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Ufa State Aviation Technical University: realities and prospects of its transformation into a world-class innovation university

Уфимский государственный авиационный технический университет: реалии и перспективы его превращения в инновационный университет мирового уровня

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ABSTRACT
Looks at the main activities of Ufa State Aviation Technical University, its best experience and achievements. It draws upon the university's potential, its contribution to training, research and innovation. Particular attention is paid to specific measures aimed to strengthen ties with the industry and practical orientation of student education. The article defines the university strategic vision for education developing and focuses on research areas. Its core goal is stated: to transform Ufa State Aviation Technical University into an innovative University 4.0.

KEYWORDS
University; science; education; experiential learning and training; training of highly qualified professional; innovative activity.

АННОТАЦИЯ
Рассматриваются основные направления деятельности Уфимского государственного авиационного технического университета (УГАТУ), его лучший опыт и достижения. Развитие УГАТУ опирается на кадровый потенциал, передовые исследования и инновации. Особое внимание уделяется мерам, направленным на укрепление связей с промышленностью и усиление прикладного аспекта в образовательном процессе. В статье представлено стратегическое видение развития университета в области науки и образования. Основной целью руководства и всех сотрудников на данный момент является преобразование Уфимского государственного авиационного технического университета в инновационный университет 4.0.

КЛЮЧЕВЫЕ СЛОВА
Университет; наука; образование; исследование; наука; подготовка высококвалифицированных кадров; инновационная деятельность.

Today, Ufa State Aviation Technical University is a large educational, scientific and innovation complex – one of the leading institutions in the Republic of Bashkortostan and the Russian Federation training candidates for the high-tech industry: aerospace engineering and technology, mechanical engineering, machine tool building, materials science, power engineering and electricity, robotics, computer and info-communication technologies. The University has around 20 000 students. The organizational structure of the university comprises 6 faculties and 3 institutes, as well as affiliates in the cities of Ishimbai and Kumertau. There are two colleges that are integral to the make-up of the USATU: Ufa Aviation College and Kumertau Aviation Technical College. The University also houses the Institute for Military and Technical Education, which is one of its kind in the region, training professionals for the Armed Forces of the Russian Federation.

Fig. 1. MiG-19 Aircraft Monument against the background of the USATU first building

Рис. 1. Памятник самолету МиГ-19 на фоне первого корпуса УГАТУ

Fig. 2. New building of the University
Рис. 2. Новый корпус университета

The University is guided by the development and growth plan to bind science, education and industry with the purpose of establishing a world-class scientific and educational centre, that would train professionals, carry out research to and drive both regional and national high-tech sector forward. As a catalyst of local development, the University shapes a creative environment to foster students' cognitive and creative activity. It is this environment that makes training of future specialists possible. Today, we can define our core strategies, which are the priority areas for the transformation of USATU into an innovative University 4.0:

- to create an educational environment and shape a professional elite in partnership with industrial enterprises of the country;
- to concentrate resources to deliver research in the most important sectors of the digital economy taking account of the cutting-edge scientific and technical developments;
- to review and enhance the ways and mechanisms to support and mentor the young generation through the development of cultural, moral and patriotic values;
- to modernize the infrastructure and provide candidates for innovative and technological business;
- to develop international cooperation in education and research.

The University trains professionals in 18 large integrated degree courses and specialised areas of study, in the Republic Bashkortostan many of which are implemented only within the walls of our university. The training covers a wide range of taught programmes, including 38 bachelor's degree programmes, 10 specialist degree programmes, 37 master's courses, 16 research degrees and 10 majors providing secondary vocational education. Educational programmes are developed in accordance with the federal state educational standards, taking into account the requirements of both national and international public and professional institutions. A number of programmes have professional-public and international accreditation.

The innovation potential of the curriculum at the university is increased through a number of complementary initiatives:

1) mainstreaming the world-leading research findings in the forward-looking curricula corresponding the advanced level of technique and technology development; defining graduates' competences in the methodology of research organization and delivery, incorporating up-to-date facilities; promoting creative project activities of our graduates;

2) defining graduates' competences in innovation economics which enable them to succeed in projects on commercialising our R&D, and which are developed through being embedded into a full range of relevant subjects, as well as through the use of design-oriented training techniques, and attracting students to innovation activity within the framework of the University infrastructure (Technoparks, centres for technology transfer, centres for Innovation and Technology, small innovative enterprises);

3) raising the language competences of graduates, which enable effective communication with other specialists in their native and foreign languages;

4) developing international collaboration and student academic mobility by engaging in international and European academic programmes (TEMPUS, ERASMUS MUNDUS, DAAD), and developing new partnership programmes with world-leading universities.

