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Space Industry in CIS Countries: Prospects of Cooperation

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Abbreviations

CIS – the Commonwealth of Independent States

DB – design bureau

ESA – European Space Agency

ERS(S) – earth remote sensing (system)

GLONASS – Global Navigation Satellite System

HFSN – high–frequency satellite navigation

ISS – international space station

IZMIRAN – Institute of Earth Magnetism, Ionosphere and Radiowaves Propagation

MCC – mission control centre

MTCR – Missile Technology Control Regime

NASA – National Aeronautics and Space Administration

NASU – National Academy of Sciences of Ukraine

NCSC – National Centre of Space Communications and Electromagnetic Compatibility of Radioelectronic Equipment

NSA (Kazkosmos) – National Space Agency of Kazakhstan

NSAU – National Space Agency of Ukraine

NSMS – National Space Monitoring System

NSSM – National System of Space Monitoring of Kazakhstan

RAS – Russian Academy of Sciences

SATC – Spacecraft Assembly and Testing Complex

SDBSE – Special Design Bureau of Space Equipment

Main conclusions

1. **An area of economic breakthrough**. The space industry is a prospective breakthrough area for the leading CIS economies. It has the greatest potential to generate multiple effects on related sectors (advanced metallurgy, mechanical engineering, chemistry, telecommunications, and many others), as it supplies them with new technical developments, which boost their efficiency. Particularly, as a result of the transfer of space technology from the military sphere to the civil sphere and the emergence of various commercial services related to the space industry.
2. **Common technical standards necessitate cooperation**. After the disintegration of the Soviet Union the assets and infrastructure of its immense space port were concentrated principally in three countries: Russia (production facilities, DBs and research centres), Ukraine (production facilities, DBs and research centres) and Kazakhstan (the Baikonur space port, research centres). All these parts of the former Soviet space port use *common technical standards*. This clearly necessitates cooperation between the three countries in the space industry.
3. **Russia is the key player in the CIS space market**. Kazakhstan and Ukraine pursue a number of projects. Russia has implemented extensive ongoing space programmes in the public, defence and civil commercial sectors, and new programmes are in the pipeline.

   Ukraine is also pursuing some ambitious space projects. Until 2010, the EU supported these, essentially in order to fuel competition with Russia. In other words, these initiatives were driven principally by political considerations rather than economic necessity. Ukraine is currently seeking cooperation with Russia, bearing in mind the common technical standards and the high capital intensity of space projects.

   Another active player in the global space market is Kazakhstan: the country embarked on building of space infrastructure and manufacture of satellites for various purposes. These activities are oriented not only towards Russia, but also France, Germany, Taiwan and other countries.

   Belarus, Azerbaijan, Uzbekistan and Turkmenistan have also shown some interest in space projects. It is likely that these countries will become consumers of the services provided by Russia, Ukraine and Kazakhstan.
4. **High capital intensity and a lack of private capital are major impediments**. The development of space industry in the CIS countries is restricted by its enormous capital intensity and investment requirements. The situation was aggravated even further by the global economic crisis, as the CIS countries had to make cuts in public spending, particularly, for space activities. These cuts were especially strict in poorer economies such as Tajikistan, Armenia, Uzbekistan, Kyrgyzstan and Moldova.

   Private capital plays a negligible role in the CIS space industry. This restricts both the economic efficiency of space projects and the adoption of new technologies. The lack of private investments in the industry can be explained by the very high levels of capital and tight security restrictions.
5. **Security restrictions impede economic cooperation**. The main impediments to cooperation between CIS countries in the space industry are:

   - *legal barriers, which restrict transfer of technology between countries*. Russia cannot supply its space technology to Kazakhstan or Ukraine for security reasons; as a result, their joint projects fall short of planned goals, not to mention missed development opportunities for the space industry in the latter two countries. The same barriers restrict the training and cooperation of research personnel;

- *differences in taxes and customs standards*. The lack of uniformity in the CIS countries' tax systems creates financial problems for joint space projects (assessment of each party's contribution, procurement of equipment, etc.);
- *differences in technical and economic development levels*. Space programmes can be afforded only by countries with higher levels of socioeconomic development (Russia, Kazakhstan and Ukraine), and poorer countries (Tajikistan, Armenia, Uzbekistan, Kyrgyzstan and Moldova) rarely take part in joint space projects.

6. **The CIS countries should pursue full integration into the global space market, whilst the existing ties between them should be preserved and strengthened**. We see no potential for a 'regional' market of space products and services, as the only way forward is to cater to the global market. At the same time, the CIS countries should adopt joint approaches towards the above problems, if they are to maintain and develop their position as powerful players of the global market of space industry services.

Introduction

Space activities evolved from being a product of global scientific and technical progress into its main driving force. Over time, the ultimate technology created for the space industry finds its way into other sectors.

The space industry directly depends on the development of industrial and telecommunications technologies. Its scientific and production base has long become an integral part of the global economy, and is closely associated with other industries. In other words, space activities generate profuse multiple effects on an economy.

The main space activities are fundamental and applied studies; design, research and development work; production of spacecraft, boosters and ground equipment; launch services; space telecommunications; earth remote sensing (ERS); satellite navigation services; and manned space missions.

The space market is a large and rapidly growing segment of the world technology market. The main engines of modern economic progress are innovative technologies in microelectronics, digital information systems, software, telecommunications, composite materials, etc. Most of these developments originated in the space industry. Space activities are traditionally divided into military space activities and open civilian and commercial space activities.

The world space market evolved under the influence of internationalisation of space activities, post–industrialisation, and globalisation of the world economy. An analysis of the space industry allows us to identify the following sustained processes:

- the number of countries employing space industry services for their research programmes steadily increases;
- different countries tend to implement space projects jointly. For example, NASA closely cooperates with the European Space Agency, which comprises 14 countries;
- developing countries are interested principally in enhancing their applied space systems, such as telecommunications;
- cost–effectiveness requirements for space studies and R&D necessitate the "dual use" of space facilities, i.e. civil facilities (including commercial ones) are used for military purposes and vice versa;
- in all countries, initial space exploration and utilisation projects are financed by governments;
- there is a rapid growth in both space activities and the share of private investments in them;
- the increasing competition between countries and corporations leads to integration of space equipment and services markets, with individual companies forming large international corporations, unions or consortia.

The purpose of this review is to give an insight into the development of space activities in the CIS countries and cooperation between them in this sphere, particularly:

- to review the current status of the space industry (governmental agencies, space programmes, ongoing projects, and cooperation within the CIS and with other countries);
- to identify the main impediments to cooperation in the space industry, and to propose solutions;
- to assess the prospects of space industry development, cooperation between CIS countries, and their integration into the global space market.

To sum up, we focus this report on the prospects, potential, and limitations of economic cooperation and integration in the CIS space industry.

1. Space activities in CIS countries: current status and prospective areas for cooperation

In the CIS, space activities are the domain of the public sector. The CIS countries have national space agencies and implement public space programmes (see Annex 1). Russia implements its own space projects and is more integrated in the world space market than any other CIS country. Ukraine and Kazakhstan are currently in search of partnerships for the development of their space industry. They maintain their focus on Russia, as these three countries have common technical standards. In other CIS countries space activities are still at the stage of strategy and programme formulation, largely due to a lack of finance. Details of the most important space projects in the CIS are given in *Annex 2*.

1.1. Scientific and technical studies

Geo–information systems

Russia, Ukraine, Kazakhstan and Belarus are making joint efforts to adapt their existing geo–information systems to particular applications. However, no formal agreements on cooperation in the development of common geo–information systems are in place.

Scientists and specialists of CIS space agencies and related research institutions have broad scientific and business ties with colleagues from other countries. For example, the Scanex Scientific & Technology Centre of Russia supplies the latest hardware and software complexes developed for the receiving and processing of satellite images. The RAS Institute of Space Studies conducts joint studies with other research institutions from the CIS countries.

Satellite navigation

Russia is implementing the *Global Navigation System* federal target programme (approved by the Government Resolution no. 587 dated August 20, 2001; the customers are various state bodies and private companies; the coordinator is the Federal Space Agency (Roskosmos).

The purpose of this programme is to assist the development and efficient use of the global navigation satellite system (GLONASS) by implementing advanced technology, thus furthering economic development and national security and maintaining Russia's leadership in satellite navigation.

Under the Global Navigation System programme satellite communications services are made available to the private sector and other CIS countries (Ukraine and Kazakhstan).

The Gonets Satellite System company designs and operates low–orbit communications satellites.

At the same time, the Space Agency of Ukraine is creating a national satellite communications system based on similar Western systems (the Lebed satellite). In Kazakhstan, applied studies in this area are being conducted by the National Space Studies and Technology Centre of the Space Agency Kazakhstan (Kazkosmos). Essentially, this is a new industry for Kazakhstan, as its projects to create spacecraft are still at the initial stage. The country will be able to avail itself of joint satellite communications projects only if agreements on joint projects to develop spacecraft production are secured. For example, a pilot project to create a multifunction personal satellite communications system by integrating the resources of the Gonets and Orbcomm low–orbit satellites was implemented jointly with Gonets Satellite System as part of an agreement between Roskosmos and Kazkosmos.

Meteorology

Meteorological studies in the CIS countries are subject to security regulations. No data on joint projects in this area is available, as any related equipment is manufactured by classified facilities.

Materials studies

There is a large volume of scientific and practical materials studies inherited from the former Soviet Union. At present, Russian and Ukrainian specialists are building on them aboard the international space station and by using special-purpose satellites.

In Kazakhstan, the National Space Studies and Technology Centre studies the properties of alloys intended for space equipment, which can be achieved in space (zero-gravity) conditions. These studies include experiments to be performed in the Russian segment of the ISS by Kazakh cosmonauts. The head organisation in the Russian party is the Central Research Institute of Mechanical Engineering, and the second contractor is the Korolyov Energiya Rocket and Space Corporation.

Ground-based and space geodynamic and geophysical monitoring

In Russia, Earth monitoring is the domain of a number of research institutions, such as the RAS Shirshov Oceanology Institute and the RAS Gamburtsev Earth Physics Institute.

Ground-based and space geodynamic and geophysical monitoring of fossil fuel deposits in the Caspian and littoral areas is also a new activity in Kazakhstan. These studies are being conducted by the National Space Studies and Technology Centre in conjunction with the Shirshov Institute and the Gamburtsev Institute.

