



SPACE ENGINEERING EDUCATION PROGRAMS IN KAZAKHSTAN

ABDIKUL ASHUROV

L. N. Gumilyov Eurasian National University,
Astana, Kazakhstan.

e-mail: ashurov_ae@enu.kz



OVERVIEW:

I. Kazakhstan Aerospace Industry

II. Education programs in aerospace engineering

III. Challenges and Capacity-building

IV. Conclusions and suggestions

I. Kazakhstan Aerospace Industry



1. Baikonur Cosmodrome - Kazakhstan

Launch of the first spacecraft
On October 4, 1957.

The first manned flight into
space on April 12, 1961.
Yuri Gagarin.



I. Kazakhstan Aerospace Industry



2. Today's Kazakhstan satellites

Three space systems.

The group of Earth remote sensing satellites KazEOSat-1 and KazEOSat-2 .

The group of scientific and technological satellites KazStSat and KazSciSat.

The geostationary communication satellites Kazsat-2 and Kazsat-3 .



KazEOSat-1



KazStSat



Kazsat-3

I. Kazakhstan Aerospace Industry



3. Ground control complexes (Astana)



National Space Company "Kazakhstan Gharysh Sapary"



Republican Center for Space Communications

I. Kazakhstan Aerospace Industry



4. Spacecraft Assembly and Testing Complex (Astana)

Kazakh-French Company LLP "Galam"



II. Education programs in aerospace engineering



1. Curriculum structure (in academic credits)

	Core subjects (acad.cr.)	University disciplines (acad.cr.)	Elective disciplines (acad.cr.)	Master's research work, including internship and master's thesis (acad.cr.)	Accomplishment and defense of Master's degree thesis (acad.cr.)	Doctoral research work, including internships and doctoral dissertations (acad.cr.)	Accomplishment and defense a doctoral dissertation (acad.cr.)	Total (acad.cr.)
Bachelor, 4 years	51	92	97					240
Master (scientific-pedagogical), 2 years	-	63	25	24	8			120
Doctor PhD, 3 years	-	35	10			123	12	180

II. Education programs in aerospace engineering



2. Educational programs of Kazakhstan universities in aerospace engineering

	University	Location	Bachelor (Education program group: B067-Air transport and technologies)	Master (Education program group: M107-Space engineering)	PhD (Education program group: D107-Space engineering)
1	L.N. Gumilyov Eurasian National University	Astana	6B07146 - Space Engineering and Technology	7M07146 - Space Engineering and Technology	8D07146 - Space Engineering and Technology
				7M07147 - Earth Remote Sensing Technologies	
				7M07148 - Aerospace Engineering	
2	Al-Farabi Kazakh National University	Almaty	6B07111 - Space Engineering and Technology	7M07119 - Space Engineering and Technology	8D07111- Space Engineering and Technology
3	Almaty University of Power Engineering and Telecommunications	Almaty	6B07112 - Space Engineering	7M07107 - Space Engineering and Technology	8D07105- Space Engineering and Technology
4	Satbayev University	Almaty	6B07121 - Space Engineering and Technology	7M07138 - Space Engineering and Technology	-

II. Education programs in aerospace engineering



3. Bachelor's disciplines. 6B07146 - Space Engineering and Technology

University	Core subjects (51 cr.)	University disciplines (92 cr.)	Elective disciplines (97 cr.)
L.N. Gumilyov Eurasian National University	<ul style="list-style-type: none"> - Foreign language; - Kazakh (Russian) language; - Physical Training; - Information and communication technologies; - Philosophy; - History of Kazakhstan; -Socio-political knowledge module. 	<ul style="list-style-type: none"> - Mathematics; - Basics of rocket and space technique; - Physics; -Theoretical mechanics; - Spacecraft; -Electrical Engineering; - Computer aided design system of technological processes of rocket and space technique; - Technology of assembling and testing of spacecraft; -Programming of technological processes for NCS machines; -.... 	<ul style="list-style-type: none"> - Technology of Structural Materials; -Applied engineering programs; - Construction mechanics of rocket and space technique; -Microprocessors and microprocessor systems in rocket and space technique; - Ballistics of aircraft; - Aeromechanics of aircraft; - Machine parts; - Construction and design of launch vehicles; - Ground equipment missile system infrastructure; -Satellite communication systems; - Spacecraft motion and control systems; -Technology of aircraft production; -Space systems for remote sensing of the Earth; -Power supply systems for space; -....