Fig. 3. Studying proccess
Рис. 3. Процесс обучения

Behind the key strategy component of the Ufa State Aviation Technical University's transition to the University Centre for Technological Development of the Region lies modernization of education and training, which includes:

- developing, modernizing and broadening a range of highly-sought qualification programmes, designed with a modular concept;

− ensuring the high quality of the educational outputs and services delivered through the creation of a modernized system for continuous engineering education and through the introduction of innovative educational technology.

The approach above manifests itself in the integration of e-learning and distance learning technologies to ensure a high-quality experience for students and staff, as well as other professionals in pursuit to improve their knowledge (for example, through Professional Development Programmes for business leaders and technical specialists). The University provides learning resources in a form of interactive electronic teaching and learning materials accessible for learners on the university website anytime. These learning materials include theory and hands-on materials (course books and practicums), study guides and tests, assignments and term project work guides, graphic calculations, and assessment tests.

Our University is a strategic partner for JSC «United Engine Corporation» offering scientific and technical support, as well as training job-ready tech candidates. The University development program is integrated with the development strategy of the Corporation in the field of science and education with the aim of training to prepare new hires and providing employees with the opportunities to obtain further professional qualification for careers in the aircraft engines engineering industry; building scientific and technical capacity of both JSC «United Engine Corporation» enterprises and the University; ensuring that young professionals will stay and grow within the enterprises of the aviation engineering industry in the region (for example, PJSC «UEC − Ufa Engine Industrial Association (UMPO)»); adding value to industry careers.

Fig. 4. Our graduates
Рис. 4. Наши выпускники

The University prepares qualified professionals and carries out research to other external companies which are part of State Corporation «Rostec»: JSC «Russian Helicopters», Holding company «Technodinamika», Concern Radio-Electronic Technologies. Within the diversification policy, the University develops professional competences sought after by State Corporation «Rosatom», PJSC «United Aircraft Corporation», PJSC «Rosneft», PJSC «Gazprom».

One of the forms of cooperation between the University and employers that plays a significant role in developing high-demand skills, is an in-company (pre-degree) internship. Every year, the University concludes over 1 500 internship agreements with enterprises and companies of various organizational and legal forms of ownership.

The transition to the federal state educational standards of higher education has significantly increased the autonomy of universities to design the taught programmes. This gives an opportunity to take full account of the employer's requirements, to shape a graduate competences model complying with the professional standards of industry and enabling to transit from setting and streaming teaching approaches to those tailored to individual needs, based on the development of modular curriculum and individual educational pathways. Today, the main niche, implementing the individual-oriented training, is a targeted training of students. The number of agreements for targeted training in USATU grows annually. They can be concluded at any stage of the student's training and offer additional funding and social guarantees. Highly interested in well-trained graduates, enterprises, that have agreements for targeted training with the University, take part in developing degree programmes, and monitoring the students' term progress. A great number of course projects, research works and final year qualification projects addressing the problem areas of an enterprise are also undertaken in academic collaboration with the industry. Today, the number of students engaged in employer-led targeted training accounts for 20 percent of the total number of students enrolled.

Since 2014, the University has been taking an active part in competitions to provide support to programmes that prepare qualified professionals for the defence sector. In 2017 our university was recognized as the winner of eight biennial programmes in which 76 students participated. Ufa Engine Industrial Association, research institutions «Molniya», «Magnetron», «Soliton» and other companies were engaged as partner enterprises.

A promising approach to raising the quality of education consists in delivering experiential learning programmes and

organizing dual training. Under the current educational standards there is an option to choose between the academic and applied professional activities when cultivating career professionals. Collaborative experience with enterprises proves that their priorities are experiential degree programmes developed according to the modular principle taking into account the specifics of the company. Hence, the number of such programmes taught at our University is increasing annually.

Our taught programmes with set educational targets are designed in such a way that beginning with the first term, part of the disciplines are trained onsite under the supervision of related enterprises. Industrial placements coupled with academic training allow students not only to acquire knowledge, but also gain technical skills and applicable work experience, as well as to obtain one or two qualifications.

The implementation of the experiential work-based programmes is not possible without enterprises and exploiting their workforce and tech resources. Such close interaction requires the development of the University basic department system and networking from industry and educational institutions. With access to the facilities, modern equipment and software available within the University basic departments located on the territory of the partner company, the students can be engaged in laboratory and hands-on learning under the supervision of the company professionals in a real working environment. This means industry leading specialists are involved in the training process, supervising work placements, tutoring course projects and final year projects, supervising final state and qualification exams as members of the examination boards.

Federal state educational standards impose rigid and specific requirements on a number of degree courses and specialised areas of training to ensure that training facilities, resources and IT systems are aligned and fit for purpose. Given a wide range of taught programmes, universities are not always able to fully and qualitatively provide effective education and training. This challenge requires that universities and industry build networking and share responsibilities. The Ufa State Aviation Technical University has established 10 basic departments and 4 affiliate departments operating within enterprises.