Biological studies

Biological and medical studies in zero-gravity conditions have been conducted by Russian and Ukrainian cosmonauts since 1990. Under the Bion project, they study the effects of zero gravity on living organisms, physiological adaptation mechanisms, and combined effects of zero gravity and other factors on humans.

In Kazakhstan, biological and medical studies and space experiments are being conducted by the National Biotechnology Centre of the Ministry of Education and Science with Russian partners (e.g. the RAS Institute of Medical and Biological Problems) as part of Kazakh space programmes on board the Russian segment of the ISS.

Fundamental studies

Russia is a leader in fundamental space studies in the CIS. The research institutions and immense scientific potential inherited from the Soviet Union put this country in a position to plan dozens of research projects, some continuing until 2020. These include studies of the Sun (Koronas-Foton), the Moon, Mars, Phobos, Venus, Mercury, Jupiter's satellites and other Solar System bodies and other galaxies (the Ultraviolet World Space Observatory, Radioastron, Astronometriya, and others).

Kazakhstan and Ukraine conduct fundamental studies of adjacent and deep space in close cooperation with other CIS countries. For example, the Kazakh Astrophysics Institute and the NSAU Institute of Space Studies are participating in the RAS project to build the VKO-UF orbital telescope for the World Space Observatory.

The Kazakh Astrophysics Institute also conducts a number of applied studies. Its optic telescopes and the quantum and optic system of the command and measurement complex of the Saryshagan centre are employed in the creation of a joint Russian-Kazakh space debris monitoring service and software for spacecraft identification by coordinate and non-coordinate data. Modernisation of the related research and experimental base is being carried out in partnership with the Russian Research Institute of Space Instrument Engineering.

The Kazakh Ionosphere Institute has a unique experimental base and is playing an active role in an international cosmic and solar radiation study. Its partners are the Russian Research Institute of Space Instrument Engineering and the Special Design Bureau of the Moscow Energy Institute.

A radio–astronomical observatory is being constructed in Uzbekistan in partnership with the Russian Research Institute of Space Instrument Engineering; it will be commissioned in the next few years.

Space studies of earthquake precursors

Projects to develop spacecraft and instruments for studying earthquake precursors are of immediate interest to the CIS countries. This work began in the Soviet period, and some significant developments were achieved by scientists from Russia, Ukraine and Kazakhstan. Russia is represented in these projects by the IZMIRAN and Tekhnologiya Geoscan. Recently, scientists from France who possess a satellite suitable for studying earthquake precursors joined this research.

Presently the French satellite is the only shared instrument available for the study of earthquake precursors. In future it will be replaced by Russian, Ukrainian and Kazakh satellites, which will be built under the respective national programmes.

Under the programme of Russian–Ukrainian cooperation in space exploration and use (2007–2011), a system of short–term earthquake forecasts and emergency monitoring system will be developed.

The *Programme for Accelerated Industrial and Innovation Development of Kazakhstan until 2014* includes plans to conduct research and R&D work with a view to building a space system capable, *inter alia*, of studying earthquake precursors based on ionosphere parameters. This system is being developed by the National Centre of Space Engineering and Technology

in partnership with the RAS Institute of Earth Magnetism, Ionosphere and Radiowaves Propagation (IZMIRAN) and Geoscan Tekhnologiya of Russia, the Yuzhnoye State Design Bureau of Ukraine and the Space Agency of France.

Retraining and qualification upgrading

The only retraining and qualification upgrading centre for space industry research and technical personnel in the CIS is the Russian Research, Training and Innovation Complex of the Aerospace Industry. Cosmonauts are trained by the Centre of Cosmonaut Training in Moscow.

Recently, Kazkosmos opened a retraining and qualification upgrading centre for space industry specialists with direct support from the Russian Research, Training and Innovation Complex of the Aerospace Industry. The latter coordinates the related activities of Russian schools and scientific institutions.

1.2. Space mechanical engineering and cooperation in production

Boosters

In the former Soviet Union, booster production was concentrated in Russia and Ukraine, and eventually these facilities became property of these two countries.

The most important producers of boosters and spare parts for them in Russia are:

- Korolyov Energiya Rocket and Space Corporation;
- Makeyev State Rocket Centre;
- Glushko Energomash Research & Production Group;
- TsSKB–Progress State Research & Production Space Rocket Centre;
- Khrunichev State Research & Production Space Centre;
- Lavochkin Research & Production Group.

Proton and Angara boosters (the latter will be used in the new Baiterek booster complex) are produced by the Khrunichev State Research & Production Space Centre, and Soyuz boosters by the Progress Special Design Bureau. A number of Russian and Ukrainian companies act as contractors, notably:

- Chemical Automatics Design Bureau (designs power packages);
- Voronezh Mechanical Works (supplies power packages);
- Isayev Design Bureau of Chemical Mechanical Engineering (supplies power packages);
- Lavochkin Research & Production Group (supplies nose fairings);
- Pilyugin Research & Production Centre of Automatics and Instrument Engineering (supplies control system equipment);
- Kuznetsov Research Institute of Applied Mechanics (supplies control system equipment);
- Korolyov Energiya Space Rocket Corporation (supplies upper stages);
- Research Institute of Control Devices (supplies gyroscopic instruments for upper stages); and
- Research & Production Company comprising Khartron–Arkos, Khartron–Plant, Khartron–Plazmed, Khartron–Yukom and Khartron–Konsat (supplies control systems).

After the disintegration of the Soviet Union, Ukraine owns the second largest booster production facilities (the Yuzhnoye State Design Bureau).

Subject	Parties	Description
Geo–information systems	Russia, Ukraine, Kazakhstan, Belarus	Joint project to adapt existing systems to individual applications
Satellite navigation	Russia (Roskosmos, Global Navigation System federal target prigramme)	Satellite navigation
Telecommunications	Russia (Roskosmos, Gonets Satellite System), Kazakhstan (Kazkosmos)	Pilot project to build a multifunction personal satellite communications system using the resources of low–orbit Gonets and Orbcomm satellites
Materials studies	Kazakhstan (the National Centre of Space Studies and Technology), Russia (the Central Research Institute of Mechanical Engineering, Korolyov Energiya Rocket Space)	Space experiments aboard the Russian segment of the ISS to study metal alloys intended for space equipment
Ground–based and space geodynamic and geophysical monitoring	Kazakhstan (the Institute of Space Studies), Russia (the Shirshov Oceanology Institute and the RAS Gamburtsev Earth Physics Institute)	Ground–based and space geodynamic and geophysical monitoring of fossil fuel deposits in the Caspian and littoral areas
Biological and medical studies	Kazakhstan (the National Biotechnology Centre of the Ministry of Education and Science), Russia (the RAS Institute of Medical and Biological Problems)	Biological and medical studies and experiments aboard the Russian segment of the ISS under Kazakh space programme
Fundamental studies	Kazakhstan (the Astrophysics Institute), Russia (RAS)	Project to build the VKO–UF orbital telescope
	Kazakhstan (the Ionosphere Institute), Russia (the Research Institute of Space Instrument Engineering and Special Design Bureau of the Moscow Energy Institute)	International cosmic and solar radiation project
	Uzbekistan, Russia (the Research Institute of Space Instrument Engineering)	Construction of a radio–astronomical observatory
Space study of earthquake precursors	Kazakhstan, Ukraine, Russia (IZMIRAN and Tekhnologiya Geoscan), France	Study of space factors relating to earthquake precursors
Retraining and qualification upgrading	Kazakhstan (the National Centre of Space Studies and Technology), Russia (the Russian Research, Training and Innovation Complex of the Aerospace Industry	A retraining and qualification upgrading centre for space industry specialists in Kazakhstan

Table 1.1.
The main ongoing space research projects in the CIS

The Makarov Yuzhny Mechanical Engineering Works produces Tsiklon, Dnepr and Zenit boosters in partnership with a number of Russian and Ukrainian companies, notably:

- Glushko Energomash Research & Production Group (supplies power packages);
- Lavochkin Research & Production Group (supplies nose fairings);
- Pilyugin Research & Production Centre of Automatics and Instrument Engineering (supplies control system equipment);
- Korolyov Energiya Space Rocket Corporation (supplies upper stages);
- Yangel Yuzhnoye State Design Bureau (provides technical supervision services and acts as the head design bureau); and
- Research & Production Company comprising Khartron–Arkos, Khartron–Plant, Khartron–Plazmed, Khartron–Yukom and Khartron–Konsat (supplies control systems).

Ukraine's main rocket projects are:

- the Dnepr project to convert the intercontinental ballistic missile RS–20 / SS–18 (known as "Satan") into Dnepr three–stage booster with the maximum use of decommissioned systems, elements and infrastructure of the experimental complex at the Baikonur space port.

Work on the Dnepr rocket space port began in 1992. To this end, the Russian–Ukrainian space company Kosmotrans was founded; it is responsible for the production and commercial use of the booster. Preparation for launch and adaptation of the booster to various spacecraft were contracted to the Yuzhnoye State Design Bureau, Makarov Yuzhny Mechanical Engineering Works and Khartron.

A Dnepr booster was launched for the first time in April 1999. The former RS–20 missile, which had been on alert for more than twenty years placed a satellite into orbit with a high degree of accuracy.

Since 1999 there have been ten commercial launches of the Dnepr, with over thirty spacecrafts owned by different countries placed into orbit. In the near future, work to create a new space tug will be finalised, and the capacity of the Dnepr will be enhanced even further.

Under the Zenit project, the Makarov Yuzhny Mechanical Engineering Works develops space shuttles of two types: Zenit–2 (operated from 1985–2009) and the modified Zenit 3SL (operated since 2008).

The National Space Agency of Ukraine (NSAU) and the Space Agency of Brazil intend to produce new Tsiklon–4 boosters based on Tsiklon–3 and Arian, using the capacity of Yuzhnoye State Design Bureau and Yuzhmash. The new booster will be powered by a modification of the third stage of Tsiklon–3 and will use the enhanced–efficiency Arian control systems; in addition, some nose fairing developments from Brazilian specialists will be incorporated.

Kazakhstan does not participate in any booster production ventures.

Space equipment

Russian companies produce the lion's share of all space equipment in the CIS. This can be explained by the fact that most of the former Soviet mechanical engineering facilities are concentrated in Russia.

