovation Agency of the Ministry of Digital Development and Transport was established to implement state support activities in this field, and various startup and hackathon competitions were held. At the same time, Sumgayit Chemical, Mingchevir, Pirallahi, and Garadagh Industrial Parks were created by the state, residents from the private sector were attracted here, and agro parks were created by private sector enterprises. However, there are still some challenges related to the development of the technopark, innovation centers, and startup ecosystem in the country:

- There is no legislation on the creation of a joint technology park between private technology parks and public and private sectors
- Lack of clear concession mechanisms for the promotion of startup and innovation-oriented activities not only among large private sector entities but also among medium and small business entities.
- Absence of relevant legislation related to scientific research and higher education institutions themselves establishing full-fledged technoparks and startup centers and attracting residents there

- Lack of legislation in the field of venture and "angel" investment in the country

Due to the indicated shortcomings, as in other higher educational institutions of the country, the activity of technopark and startup ecosystems is feeble at Azerbaijan Technical University.

The involvement of university educators and postgraduates in competitions that can encourage their scientific creativity and innovative ideas has been happening only in the last year. They are already victorious in these competitions and this serves as an influential motivation for other teachers and students. However, despite the presence of competent and start-up-spirited teachers and students at the University, certain problems remain:

- Absence of a single center in the university where teachers and students with innovative ideas can work together, as well as students from other universities and representatives of the private sector can work together
- Failure to do work related to the preparation of industrially important innovative ideas of teachers and students to pass the start-up ecosystem stages such as "incubation" and "acceleration" and prepare for commercialization

Taking into account the mentioned problems and the existing academic opportunities of the University, the following were defined as strategic goals in this direction for 2020-2030:

- Establishment of a Technopark and Innovation Center where teachers and students with innovative ideas can work together, as well as students of other universities and representatives of the private sector can work together and provide appropriate infrastructure
- Creation of entrepreneurial skills in idea owners and commercialization of relevant ideas to commercialize ideas that have passed the "incubation" and "acceleration" stages in the technopark and are of industrial importance
- Continuously supporting the participation of university teachers and students in "startup" and "hackathon" competitions.