An effective mechanism of attracting talented students to the industry is a special companies-sponsored scholarship scheme that offers additional financial support to students actively engaged in research focused on key areas of the enterprise and who have good and excellent academic achievements. Such relevant companies and organizations as Ufa Engine Industrial Association, «Bashneft», «Alfa-bank» and «Rosselkhozbank», together with the companies participating in the employment project «New career professionals for the defence sector» have created corporate scholarships programmes available to the students of Ufa State Aviation Technical University. Our top students are awarded with special scholarships of the President and the Government of the Russian Federation in fields of basic and applied research of higher priority for economic modernisation and technological development, as well as scholarships of the Head of the Republic of Bashkortostan.

To boost the employability of our graduates, offer industry placements and deliver high level of professional training, the University has built industrial collaborations with the leading industry employers. Every year in November and April, the University hosts «Career Days» which has an extensive reach with up to 60−70 Ufa companies, as well as industrial centres from the Republic of Bashkortostan and other regions of the Russian Federation. «Career Days» is a great venue for university career fairs, for companies to showcase employment opportunities, for recruiters and career advisors to present masterclasses, and for company representatives, heads of the Department of Education and graduates producing departments to hold meetings aimed at raising the level of training and enhancing the interaction between the enterprises and the University. Since 2015, Ufa Engine Industrial Association, our leading partner and employer, has been organizing its annual presentation days at the University. The framework of this traditional practice offers such events as meetings of the leading specialists from across the Association structure with the students and staff; a foresight-session called «The prospects of employer-student interaction», business-game «Career compass», a quest called «Teambuilding», and masterclasses.

The University provides continuing education and training for industry experts and organization professionals, as well as teachers and students. We deliver 180 professional development programmes and 24 professional retraining programmes. The students and staff of Ufa State Aviation Technical University regularly take training courses and short workshops in cities across Russia and abroad, as well as professional development courses at other universities.

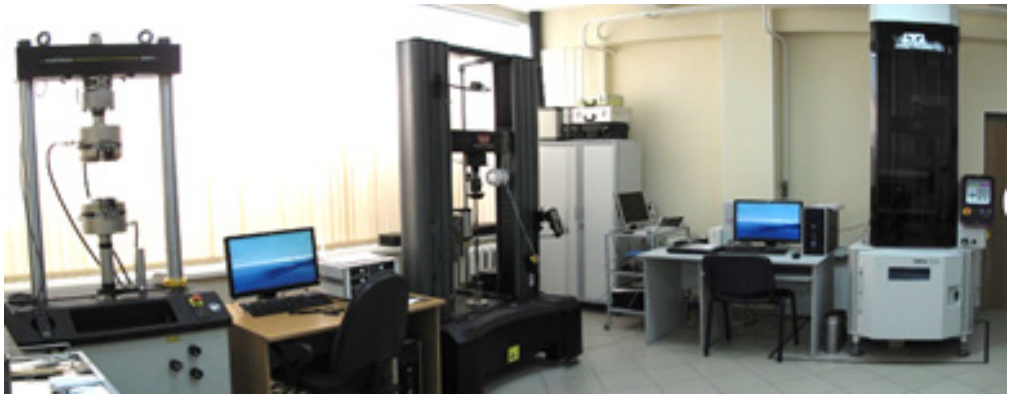

Fig. 5. Shared facilities centre
Рис. 5. Центр коллективного пользования

The University is recognised nationally and internationally and highly ranked by various agencies and centres on a yearly basis. In 2017, the Shanghai Global Ranking of Academic Subjects (ARWU) ranked Ufa State Aviation Technical University alongside 12 top Russian universities. We were ranked in the top 101–150. This rating of universities was released in 52 subjects across Natural Sciences, Engineering, Life Sciences, Medical Sciences, and Social Sciences. In total, more than 4000 universities were ranked.

It should be noted that in the «Rector of the Year 2016» competition, prof. Nikolay Krioni, the University rector and one of the authors of this article, has won an award in the category «Science in Higher Education Institutions». The competition was held by the «Panorama» publishing house and the editorial board of the «Rector» journal.

A modern university can be described as an innovative institution of higher education, which does not only provide training but also creates new technologies and brings them to the world market, finds solutions to some of the industry's biggest challenges and shapes its development areas. Such university is defined as University 4.0.