Kazakhstan does not produce equipment for ground infrastructure, e.g. launching complexes, but purchases equipment for the Baiterek booster complex and participates in related design work. The construction of Baiterek is contracted to Russian companies; the head organisation is the Khrunichev State Research & Production Space Centre, and the others are:

- Barmin Design Bureau of General Mechanical Engineering
- Design Bureau of Heavy Engineering;
- Central Design Bureau of Vehicle Engineering;
- Ground Space Infrastructure Operation Centre;
- 31st State Design Institute of the Satellite Communications;
- Ipromashprom;
- Vympel Experimental Design Bureau.

The National Centre of Space Studies and Technology conducts design work to develop:

- a synchronised network of GPS receivers and a data reception and processing complex for studying the stress–strain state of the earth's crust (jointly with the RAS Shirshov Oceanology Institute and the RAS Gamburtsev Earth Physics Institute);
- a system of ground and space monitoring of the stress–strain state of the upper levels of the earth's crust in industrial regions (jointly with the RAS Shirshov Oceanology Institute and the RAS Gamburtsev Earth Physics Institute);
- a system of engineering and geological satellite monitoring and comprehensive analysis of the stress state of the earth's crust based on satellite geodetic data and ERS (jointly with the RAS Shirshov Oceanology Institute and the RAS Gamburtsev Earth Physics Institute);
- an expert and analytical centre for processing and studying satellite optical and trajectory data (jointly with the Moscow Research Institute of Space Instrument Engineering);
- software and mathematical support for the ground customer segment of a high–precision satellite navigation system (jointly with the Moscow Research Institute of Space Instrument Engineering of Russia and the Research Institute of Radio Metering of Ukraine);
- software and mathematical support and a simulation model for spacecraft control systems and the imitation modelling of space systems (jointly with the Central Research Institute of Mechanical Engineering).

Infrastructure

After the disintegration of the Soviet Union, the Baikonur space port became the property of Kazakhstan. However, in 1994 pressing social problems and a lack of funds and qualified personnel pushed the country to lease the facility to Russia for twenty years. In 2004 the lease was extended until 2050. The annual leasing fee is $115 million.

Since the execution of the Baikonur lease agreement, Russia and Kazakhstan have held annual talks.

Thus, on September 24, 2009, the city of Baikonur hosted the 12th session of the Russian–Kazakh intergovernmental committee on Baikonur, at which the following matters were settled:

- utility rates were agreed and a joint working group responsible for prompt solution of power supply problems was set up;
- a draft agreement on medical services for space port personnel and the population of Baikonur, Akai and Tyuratam was approved;
- as part of the local environmental effort, the parties agreed to jointly plan inspections of unauthorised waste utilisation sites and contaminated land plots within the launch area;
- common conceptual approaches to some key issues were agreed, e.g. recognition and accounting of inseparable improvements made to leased facilities by the Russian party;

- joint measures to improve general education and secure pension rights of the residents of Baikonur were agreed;
- first practical steps were made to create the Baiterek booster complex on the basis of the Baikonur space port.

Russia has an operational launching complex in Kapustin Yar, Arkhangelsk Oblast, which is used to launch low-orbit ERS and communications satellites. In addition, the new Vostochny launch site will be constructed in Amur Oblast; this will be used to put manned spacecraft and satellites into orbit after the expiry of the Baikonur lease agreement.

Belarus commenced the construction of a mission control station (MCC) as part of its long-term space programme aimed at expanding cooperation with Roskosmos. This MCC will enable the country to make fuller use of a prospective group of Russian-Belarusian ERS satellites.

Satellites

The main Russian manufacturers of communications satellites are:

- Reshetnyov Institute of Communications Satellites;
- Khrunichev State Research & Production Space Centre;
- Korolyov Energiya Rocket and Space Corporation.

Kazakhstan does not produce satellites, but intends to start a joint venture to this end.

In order to develop the national satellite communications and broadcasting system, the Kazakh Government issued a resolution dated December 30, 2003 on the construction and placing into orbit the Kazsat-1 geostationary satellite, as well as the establishment of the National Centre of Space Communications and Electromagnetic Compatibility of Radioelectronic Equipment (NCSC). This company was authorised to operate national communications and broadcast satellites and a respective MCC, and to determine the electromagnetic compatibility of radio-electronic equipment and civil high-frequency devices.

The same resolution named the Khrunichev State Research & Production Space Centre as the contractor for construction and launch of the Kazsat-1 satellite.

The contract on creating the Kazsat-1 space system was signed on January 7, 2004 between the Khrunichev State Research & Production Space Centre and the National Innovation Fund of Kazakhstan. The Kazakh Government allocated $65 million to this, including $7 million for the purchase of equipment for a ground control and monitoring centre in Akkola.

Kazsat-1 was successfully placed into geostationary orbit on June 18, 2006 and put into regular operation in October 2006. Control of the satellite and provision of its resources to ground communications operators was the responsibility of the NCSC. Over 18 Kazakh communications and broadcasting companies leased the satellite's channels and sold space communications services to end users.

On June 8, 2008, as a result of a contingency event, major problems occurred in the control system of Kazsat-1. The Khrunichev State Research & Production Space Centre made unsuccessful attempts to restore control over the satellite, and eventually Kazsat-1 was de-orbited and shut down. The NCSC is currently seeking insurance benefit in connection with the loss of the satellite with technical support from the Khrunichev State Research & Production Space Centre.

The second national geostationary communications and broadcasting satellite Kazsat-2 is now in development. The NCSC and the Khrunichev State Research & Production Space Centre signed an agreement to that effect in October 2006. As at March 1, 2010, the Kazakh party had discharged 90% of its financing obligations.

The design concept for Kazsat–2 is principally identical to that of Kazsat–1, and therefore no major changes are possible. With this in mind, Kazkosmos proposed to make improvements to the control system of the new satellite. Particularly, a number of control devices (gyroscopes, star trackers, solar sensors, etc.) were replaced by foreign–made products.

The parties agreed to postpone the launch of Kazsat–2 until the end of 2010.

In order to develop a modern facility for the design, assembly and testing of spacecraft as part of the Special Design Bureau of Space Equipment (SDBSE) and the Spacecraft Assembly and Testing Complex (SATC), Kazakhstan decided to choose a strategic partner from the following candidates: the Reshetnyov Applied Mechanics Research and Production Group, the Korolyov Energiya Rocket and Space Corporation, Khrunichev State Research & Production Space Centre (Russia), Yuzhnoye State Design Bureau (Ukraine), EADS Astrium and Thales Alenia Space (France), MDA (Canada), and NEC (Sumitomo, Japan).

EADS Astrium was selected and came up with a package solution to the following tasks:

- creating an ERS system for the SDBSE and the SATC;
- technology transfer and specialist training in the design, assembly and testing of spacecraft;
- enhancing the commercial efficiency of projects by promoting the services of the SATC and the ERS system in the global space market.

A Kazakh–French joint venture was established with the mandate to build, equip and commission the SATC in Astana by the end of 2012. In parallel with that, EADS Astrium is training Kazakh specialists in the course of joint design, assembly and testing of the ERS system for Kazakhstan, which will include two optic ERS satellites (of high and medium resolution), a ground satellite control centre and a target complex for the receiving, processing and distribution of satellite images. In addition, the French party is assisting Kazakhstan's entry into the global market for space imagery through its affiliates Spotimage and Infoterra, thus ensuring fuller use of the resources of the new ERS system.

In 2006 Ukraine launched its ERS satellite Sich–1. The satellite was placed into orbit from Baikonur by a Dnepr booster.

The launch of the new Sich–2 satellite was scheduled for April 2010 (also by Dnepr from Baikonur), but postponed until 2011 due to financial problems. This satellite is intended for optical–range Earth studies, and is equipped with a domestically made optical scanner with a resolution of 6–7 m.

Ukraine also intends to launch its first communications satellite Lebed in September 2011. The National Space Agency of Ukraine is implementing this programme in partnership with the Yuzhnoye Design Bureau, Yuzhmash, Khartron, Arsenal and Canadian specialists.

The NSAU started a project entitled *GMES-Ukraine* to create the Ukrainian segment of GMES. The foundation for the country's participation in this initiative was laid by leading national space industry institutions, universities and the NSAU in 2003–2008. The preparatory phase was coordinated by the National Academy of Sciences of Ukraine (NASU), NSAU Institute of Space Studies under a contract with the NSAU. Negotiations between the NSAU and European Space Agency are now under way.

Belarus, in partnership with Roskosmos, is developing a new high–resolution ERS satellite, the so–called "flying telescope", which will be placed into orbit in 2015.

In September 2008, Russia and Uzbekistan approved an intergovernmental programme of peaceful Earth and space studies; it includes, *inter alia*, provision of ERS services by Russia to Uzbekistan.

At the end of 2009 the National Aerospace Committee of Azerbaijan finalised the design of a national communications and TV broadcasting satellite. It is planned that this satellite will be placed into orbit from Baikonur by a Zenit booster as part of the Land Launch project.

On September 4, 2009, the Cabinet of Ministers of Turkmenistan adopted a resolution to develop the first Turkmen communications satellite with a view to furthering the country's IT development.