II. Education programs in aerospace engineering



4. Master's disciplines. 7M07146 - Space Engineering and Technology

University	Core subjects	University disciplines (63 cr.)	Elective disciplines (25 cr.)
L.N. Gumilyov Eurasian National University	-	<ul style="list-style-type: none"> - Higher School Pedagogy; - Management psychology; - High technology in engineering; - Foreign language (professional); - History and Philosophy of Science; - Aircraft diagnostics and testing; - Control system of small spacecraft; - Software for calculation of the orbital movement of spacecraft; - Models and methods of planning of experiments; - Modern planning and resource management of the enterprises of space industry; - Teaching internship; - Research practice. 	<ul style="list-style-type: none"> - Intelligent control systems and drives robots / Integrated miniaturization of microwave spaceborne radio equipment; - On-board systems of small spacecraft / CAD tools for design of systems on the chip; - Modeling of mechatronic, robotic systems / Electric, hydraulic drives of mechatronic and robotic devices; - Digital processing of signals on satellite systems / Microcontrollers and practical robotics; - Exploitation of ground send-receive segment / Design of Mechatronics and Robotics devices.

II. Education programs in aerospace engineering



5. Master's disciplines. 7M07147 - Earth remote sensing technologies

University	Core subjects	University disciplines (63 cr.)	Elective disciplines (25 cr.)
L.N. Gumilyov Eurasian National University	-	<ul style="list-style-type: none"> - Higher School Pedagogy; - Management psychology; - Methods of digital processing of aerospace images; - Foreign language (professional); - History and Philosophy of Science; - Geographic Information Systems (GIS); - Remote sensing technologies for solving forestry problems; - Global navigation satellite systems; - Remote sensing methods for solving agricultural problems; - Radar systems for remote sensing of the Earth; - Teaching internship; - Research practice. 	<ul style="list-style-type: none"> - Physical foundations of remote sensing of the Earth / Physical models in remote sensing; - Remote sensing technologies for creating cartographic products / Creating digital terrain models; - Earth remote sensing technologies for solving environmental problems/ Application of remote sensing technology in meteorology; - Application of remote sensing technologies in the tasks of geology and exploration of deposits/ Remote sensing methods for the oil and gas sector; - Application of remote sensing technologies in emergency situations/ Remote sensing methods for monitoring water bodies.

II. Education programs in aerospace engineering



6. Master's disciplines. 7M07148 - Aerospace engineering

University	Core subjects	University disciplines (63 cr.)	Elective disciplines (25 cr.)
L.N. Gumilyov Eurasian National University	-	<ul style="list-style-type: none"> - Higher School Pedagogy; - Management psychology; - Spacecraft design; - Foreign language (professional); - History and Philosophy of Science; - Technology of spacecraft production; - Programming of microcontrollers; - Design of on-board systems; - Launch vehicle design methods; - Rocket production technology; - Teaching internship; - Research practice. 	<ul style="list-style-type: none"> - Aerogasodynamics of aircraft/ Aerogasodynamics in rocket technology; - Composite materials in space technology/ Space materials science; - Modern computer technologies for designing aerospace vehicles/ Modern technical means of designing aircraft; - Modern technologies for the development of electronic systems/ Modern electronic components of aircraft; - Methods of designing rocket propulsion systems/ The finite element method in the design of aerospace vehicles.