Through our research and developments in areas as diverse as Materials Science, Nano Systems Engineering, ICT and Supercomputers, Biotechnology, Conservation Science, we stated our aim to be among the leading universities in the world for engineering and technology, and to be among the top universities as measured by QS WUR, as well as to ensure that the University is in Top 100 Universities in subjects Mechanical Engineering, Aeronautical & Manufacturing as ranked by higher education data specialist QS. To achieve this goal, the University focuses on world-class investigations to build scale of breakthrough research developments in key areas that make up the core of the IV technological paradigm.

Today, the University has the most relevant facilities and equipment to carry out research: 7 research institutes, 43 in-house training and research laboratories, 4 joined-up research and industrial laboratories and 4 complexes, 14 research and training centres, shared facilities centre «Nanotech», a supercomputer and a test bed complex «Airport». It is our understanding that a world-class research in the field of both basic and applied sciences is impossible without expensive and special-purpose equipment. Over the last decade the quality of the University research equipment fleet has seen significant improvement with over hundreds of million rubles invested, which boosted our investigations across world research beacon areas. All these became possible after the University embarked on and won a number of ambitious national competitions, including the National Priority Project «Education», the Federal Target Program «Russian Nanotech Infrastructure Development 2008–2011», three projects under Government Resolution «On Measures of State Support for Cooperation of Russian Institutions of Higher Education and High-tech Manufacturing Enterprises» and others.

As we move forward and set challenging targets, the need for state-of-the-art equipment is known to increase. Cooperating with scholars from Russian and world scientific centres, establishing regional and national academic shared facilities centers, we can ensure that the needs are met. We already use a range of measures in order to capitalize on the opportunities to build scientific links with universities and research institutions across Bashkortostan and Russia. Besides, our scholars benefit from the equipment of the leading universities of Great Britain, France, Germany, China, Slovakia and other countries.

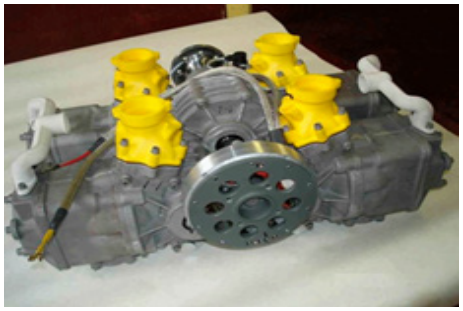

Fig. 6. Innovative engine for small aircraft

Рис. 6. Инновационный двигатель для малой авиации

A diversity of research areas requires a balanced approach. Among our research priorities are development and processing of new materials, design and operation of products and control systems for complex technical objects, info-communications, energy and resource saving, environmental management, supercomputer modelling. High-strength nanostructured metallic materials with a complex of attractive functional properties, coordinated high-precision forming and surface hardening technologies, advanced aircraft engine blades, aerospace electrical equipment, new-info communication technologies: these are our research developments among others that arouse much interest among researchers both in Russia and abroad.

The University is a Competence Centre of UEC in the field of additive and foundry technologies, materials design and processing technologies. Our effective collaboration with industry and a number of research organizations (Institute for Metal Superplasticity Problems of Russian Academy of Science (RAS), Scientific and Production Association «Technopark for Aviation Technologies (AT)», PAO «UEC-Ufa Engine Industrial Association», JSC «UEC-Aviadvigatel») has delivered an innovative product – a hollow first-stage fan blade of the PD-14 engine. The invention refers to the research area of metal processing by pressure using superplastic forming technologies and diffusion welding. Thanks to combination of academic thinking and industry expertise there are many other notable achievements. Our industry-academic collaborations have already resulted in and are still producing unique innovative outputs.

The University has five operating Dissertation Boards. In 2017, 17 candidate of science theses defenses and 4 doctor's theses defenses took place.

Much attention is paid to experiences that engage undergraduate, postgraduate and research degree students in a range of intellectually challenging research and innovation activities such as all-Russia Winter School for postgraduates and young researchers (with international reach), «The Week of Science» comprising student scientific and technical conferences, Olympiads, «Best student project» competitions, all-Russia Scientific Conference for young researchers «Mavlutov Readings». Last year for the first time, the University announced the results of the «The best USATU youth innovative project» competition, when nine youth teams were named winners. Such competitions as «UMNIK», TechNet GenerationS RoadShow and Festival of Science are also held at the University to encourage students to embrace research and innovation. We have reason to be proud of the «USATU racing team» of the student design laboratory «Formula student», which was recognized with a «WILL to WIN» Cup Award at the «Shell Eco Marathon 2017» in London. In 2017, The University encouraged students to take part in 25 forums, 19 conferences, 6 Olympiads. Our postgraduate students take opportunities to pursuit a PhD at the leading universities of West Europe (France, Germany, Great Britain and Austria).

In conclusion, we would like to note that we look to the future with growing confidence and do our best for Ufa State Aviation Technical University to become an innovative University 4.0. We are very positive that the goals we set are realistic and attainable.