Table 1.2.
The main space mechanical engineering projects in the CIS

Subject	Parties	Description
Boosters	Ukraine, Russia (Glushko Energomash Research & Production Group, Lavochkin Research & Production Group, Pilyugin Reserch & Production Centre of Automatics and Instrument Engineering; Korolyov Energiya Rocket and Space Corporation; Yangel Yuzhnoye State Design Bureau, Khartron–Arkos, Khartron Plant, Khartron Plazmed, Khartron–Yukom, Khartron –Konsat)	Production of the Tsiklon, Dnepr and Zenit boosters
	Ukraine, Russia (Chemical Automatics Design Bureau, Voronezh Mechanical Works; Isayev Design Bureau of Chemical Mechanical Engineering; Lavochkin Research & Production Group; Pilyugin Reserch & Production Centre of Automatics and Instrument Engineering; Kuznetsov Research Institute of Applied Mechanics; Korolyov Energiya Rocket and Space Corporation; Research Institute of Control Devices, Khartron–Arkos, Khartron Plant, Khartron Plazmed, Khartron–Yukom, Khartron –Konsat)	Production of Proton and Angara boosters (the latter will be used in the Baiterek booster complex)
	Ukraine (Yuzhnoye State Design Bureau and Yuzhmash), Brazil (Space Agency of Brazil)	Design and production of the new Tsiklon–4 booster based on Tsiklon–3 and Arian
Space equipment	Kazakhstan (Baiterek), Russia (Khrunichev State Research & Production Space Centre)	Design of launch and technical areas for Baiterek
Infrastructure	Russia, Kazakhstan	Operation of Baikonur
Satellites	Kazakhstan, Russia (Khrunichev State Research & Production Space Centre)	Design and launch of the Kazsat–1 and Kazsat–2 geostationary communications and broadcasting satellites
	Kazakhstan, France (EADS Astrium)	Construction of a satellite assembly and testing complex (SATC) in Kazakhstan
	Ukraine (NSAU)	The launch of the new Ukrainian ERS satellite Sich–2
	Ukraine (NSAU, Yuzhnoye Design Bureau, Yuzhmash, Khartron, Arsenal), Canada	The launch of the first communications satellite Lebed
	Ukraine (NSAU)	Participation in GMES; the *GMES-Ukraine* project to develop the Ukrainian segment of GMES

1.3. Use of space facilities and technology

Launch services

The CIS countries cooperated in two launch services projects: the *Land Launch and the Sea Launch*.

At present, only the *Land Launch* project is operational, and launch services are being provided at Baikonur using Zenit–1 and Zenit–3 SL boosters. This project is being implemented by Russia in partnership with Ukraine (the Russian–Ukrainian joint venture International Space Services).

This joint venture received a total of $25 million in investments for the modernisation of the Zenit booster complex, in particular, the launch and technical areas located at Baikonur. At present, the design work is under way. The contractors are the leading Russian and Ukrainian companies: the Yuzhnoye State Design Bureau, the Makarov Yuzhny Mechanical Engineering Works, and the Korolyov Energiya Rocket and Space Corporation. After modernisation, Zenit–2 and Zenit–3 SL boosters will be made more competitive on the international space services market.

The second project, the *Sea Launch*, ended in failure due to a lack of demand and low profitability. The company announced its bankruptcy and financial reorganisation on June 22, 2010, following Boeing's withdrawal from the project.

The *Sea Launch* began in 1995, when the Yangel Yuzhnoye State Design Bureau and the Makarov Yuzhny Mechanical Engineering Works entered into a joint venture with Boeing Commercial Space Company (USA), Kvaerner (Norway) and the Korolyov Energiya Rocket and Space Corporation (Russia). The project was prepared and implemented at arm's length, i.e. with no public funding; however, state agencies supervised the project and provided institutional assistance.

It was at that time that the concept of using a sea platform for commercial launches from the equatorial zone using Zenit–3 SL boosters was first voiced and elaborated. The main advantage of a floating launch facility is its equatorial position, which enables the booster to make maximum use of the earth's rotation effect, resulting in lower costs of placing payload into orbit. The *Sea Launch* programme targeted principally high–orbit geostationary satellites.

Kazakhstan, the owner of the world's largest Baikonur space port, does not provide launch services, as the complex is leased to Russia until 2050. However, the country does intend to secure a position in the launch services market through its title to Baikonur, as is indicated in the State *Programme for Accelerated Industrial and Innovation Development of the Republic of Kazakhstan until 2014*.

Practical steps to expand Kazakhstan's involvement in the development of Baikonur and launch services include the following projects:

1) to create the Baiterek booster complex as a replacement for Proton boosters, which use environmentally dangerous fuel components, in accordance with the Russian–Kazakh intergovernmental agreement dated December 22, 2004. The Kazakh party will finance the construction of the launch and technical areas with all ground equipment, and the Russian party will finance the production of Angara boosters;
2) to purchase the share of the Russian–Ukrainian company International Space Services in the *Land Launch* project (which uses Zenit boosters) and invest in:
    - modernising of Zenit boosters in order to improve their power characteristics,
    - allocating new drop areas within the range of Zenit boosters, which is necessary in order to increase their payload capacity;

- building a technical area for preparation and fuelling of boosters, as well as assembly and testing of nose fairings;

3) to purchase shares in the Russian–Ukrainian company Kosmotrans, which implements the Dnepr commercial programme, and invest in:
   - allocating new drop areas within the range of Dnepr boosters, in order to enable them to place payload into sun–synchronous orbits,
   - constructing a technical area for preparation and fuelling of boosters, and assembly and testing of nose fairings (to service both Zenit and Dnepr boosters);
4) to build an international space centre at Baikonur, which will coordinate various programmes and projects financed by Kazakhstan and international commercial programmes using Baiterek, Zenit and Dnepr (in partnership with Kazakhstan, Russia and Ukraine).

To date, there are no political barriers to the above projects, as all issues of Kazakhstan's participation in the operation of Baikonur were settled in the 1994 lease agreement. In accordance with clause 6.7 of the agreement, Russia is obliged to provide assistance to Kazakhstan (on a contractual basis) in implementing space projects and constructing common facilities. Clause 8.1 provides that Russia has the preemptive right to participate in joint projects and related programmes, and international and commercial programmes at Baikonur. Kazakhstan's participation is subject to availability of finance, i.e. the country is free to join any projects that it is prepared to pay for.

Although the issue of financing Kazakhstan's participation in Baiterek was settled in 2004, this project is still at the design phase. The detail design should have been completed by the end of 2009, but the completion date has been postponed until 2012 for technical reasons.

There are currently very favourable conditions for Kazakhstan to join the *Land Launch* project.

First, the country can become a cofounder of this private international company without any administrative barriers and, being in a position to secure direct government support, take the lead in its management.

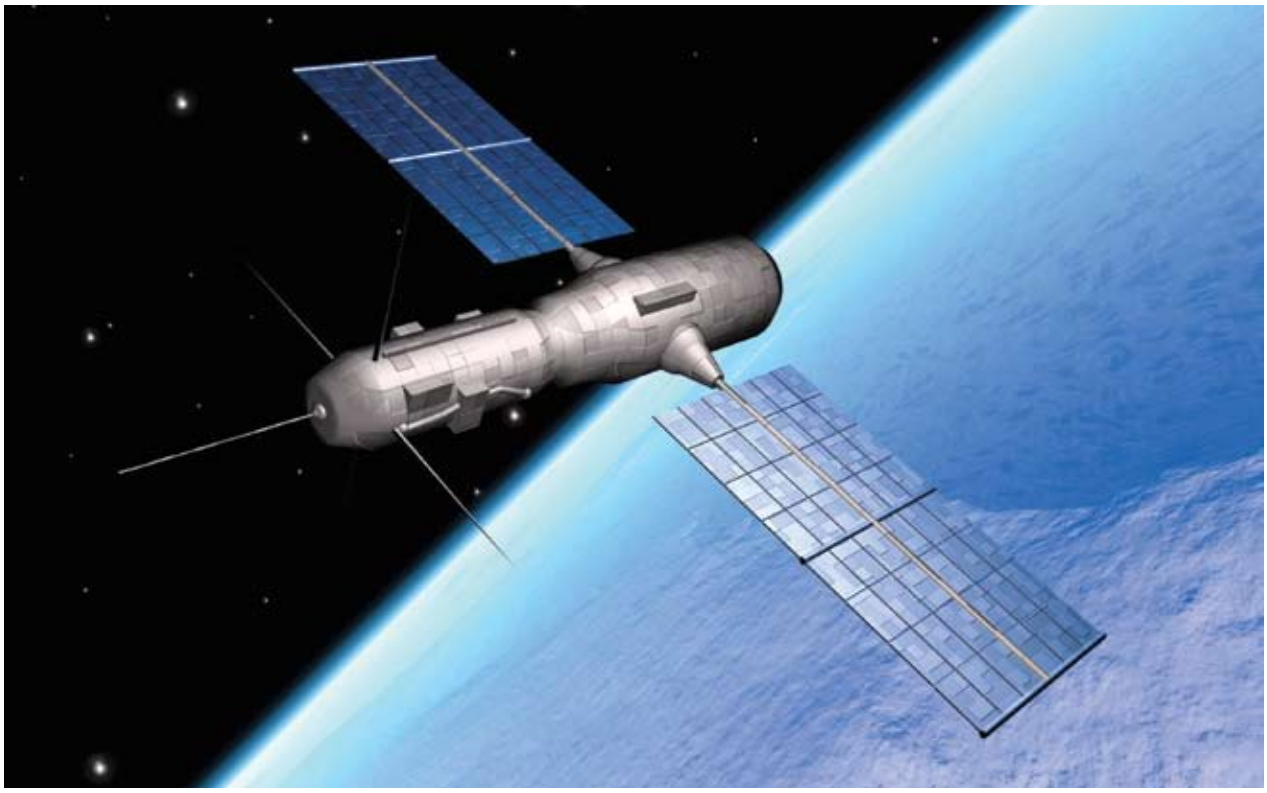
Second, the government stake will raise the project's status dramatically and open new vast commercial opportunities, which make Zenit boosters even more competitive internationally.

Third, Kazakhstan will participate in managing both the technical operations and the commercial segment of the project, and create new jobs at the launch complex and production facilities.

Fourth, in view of Russia's forthcoming withdrawal from Baikonur, the development of commercial space services by International Space Services will determine the future of the complex.

Russia will have the following benefits from Kazakhstan's participation in *Land Launch*:

- International Space Services' working capital will be replenished with the proceeds of the shares sale;
- the project's status will be raised, and new commercial opportunities for International Space Services will open;
- Russian companies participating in the production of Zenit–3SLB boosters (Energomash, Pilyugin Research & Production Centre of Automatics and Instrument Engineering, Lavochkin Research & Production Group and Energiya) and provision of launch services (Ground Space Infrastructure Operation Centre, Design Bureau of Heavy Engineering, Design Bureau of Chemical Mechanical Engineering, and Vympel) will have guaranteed orders from International Space Services;



- income from Zenit commercial launches will be allocated for the maintenance and development of production and technical areas of Baikonur and expansion of international cooperation;
- the need for federal allocations to Baikonur will be reduced;
- new opportunities for mutually beneficial cooperation with Kazakhstan will open;
- orders for satellite launches under Kazakhstan's space programme will envisage the use of Zenit boosters.