II. Education programs in aerospace engineering



7. Doctoral disciplines. 8D07146 - Space Engineering and Technology

University	Core subjects	University disciplines (35 cr.)	Elective disciplines (10 cr.)
L.N. Gumilyov Eurasian National University	-	<ul style="list-style-type: none"> - Academic writing; - Science research methods; - Modern methods of spacecraft motion control ; - Teaching practice; - Research intership. 	<ul style="list-style-type: none"> - Technology of modern satellite construction / Intelligent control systems for space vehicles; - Modern methods of intelligent processing of satellite images/ Methods for data processing of radar systems for Earth remote sensing.

III. Challenges and Capacity-building



1. Capacity building activities in higher education

Type of capacity	Capacity building activities
Human (knowledge, skills of the teacher staff, etc.)	<ol style="list-style-type: none"> 1) Increasing the level of competencies and skills of teaching staff. 2) Supporting academic cooperation, mobility for students, staff and researchers.
Organizational (interaction, collaboration, and communication among people, internationalization)	<ol style="list-style-type: none"> 1) Strengthening the capacity of management, financing, entrepreneurial capacities and internationalization. 2) Strengthening link and collaboration with the private sector, promoting innovation and entrepreneurship.
Structural (policies, procedures, and practices, etc.)	<ol style="list-style-type: none"> 1) Improving the quality of the education and its alignment with labour market needs. 2) Developing new and innovative education programs.
Materials (fiscal resources, materials, and equipment, etc.)	<ol style="list-style-type: none"> 1) Strengthening the material and technical base, creating new training laboratories 2) Providing access for students and teaching staff to a database of educational and scientific literature.

III. Challenges and Capacity-building



2. Due to the fact that Kazakhstan is only developing the space industry, there are certain challenges in the educational process in aerospace engineering:

Type of capacity	Challenges in the Capacity building
Human (knowledge, skills of the teacher staff, etc.)	1) Deficiency of university lecturer with spacecraft design experience
Materials (fiscal resources, materials, and equipment, etc.)	1) Modern educational laboratories and equipment are needed 2) Need more specialized literature in their native language (few students know English) 3) Places of practice are needed where students could get acquainted with the real process of designing and manufacturing spacecraft

III. Challenges and Capacity-building



3. Partly Solution of the challenges

The **Consortium** consisting of the:

- L.N. Gumilyov Eurasian National University (Astana),
- National Company "Kazakhstan Gharysh Sapary"(Astana),
- Kazakh-French Company LLP "Galam"(Astana).

This **Consortium** pools the resources of its members to share human and material resources, and to pool academic and administrative resources. It creates conditions for high-quality education of students and create opportunities for capacity building.

III. Challenges and Capacity-building



4. What does the Consortium give us today?

Today, in accordance with the Consortium,

- part of the specialists of the two companies of the Consortium are involved in the educational process,
- part of the student classes are held at their base,
- students do their internship there,
- teachers of the department, students and specialists of the company carry out joint scientific research, etc.

Thus, the Consortium allowed us to launch the process of integrating the educational process with business.

IV. Conclusions and suggestions



1. Despite our certain successes in solving problems in the educational process, many issues of improving the quality of education and capacity building still remain unresolved.

Solving these issues requires large financial costs. Because the space industry itself is a high-tech industry.

Unfortunately, many developing countries are currently unable to allocate such funds from the national budget.

III. Challenges and Capacity-building



2. My suggestions:

1) I suggest considering the possibility of initiating a UNOOSA Program to support Emerging Space Nations universities in the implementing educational programs in the space industry. The goal of the Program should be financial support of the capacity building process of these universities.

2) If such a Program is initiated, create a working group headed by a UNOOSA representative to discuss the details of this Program and develop a roadmap.

3) Call for project proposals.



THANK YOU!

ABDIKUL ASHUROV

L. N. Gumilyov Eurasian National University,
Astana, Kazakhstan.

e-mail: ashurov_ae@enu.kz