Benefits for Ukraine will be similar:

- International Space Services' working capital will be replenished with the proceeds of the sale of shares;
- the project's status will be raised, and new commercial opportunities for International Space Services will open;
- Ukrainian companies participating in the production of Zenit–3SLB boosters (Yuzhnoye State Design Bureau and Yuzhmash) will have guaranteed orders from International Space Services;
- income from Zenit commercial launches will be allocated for the maintenance and development of production and technical areas of Baikonur and expansion of international cooperation;
- new opportunities for mutually beneficial cooperation with Kazakhstan will open;
- orders for satellite launches under Kazakhstan's space programme will envisage the use of Zenit boosters.

At present, pursuant to the resolution of the Kazakh Government on participation in the *Land Launch* project and the Dnepr programme (i.e. commercial launches of Zenit and Dnepr boosters from Baikonur), Kazkosmos' Kazakhstan Garysh Sapary National Company is formulating the mechanisms of its participation in the above activities.

Satellite communications systems

The operator of satellite communications systems in Russia is Space Communications.

Negotiations are under way between the National Academy of Sciences of Belarus and Roskosmos over Belarus joining GLONASS. Ukraine uses the services of international (Eutelsat, Amos and Thuraya) and Russian (Gonets and GLONASS) satellite systems.

Kazsat satellites will enable Kazakhstan to enter the world market of satellite communications and become a provider of a wide range of services (telephone communications, TV, the Internet, etc.). Kazakhstan will potentially also be able to provide satellite communications services to other CIS countries (Kyrgyzstan, Tajikistan and Uzbekistan).

ERS systems

Having ample infrastructure and qualified personnel at its disposal, Russia remains the main provider of ERS services to other CIS countries (Ukraine, Belarus, Azerbaijan and Uzbekistan).

Space monitoring complexes are being developed in Kazakhstan under the National Space Monitoring System (NSMS) research and technical development programme in partnership with Roskosmos. To date, Kazakhstan has a basic NSMS infrastructure operational including:

- an ERS data receiving and processing network;
- an archive of satellite images of Kazakhstan's territory;
- a ground network of ERS data calibration;
- a package of geo–information technology solutions for monitoring agriculture, emergencies, environmental and geological conditions.

At an early stage of NSMS development, when Kazakhstan did not plan to launch its own ERS satellites, the emphasis was on ground infrastructure for receiving, archiving, processing and distributing ERS data and products using available international ERS systems.

Kazakhstan is now developing a space ERS system, which includes two national optic ERS satellites and the existing NSMS. This system will boost the capacity of the Kazakh NSMS and enable it to provide a wider range of services.

Satellite navigation systems

In Kazakhstan, the development of ground infrastructure for high–frequency satellite navigation (HFSN) is the responsibility of Kazakhstan Garysh Sapary National Company, within framework of the state research and design space programme.

This work will be coordinated as part of the CIS international radio–navigation programme until 2012. HFSN infrastructure is being developed in partnership with the Moscow Research Institute of Space Instrument Engineering and the Research Institute of Radio Metering (Kharkov, Ukraine).

Table 1.3.
The main space use and technology projects in the CIS

Subject	Parties	Description
Launching services	Russia and Ukraine (International Space Services; Yuzhnoye State Design Bureau;, Makarov Yuzhny Mechanical Engineering Works, Korolyov Energiya Rocket and Space Corporation), Kazakhstan	The *Land Launch* project: launch services using Zenit–2 and Zenit–3 boosters at Baikonur; modernisation of Zenit
Satellite communications services	Russia (Roskosmos, Space Communications)	Satellite communications
ERS services	Kazakhstan (National Space Monitoring System), Russia (Roskosmos)	Space monitoring system
Satellite navigation services	Kazakhstan (Kazakhstan Garysh Sapary National Company), Russia (Research Institute of Space Instrument Engineering), Ukraine (Research Institute of Radio Metering)	Building ground infrastructure for HFSN

2. Economic cooperation in space industry: prospects, problems and solutions

2.1. Main impediments to cooperation between CIS countries in space industry and possible solutions

The existing ties between the CIS countries in the space industry do not fully match the potential for cooperation they actually have. This cooperation is restricted by a number of problems; the most important ones are outlined below.

High capital intensity of the space industry and differences in the socioeconomic development levels of the CIS countries

Socioeconomic development levels vary greatly across the CIS, and this largely determines the degree of these countries' involvement in space activities. Space programmes can only be afforded by countries with higher levels of socioeconomic development (Russia, Kazakhstan and Ukraine), and poorer countries (Tajikistan, Armenia, Uzbekistan, Kyrgyzstan and Moldova) rarely take part in joint space projects.

Space activities are extremely capital–intensive. The high levels of required investment often prevent the CIS countries from participating in space projects but, on the other hand, make them strongly supportive of the cooperative approach. The need for cooperation also ensues from the unity of the technical standards adopted by the CIS countries.

The space industry is capable of producing profound multiplicative effects in related sectors. According to our calculations based on Russia's interindustry balance data for 2005, these multiple effects average at 1.72 in mechanical engineering, 1.44 in electronics, 1.33 in chemical production, and 1.3 in metallurgy (Russia's average is 1.1). Bearing in mind that the space industry interacts with the top segments of these industries, we see upward risk in these calculations.

Lack of private capital

The CIS countries implement their space projects exclusively through state owned companies (or companies in which the government has a controlling stake). This restricts both the economic efficiency of these projects (e.g., profitability and speed) and adoption of new technology.

The absence of private capital in the space industry in the CIS can be explained by the scale of its capital intensity and, accordingly, a lack of "eligible" investors. In addition, unlike most countries, the CIS countries tend to classify their space activities heavily, which restrict private sector involvement even further.

The CIS countries should consider the positive US experience. For example, production of suborbital shuttles in the US has become the domain of the private sector in the 2000s. In our opition, private–public partnership projects would become a mechanism for encouraging private investments in the space industry. At an early stage, the volume of these investments would be rather symbolic, yet it is important to start developing this practice.

Legal and security barriers to transfer of space technology imposed by Russia, Ukraine and international organisations

Typically, international cooperation at a research stage proceeds as a regular exchange of findings and achieved results at conferences rather than any physical joint work. A few exceptions are studies employing extremely expensive equipment or laboratories, which have been created jointly for shared use.

Therefore, most studies, especially theoretical ones, are being conducted nationally. Researchers from different countries meet at conferences to exchange ideas and compare achieved results. Notably, this open exchange is possible only to the extent that no know–how is concerned. In other words, these conferences are merely an opportunity for researchers to verify the validity of their approaches or conclusions.

Some applied studies, aimed at developing know–how, are subject to confidentiality restrictions. It is obvious that these studies could be far more productive were they transformed into an international effort. However, disclosure of any results is often forbidden by national or institutional rules, and this situation is unlikely to improve in the near future.

These restrictions apply even to studies conducted on the order of one of the participating countries.

The recent contract between the Kazakhstan Garysh Sapary National Company and the Moscow Institute of Heat Engineering for a feasibility study and concept design of the Ishim aerospace port is a typical illustration to this end. The contract was fully performed by the Moscow Institute and fully paid by Kazakhstan Garysh Sapary, but to this very day the latter cannot receive the deliverables due to Russian legal restrictions. The parties ended up raising claims against each other, with their senior management being accused of violating the laws of both states. This legal environment is a major barrier to mutually beneficial cooperation at a company level.

Another barrier is associated with restrictions imposed by international treaties. Kazakhstan, supported by Russia, has been seeking membership of the Missile Technology Control Regime (MTCR) international club for more than a decade. However, the sharp increase in the number of applicant countries (including China) in recent years effectively led to an admission moratorium.

As a non–MTCR country, Kazakhstan faces serious restrictions on cooperation with Russia and Ukraine in rocket development and modernisation.

The practice of entering intergovernmental agreements on individual space projects offers partial solution to this problem. Some of these agreements were mentioned above, e.g. the Kazsat agreement, under which Kazakhstan received a ready national satellite communications and broadcasting system and had its MCC personnel trained. Yet this agreement did not cover the issues of satellite technology transfer and specialist training, which are vital to Kazakhstan.

In search of a sustained solution Kazakhstan sought for a strategic partner capable of meeting its technology and training needs. Unfortunately, none of the CIS space industry companies was in a position to do so, and the country turned its attention to the global space powers. As we have mentioned above, Kazakhstan eventually secured a strategic partnership with EADS Astrium of France, a leading international supplier of satellite technology. The company undertook to supply technology and train specialists for the Kazakh ERS system. In parallel with that, the strategic partner commenced the construction of a SATC in Astana based on its technology and promoting Kazakhstan to the global satellite imagery market.

Kazakhstan's example clearly indicates that the CIS countries need to revise national laws and get rid of excessive restrictions on international cooperation, at least in order to reduce economic losses. Russia has already initiated revision of legal restrictions on civil uses of GLONASS services. This, accordingly, will allow many documents to be declassified and the developers of satellite navigation technology to freely enter into commercial contracts.

Taxes and customs

The existing tax and customs regulations seriously impede international scientific cooperation. For example, if a research organisation wishes to establish a joint venture with a production

company and contribute its know–how to the charter capital of this joint venture, it will be required to pay a substantial amount as tax. Typically, research institutions and DBs do not have such financial resources at their disposal.

It is expected that inception of the Customs Union in 2010 and the Single Economic Space of Russia, Kazakhstan and Belarus in 2012 would be a significant step towards removal of existing barriers.

Issues surrounding the shared use of Baikonur

Although the issues surrounding the shared use of Baikonur concern only Russia and Kazakhstan, they also impact the development of space activities in other countries, because, as we have mentioned above, most space systems in the CIS (e.g., launch systems) are closely interrelated. Therefore, settling these matters is a precondition for the successful integration of space activities of the CIS countries.

The Russian and Kazakh parties meet annually at Baikonur, yet there is a number of pending issues, particularly:

- reaching consensus between Roskosmos and Kazkosmos over compensation to Russia for the the so–called "inseparable improvements", i.e. technical changes made to various facilities at Baikonur, which cannot be isolated physically;
- defining implementation mechanism of compensating Kazakhstan for environmental damage caused by booster impact;
- defining the status of Kazakh nationals residing in the city of Leninsk (with respect to provision of social welfare – education, healthcare and insurance rights).

Both parties should be prepared to make serious compromises, if they are to settle these matters permanently.

Deliberate solution of the problems outlined above can open new opportunities for international cooperation and development of national space industries alike, which in turn can dramatically accelerate the technical and economic development of the CIS countries.

2.2. Prospects for integration of CIS countries' space activities

Fundamental and applied studies

The prospects of joint theoretical research are good, as there are no legal restrictions on such activities. International space research programmes can only face difficulties with funding.

By contrast, regulation of applied research is overly strict, which seriously impedes international cooperation. The situation calls for political decisions to ease this regulation, at least as concerns certain joint space studies, which can potentially bring about considerable economic benefits to participating countries.

Design and development

Rigid regulation also applies to the sphere of design and development. Again, there is the need for political will to create favourable conditions for the implementation of joint projects, which could yield economic benefits to the parties concerned. The Russian–Kazakh agreement on establishing Baiterek booster complex in Baikonur dated December 22, 2004, facilitates the design potential of Russian and Kazakh companies to be amplified.

Spacecraft and ground equipment production

Russia and Ukraine possess facilities capable of producing spacecraft and ground equipment, and Kazakhstan is continuing work to create the SDBSE and the SATC.

Russia is able to manufacture spacecraft of any type and the full package of ground equipment on its own. The most renowned producers of communications satellites are the Reshetnyov Applied Mechanics Research and Production Group, the Korolyov Energiya Rocket and Space Corporation, and the Khrunichev State Research & Production Space Centre. Satellites for ERS, hydrometeorology and environmental and emergency monitoring were produced by the Khrunichev State Research & Production Space Centre, the State Research and Production Space Rocket Centre, and the Progress Central Special Design Bureau. GLONASS satellites were produced by International Space Services.

Ukraine has the capacity to manufacture ERS and scientific satellites at the Yangel Yuzhnoye State Design Bureau.

The above mentioned Russian and Ukrainian satellite producers maintain cooperation, which can be traced back to the Soviet period, and in 2008 they all bid for a contract to build an ERS system in Kazakhstan. A comparative analysis of satellites offered by Russian, Ukrainian and European companies showed that, whilst CIS products were vastly cheaper, they were notably inferior to European ones in technical and reliability terms. Most elements of CIS satellite designs were essentially engineering prototypes, whereas European companies offered more reliable, commercial–grade solutions, which had already been tested.

The results of this comparison and problems with space technology transfer and specialist training in Russia determined the choice of EADS Astrium as strategic partner for the creation of the SDBSE and the SATC in Kazakhstan.

The SDBSE and the SATC is only the beginning of fully–fledged satellite production in the country, and the next step will be to build facilities or develop cooperation of enterprises for the manufacturing of satellite components. Undoubtedly, both Russia and Ukraine stand at the international level, and some of their companies are part of international cooperation in satellite production. Kazakhstan is likely to revert back to their proposals at the second stage, after full adoption of Western SATC technology.

Rocket and ground equipment production

The former Soviet facilities capable of manufacturing boosters and ground equipment are all located in Russia and Ukraine.

Russia is able to produce the full package of ground equipment on its own, and currently produces Proton and Soyuz boosters and the main components of Zenit.

Ukraine produces selected ground equipment items, as well as Zenit and Tsiklon boosters. The country is also the developer and producer of RS–20 intercontinental ballistic missiles (Dnepr).

Booster technology is subject to MTCR restrictions and cannot be freely transferred by MTCR members to non–MTCR countries. Kazakhstan is not a MTCR country, and does not intend to develop booster production in the near future. However, the production of selected elements of boosters and ground equipment could be set up at the Pavlodar Heavy Engineering Plant.

Launch services

Being the owner of Baikonur, the world's largest launching facility and the absolute leader in the number of launches, Kazakhstan intends to strengthen its position on this market. The preconditions for that are already there:

- notable developments in the implementation of the first national space programme in 2005–2007;
- the country's needs and capacities to assume a more active role in the commercial use of the existing Zenit and Dnepr rocket complexes and the new Baiterek complex in order to secure the future operation of Baikonur, taking into account Russia's moves to reorient launches under the federal prorammes towards the Vostochny site;

- the prospective development of national booster production will require preferential conditions for the launch of domestically made boosters from Baikonur; this will also secure orders for both high–tech industries in Kazakhstan and Baikonur itself.

Kazakhstan has already commenced the implementation of the Baiterek project at Baikonur in partnership with Russia. In addition, Kazkosmos is keen to become a shareholder in the Russian–Ukrainian ventures International Space Services and Kosmotrans and invest in the Land Launch and Dnepr programmes. After these matters are settled, Russia, Ukraine and Kazakhstan will be in a position to jointly develop an international commercial launch services centre at Baikonur.

Satellite communications services

Presently only Russia has a group of communications satellites, thus satellite communications services are available only from Russian providers. Before the Kazsat–1 failure, which occurred on June 8, 2008 Kazakhstan had also been capable of providing such services. Kazsat–1 was built by the Khrunichev State Research & Production Space Centre; this company also allocated a station point on the geostationary orbit for it.

According to the national space programmes of Kazakhstan, Ukraine, Azerbaijan and Uzbekistan, these countries intend to launch their satellites in the near future.

The Khrunichev State Research & Production Space Centre is now working on the new Kazsat–2 communications satellite, which will be placed into orbit in the end of 2010. The company's obligations include the launch and the allocation of a station point. Kazsat–2 will be operated by NCSC with the support of the Khrunichev State Research & Production Space Centre.

The first Ukrainian communications satellite will be built in partnership with MDA of Canada using a preferential loan facility. Negotiations are under way over the terms of this cooperation. The satellite will be placed into orbit from Baikonur by a Zenit booster.

Azerbaijan is in the process of selecting contractor to build its first communications satellite. It has already been agreed that this satellite will be launched by International Space Services from Baikonur using a Zenit booster.

ERS services

Presently only Russia has a group of ERS satellites, and only Russian companies can provide ERS services using their own satellites. However, other countries can build ground systems for receiving, processing and distributing of satellite images from foreign satellites, and many countries do so under their national space programmes.

Kazakhstan, Belarus and Ukraine intend to launch national ERS satellites in the near future.

Kazakhstan has plans to build optical–electronic high– and medium resolution ERS satellites jointly with its strategic partner, EADS Astrium. The country also secured a preliminary agreement with Gazkom of Russia on forming a group of shared ERS satellites by uniting Russian and Kazakh ERS resources. This will enable the parties to expand frequency range, to drastically enhance the promptness of taking images of target territories, and to strengthen their positions on the global market. The launch of these satellites is scheduled for late 2013. Launch services will be provided by, Kosmotrans, the Russian–Ukrainian venture, at Baikonur using Dnepr boosters.

A Belarusian ERS satellite is being designed in partnership with Russian companies. It will be launched by Kosmotrans from Baikonur using Dnepr boosters.

Ukraine has a track record in ERS satellite building. The country placed into orbit a national ERS satellite and built another one for Egypt. Now work is under way to launch the second Ukrainian ERS satellite; launch services will be provided by Kosmotrans at Baikonur using a Dnepr booster.

Satellite navigation services

Only Russia is able to provide services in the space segment of satellite navigation. On the whole, there are only two operational groups of navigation satellites in the world: GLONASS (Russia) and GPS (the USA). The third satellite navigation system, Galileo (the EU), is now under development.

High–precision positioning of navigation satellites largely depends on the ground segment, i.e. high–frequency satellite navigation infrastructure. The purpose of the ground segment is to generate differential corrections, which compensate positioning errors occurring for various reasons, and to ensure positioning precision up to millimetres.

In May 2008 Kazakhstan entered into an intergovernmental agreement with Russia on shared use of GLONASS. This agreement provides for the creation of the Kazakh space segment of GLONASS based on Kazsat communications satellites and ground HFSN infrastructure compatible with GLONASS and GPS.

Ukraine achieved significant developments in the construction of ground HFSN infrastructure. This work was performed by the Research Institute of Radio Metering in close cooperation with the European Satellite Navigation Organisation. Even Russia does not possess this kind of system, because the issues of civil and commercial uses of satellite navigation were not given due attention in the past.

In Kazakhstan, a project to build ground HFSN infrastructure is being implemented by Kazakhstan Garysh Sapary National Company in partnership with Russian and Ukrainian companies. This infrastructure is expected to be ready for commercial use by the end of 2012.

Manned space missions

The Gagarin Cosmonaut Training Centre is a unique facility and the only organisation of this kind in the CIS. It trained numerous cosmonauts, including US and EU nationals. The Centre's vast experience enabled it to pioneer space tourism services, and in 2001 the first space tourist was launched into space (Kazakh cosmonaut Talgat Musabayev was the mission commander and guide).

The popularity of space tourism is growing after that first successful trial. To date, seven space tourists accomplished a mission to the ISS. Private US and European companies began financing projects to build boosters and spacecraft for short–time suborbital and space flights. Russia also has similar projects, but they are still at the conceptual design phase; therefore in the near future Russia will only be able to offer space tourists travel to the ISS. However, the country's space tourism potential will be seriously enhanced after completion of the Vostochny launch complex and a new spacecraft accommodating six cosmonauts.

Kazakhstan does not have a cosmonaut training centre: such a facility would be uneconomic, bearing in mind the overall volume of the national space programme. Kazakh cosmonauts are being trained at the Gagarin Centre — an optimum solution for both parties in economic terms.

Four Kazakh citizens took a full training course at the Gagarin Centre and qualified as a "pilot–cosmonaut". Two of them actually travelled into space: Toktar Aubakirov (one mission) and Talgat Musabayev (three missions). Mukhtar Aimakhanov and Aidyn Aimbetov have not flown yet.

In autumn of 2009 one of the two candidates was given an opportunity to make a short–time flight. A contract between Kazkosmos and Roskosmos was signed and a programme of space experiments was prepared, but eventually the mission was put on hold due to the 2009 Kazakh budget cuts. At present, the parties are negotiating a new timing for this flight.

2.3. The CIS space industry in the world space services market

As we have mentioned above, Russia, Ukraine, Kazakhstan, Belarus, Uzbekistan and Azerbaijan engage in space activities or are interested in doing so. They interact with each other and non–CIS countries.

In our opinion, there are three possible scenarios for the development of space activities in the CIS:

1. The formation of a space market within the CIS and maintaining existing ties with other countries (the US, the EU, China and India). This scenario envisages that the CIS countries would be isolated from other markets to some extent and rely in the first place on their own resources and technology.

   Strengths:

   - production and technical ties inherited from the Soviet period will be preserved and the integration of the CIS countries will be promoted.

   Weaknesses:

   - competition will be limited and inefficient former Soviet facilities will stay afloat;
   - latest technology will become inaccessible, hence technical lagging and increased spending on national studies;
   - each country will bear the heavier financial burden for space projects.

2. Full integration of the CIS countries into the global space market, with each country finding its own niche. This essentially means following the overall globalisation trend.

   Strengths:

   - vast opportunities to exchange experience, as well as production and management technology;
   - the financial burden of joint space projects will be considerably eased.

   Weaknesses:

   - economic, production, technical and other ties between the CIS countries will weaken.

3. Full integration of the CIS countries into the global space market in parallel with preservation and development of existing ties between them. This scenario envisages that the CIS countries would be strongly oriented towards each other.

   Strengths:

   - vast opportunities to exchange experience, as well as production and management technology;
   - the financial burden of joint space projects will be considerably eased;
   - economic, production, technical and other ties between the CIS countries will be preserved and developed.

The third scenario appears to be the most feasible. On the one hand, the CIS countries will become full members of the global market and have access to the best international experience and technology. On the other hand, the vast potential for economic and technical cooperation between them will be finally realised. The valuable ties that remained after the disintegration of the Soviet Union should be preserved and expanded, as they would enable individual the CIS countries to exert greater leverage over external markets.

Conclusions

Summarising the above information from the perspective of the potential cooperation between the CIS countries in space activities, we can draw the following conclusions.

1. Joint research projects in space and related industries are included in the above mentioned joint programmes between the CIS countries. However, most of these projects do not receive funding. Unfortunately, so far the CIS countries have not adopted the EU's practice of cofinancing general research programmes, which comprise individual studies initiated by individual countries. Eventually each participating country finances its own studies, which complement other countries' studies, and the results can be generalised and shared by all. This approach enables considerable savings by eliminating the doubling of research work.

Successful cooperation of this kind is exemplified by:

- the Russian–Belarusian–Kazakh effort to develop an international radio–navigation programme by 2012;
- the Russian–Ukrainian–Kazakh project to launch a satellite for studying the ionosphere and earthquake precursors;
- the Russian–Kazakh projects to build the VKO–UF World Space Observatory with a view for studying cosmic and solar radiation using a unique neutron monitor and the Orbita survey area; to build a ground complex for receiving and processing ERS data; and to carry out space programmes and experiments aboard the Mir Orbital Station and the ISS.

2. The prospects of technical cooperation in the space and related industries largely depend on legal restrictions on technology transfer in the CIS countries. Examples illustrating this conclusion are given in *Section 2*. Future development of technical cooperation in promising areas requires political decisions to revise national laws.

   A number of such political decisions were adopted by Russia, Ukraine, Belarus, Kazakhstan and Uzbekistan on a bilateral basis. These include intergovernmental agreements on space cooperation and the above mentioned individual follow–up programmes, and agreements on exchange of secret information.

   There are very favourable conditions for technical cooperation between Russia and Belarus. The prospects for the Russian–Ukrainian joint space programme are also good, especially in the sector of aerospace equipment in which these countries successfully cooperated as early as the Soviet period. Some positive developments are being observed in the Russian–Uzbek space programme.

Russia and Kazakhstan cooperate under the following projects:

- Kazsat–2 communications and broadcasting satellite;
- Baiterek booster complex;
- ground and space HFSN infrastructure;
- Kazakh segment of the Gonets (Orbcomm) international low–orbit data transfer system;
- group of shared ERS satellites and a network for receiving and processing ERS data;
- ground and space geodynamic and geodetic monitoring system;
- hardware and software for spacecraft traffic simulation and space systems operation modelling.

3. Space projects in the CIS countries are implemented principally by governmental agencies and their subordinate organisations.

Involvement of the private sector in these projects would enhance their efficiency and competitiveness. This in turn would make space companies from the CIS countries attractive partners for international cooperation and technology exchange. In addition, the space industry would become a target for mutual private investments.

Private–public partnership projects would become a mechanism for encouraging private investments in the space industry. At an early stage, the volume of these investments would be rather symbolic, yet it is important to start developing this practice.

4. The CIS countries should preserve and develop their mutual ties despite all the impediments to cooperation, as they share space technology inherited from the Soviet period. Russian and Ukrainian boosters cannot be launched from US or EU facilities due to differences in technical standards, and vice versa. ERS and satellite communications systems in the CIS countries are also largely incompatible with other systems.

Cooperation in the space industry would amplify the CIS countries' potential to develop new technology, and is economically warranted despite the existing barriers. The profound multiple effects of space industry development would eventually boost the efficiency of CIS members' national economies and their potential for international competition.

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Official website of the Yuzhnoye Design Bureau: http://www.yuzhnoye.com/

Official website of the CIS Executive Committee: http://cis.minsk.by/

Annex 1. Summary of State Space Agencies and Space Programmes in CIS Countries

Russia

The Federal Space Agency of Russia (Roskosmos) supervises space activities in the best interests of science, technology development and various industries, and coordinates efforts to develop space equipment for economic and social uses and (jointly with the federal executive defense agency) double–up civil and military uses.

To this end, the Agency:

- supervises the implementation of public policy on space activities jointly with the federal executive defense agency and other organisations involved in the development and operation of space equipment;
- drafts the Federal Space Programme;
- places public orders for the development, production and supply of space equipment and infrastructure components for scientific, social and economic purposes, including services for Russia's international space projects;
- coordinates the use of space equipment for the purposes of the Federal Space Programme;
- jointly with the federal executive defense agency places public orders for the development, production and supply of space equipment and infrastructure components for double civil and military uses;
- organises systematic studies for the justification of the development of particular space equipment for scientific, social and economic uses and (jointly with the federal executive defense agency) double civil and military uses;
- jointly with other federal bodies, supervises design, research and development activities aimed at creation of space equipment for scientific, social and economic uses, purchases serial space equipment and (jointly with the federal executive defense agency) supervises the use of the equipment;
- organises and coordinates work for commercial space projects and promotes them;
- supervises the development of space infrastructure jointly with the federal executive defense agency and other federal bodies;
- jointly with other federal bodies, organises and conducts state flight testing of space equipment for scientific, social and economic uses;
- organises certification of space equipment for scientific, social and economic uses;
- ensures safety of space activities jointly with other public bodies;
- interacts with foreign national and international organisations on space activities and enters into respective international agreements;
- finances the Federal Space Programme in accordance with the approved budget;
- performs other functions as directed by the Government of the Russian Federation.

Russia's space industry comprises about 100 production companies, design bureaus and research institutions:

Annex 1. Summary of State Space Agencies and Space Programmes in CIS Countries

№	Company
1	Moscow Institute of Heat Engineering
2	Vozdushny Start Aerospace Corporation
3	Novator
4	Kosmonit Research & Technology Centre
5	Spacecraft Research Institute (branch of the Khrunichev State Research & Production Space Centre)
6	Avangard
7	Berdsk Electromechanical Works
8	Krasnoye Znamya Works
9	Aksion–Kholding Izhevsk Motor Works
10	Izhevsk Radio Works
11	Mechanical Engineering Facilities Design Institute
12	Kompozit
13	Chemical Automatics Design Bureau
14	Kompomash Corporation
15	Rosobschemash Corporation
16	Krasnoyarsk Mechanical Engineering Works
17	Arsenal Mechanical Engineering Works
18	Miass Mechanical Engineering Works
19	Precision Instrument Systems Research Corporation
20	Germes Research Institute
21	Moscow Research Institute of Space Instrument Engineering
22	Precision Mechanics Research Institute
23	Precision Instruments Research Institute
24	Physical Metering Research Institute
25	Electromechanics Research Institute
26	Istochnik Accumulator Research and Design Institute
27	REKOD Research & Production Corporation
28	Orion Research & Production Organisation
29	Iskra Research & Production Group
30	Novator Research & Production Group
31	Instrumentation Research & Production Group
32	Electromechanics Research & Production Group
33	Geofizika–Kosmos Research & Production Company
34	Kvant Research & Production Company
35	Kvant Space Instrument Engineering Research & Production Company
36	Polyus Research & Production Centre
37	Special Design Bureau of the Moscow Energy Institute
38	Mashinostroitel Perm Works
39	Prikamsk Industrial Facilities Design Institute
40	IRIS Production and Design Company
41	Zlatoust Mechanical Engineering Works
42	Strela Production Group
43	Proton Permskiye Motory
44	Korolyov Energiya Rocket and Space Corporation
45	Russian Space Systems
46	Saturn
47	Siberian Instruments and Systems
48	Ural Composite Materials Research Institute
49	Mashpribor
50	Reshetnyov Institute of Communications Satellites

№	Company
51	Mechanical Engineering Research & Production Group
52	Makeyev State Rocket Centre
53	Motorostroitel
54	Glushko Energomash Research & Production Group
55	Polyot Production Group (branch of the Khrunichev State Research & Production Space Centre)
56	Progress Special Design Bureau of the State Research & Production Space Rocket Centre
57	Motor Design Bureau
58	Research Institute of Control Devices
59	Alternativnaya Energetika Research & Production Complex
60	Iosifyan Research & Production Company
61	Fakel Experimental Design Bureau
62	Agat
63	Zvyozdny Centre
64	Geofizika Central Design Bureau
65	Central Design Bureau of Vehicle Engineering
66	Central Research Institute of Mechanical Engineering
67	Ekho
68	Khrunichev State Research & Production Space Centre
69	Vokinsk Works
70	Design Bureau of General Mechanical Engineering
71	Design Bureau of Vehicle and Chemical Engineering
72	Isayev Design Bureau of Chemical Mechanical Engineering
73	Impuls
74	Pilyugin Reserch & Production Centre of Automatics and Instrument Engineering
75	Kirov Ust–Katavsk Wagon Works
76	Voronezh Mechanical Works (branch of the Khrunichev State Research & Production Space Centre)
77	Prozhektor
78	Zvezda
79	Keldysh Research Centre
80	Design Bureau of Vehicle Engineering
81	Design Bureau of Heavy Engineering
82	Frunze Arsenal Design Bureau
83	Moscow Electromechanical Works
84	Mars Moscow Experimental Design Bureau
85	Lavochkin Research & Production Group
86	Research Institute of Mechanical Engineering
87	Research Institute of Microinstrumentation
88	Kosmotrans Research & Production Company
89	Semikhatov Research & Production Group
90	Tekhnimash Research & Production Group
91	Zarya Research & Technical Centre
92	Vympel
93	Special Design Bureau of Fire Fighting Equipment
94	Korpus Production Group
95	Titan Special Design Bureau
96	Turbonasos
97	Ground Space Infrastructure Operation Centre
98	Kometa Central Research Institute
99	Berg Radiotechnics Central Research Institute
100	Research & Testing Centre of the Rocket and Space Industry

The *Federal Space Programme for 2006–2015* was adopted by a resolution of the Russian Government on October 22, 2005.

The main purpose of the Programme is to satisfy the growing demand for space services from governmental bodies, regional structures and the population.

The main tasks of the Programme are:

- to develop and maintain a group of orbital spacecraft in the interests of socioeconomic development, science and national security (communications, TV broadcasting, rebroadcasting, ERS, hydrometeorology, environmental monitoring, emergency control, fundamental space research and space microgravity studies);
- to create and operate the Russian segment of the ISS with a view to conducting fundamental and applied research and implementing a long-term programme of applied studies and experiments aboard the Russian segment;
- to maintain the Russian segment of the international satellite search and rescue system COSPAS/SARSAT;
- to develop booster systems for placing spacecraft into orbit;
- to maintain and develop various facilities at the Baikonur space port;
- to organise production of rocket and space equipment in compliance with international standards.

During phase one (until 2010), the following projects will be implemented:

- a system of stationary satellite navigation and broadcasting system comprising 13 spacecrafts;
- a system of mobile satellite navigation system comprising 6 spacecrafts;
- a system of meteorological monitoring comprising 5 spacecrafts;
- a system of environmental monitoring comprising 4 spacecrafts;
- space ports for fundamental research comprising two astrophysical observatories;
- a spacecraft for sun studies;
- a spacecraft for Mars studies and delivering Phobos soil to the Earth, and an individual small spacecraft, e.g. for medical and biological studies;
- the Russian segment of COSPAS/SARSAT comprising 2 spacecrafts;
- the Russian segment of the ISS comprising 5 modules;
- a multifunction ground complex for the receiving, recording and processing of satellite data and related ERS systems.

During phase two (until 2015), the following orbital groups will be maintained and developed:

- a system of stationary satellite navigation and broadcasting system comprising 26 spacecrafts;
- a multifunction rebroadcasting system comprising 2 spacecrafts;
- a system of mobile satellite navigation system comprising 12 spacecrafts;
- a system of meteorological monitoring comprising 3 fourth-generation spacecrafts and 2 third-generation spacecrafts;
- a system of environmental monitoring comprising 5 spacecrafts;
- space ports for fundamental research comprising three astrophysical observatories;

- 3 spacecrafts for sun studies, a spacecraft for moon studies and an individual small spacecraft, e.g. for medical and biological studies;
- the Russian segment of COSPAS/SARSAT comprising 2 spacecrafts;
- the Russian segment of the ISS comprising 8 modules;
- technical space ports with a spacecraft and an individual short-life spacecraft.

Kazakhstan

The National Space Agency of Kazakhstan (Kazkosmos) is a central executive body in charge of state regulation and interindustry coordination of space activities.

The main tasks of Kazkosmos are:

- to formulate and implement common public policy on space activities;
- to regulate and coordinate space activities within the scope of its competence;
- to develop a space industry in Kazakhstan including target space systems, ground infrastructure, space studies and technology, and specialists;
- to create conditions for the development of a space technology and services market;
- to create a legal framework for space activities in Kazakhstan;
- to exercise state control over space activities;
- to participate in international space activities;
- to coordinate the issues surrounding the Baikonur lease within the scope of its competence.

The following organisations are subordinate to Kazkosmos:

- the National Centre of Space Studies and Technology and its affiliates (the Astrophysics Institute, the Ionosphere Institute, the Institute of Space Studies and the Institute of Space Technology). The National Centre directs priority fundamental and applied studies in astrophysics, adjacent and deep space physics, atmosphere and ionosphere physics, and space equipment and technology;
- the National Centre of Space Communications and Electromagnetic Compatibility of Radioelectronic Equipment (development and operation of national communications and broadcasting satellites, ground control infrastructure and electromagnetic compatibility services);
- the Russian-Kazakh joint venture Baiterek (development and operation of a new, environmentally friendly booster complex based on Russian Angara boosters and ground infrastructure at Baikonur);
- the Kazakhstan Garysh Sapary National Company (development, production and operation of internationally competitive space equipment and infrastructure);
- Infrakos (maintenance and efficient use of various facilities at Baikonur);
- Infrakos-Ekos (assessment and mitigation of the impact of space activities on the environment and human health); and
- Baikonyrbalans (accounting of Baikonur assets leased to Russia).

The State Programme for the Development of Space Activities in Kazakhstan for 2005-2007 was approved by a presidential decree dated January 25, 2005.

The main purpose of the Programme is to establish the space industry as a science-intensive, high-tech economic sector capable of providing an impetus for accelerated economic

development, strengthening national security and defence, and contributing to Kazakhstan's entrance to the top 50 competitive countries.

The main tasks of the Programme are to develop:

- a base for the production and launch of domestic spacecrafts for various purposes;
- ground infrastructure for the launch of spacecrafts for various purposes;
- a programme of studies and experiments to be carried out by Kazakh cosmonauts aboard the ISS;
- space information technology based on satellite communications systems;
- a national system for space monitoring of Kazakhstan's territory;
- a system for ensuring environmental security of booster complex operation;
- a professional training system for the space industry; and
- a legal framework and economic basis for the space industry.

At present, the *State Programme for the Development of Space Activities in Kazakhstan for 2009-2020* is being formulated.

Ukraine

The National Space Agency of Ukraine is a central executive body authorised to implement public policy on space activities and supervise the development of the space industry.

To this end, the Agency:

- formulates the conceptual basis of public policy on the exploration and peaceful uses of space in the best interests of national security;
- organises space activities in Ukraine and elsewhere;
- promotes the use of space equipment for defence and national security purposes;
- cooperates with other countries and international space organisations.

The NSAU was established by presidential decree dated February 29, 1992. In 1999 its status changed, and over 20 organisations were placed under its control, including the Yuzhnoye State Design Bureau and the Makarov Yuzhny Mechanical Engineering Works. Ukraine inherited a number of facilities from the former Soviet Union, capable of producing boosters and space equipment, and is a world space power with great potential.

The National Space Programme of Ukraine for 2008–2012 was adopted by the Government on December 20, 2007.

The purpose of the Programme is to ensure a common public approach to space activities and efficient use of the national scientific, technical and production potential in the best geopolitical and economic interests of Ukraine.

The main tasks of the Programme are:

- to develop a national system of Earth space monitoring for general public, social, economic, security and defence purposes;
- to introduce satellite systems into the national telecommunications infrastructure;
- to conduct fundamental studies of adjacent space, the Solar System, deep space, and biological and physical processes in microgravity conditions;
- to develop systems necessary for the implementation of national and international projects in space, and to promote domestically made boosters on the global launch services market;
- to develop advanced space equipment;

- to promote innovations in the space industry, and to modernise its experimental and production base.

Belarus

In Belarus, space activities are the domain of the National Academy of Sciences of Belarus – the supreme scientific organisation, which conducts and coordinates fundamental and applied studies in natural, technical, liberal and social sciences, and arts.

The main space activities of the academy are:

- development of ERS spacecraft and advanced space technology and equipment;
- development of ground infrastructure for receiving, processing and distributing satellite data and spacecraft control;
- development and introduction of space information technology;
- development of a satellite communications system;
- development of a single geodetic, navigation and time system based on the national ERS system;
- space industry personnel training.

The National Space Programme of Belarus for 2008–2012 was adopted by the Cabinet of Ministers on October 20, 2007.

The main purpose of the Programme is to develop and efficiently use the national scientific and technical potential for developing space equipment and technology in the interests of various industries, national security, science and education.

The tasks of the Programme are:

- to develop ERS spacecraft and advanced space equipment and technology;
- to develop ground infrastructure for receiving, processing and distributing satellite data and spacecraft control;
- to develop space information technology and adapt them for various socioeconomic uses;
- to develop a satellite communications system;
- to develop a state geodetic, navigation and time system based on the national ERS system;
- to conduct research for developing basic elements of space equipment and advanced technology;
- to develop a system of training and retraining specialists for the space industry;
- to formulate public policy on space activities;
- to implement foreign policy measures for Belarus joining international organisations and treaties;
- to develop a legal framework for space activities in Belarus.

Other CIS countries

The National Aerospace Agency of Azerbaijan is a governmental body in charge of implementing the country's space and aviation programme. The agency was founded in 1974 as the Caspy Research Centre of the National Academy of Sciences.

In 1992, pursuant to a presidential decree, the agency received its present–day status and was placed under the control of the Ministry of the Defence Industry.

The main activities of the agency are:

- to implement public policy on space and Earth studies;

- to develop and implement national aerospace programmes;
- to coordinate activities under international space projects;
- to adapt space technology for national security and economic uses.

The agency has the following branches:

- Research Institute of Aerospace Information Science;
- Special Design Bureau of Space Instrument Engineering;
- Institute of Space Natural Resources Studies;
- Ecology Institute;
- Experimental Space Instrument Engineering Works;
- Special Technology Design Bureau.

Annex 2. Major Ongoing Space Projects in the CIS as of January 1, 2010

Project	Cost ($ million)
Kazakhstan	
Kazsat–2 geostationary communications and broadcasting satellite	115
Kazsat–3 geostationary communications and broadcasting satellite	180
Kazsat–4 geostationary communications and broadcasting satellite	190
Launch and technical areas of Baiterek	223
ERS system with two optic satellites (of medium and high resolution)	370
SATC	190
Ground HFSN infrastructure	20
Investments in improving the power characteristics of Zenit boosters and International Space Services' business; buying shares in the company	60
Technical area for preparation of Zenit and Dnepr nose fairings at Baikonur	20
Radiolocation satellite for the ERS system	180
Scientific space system	15
Astana National Space Centre	100
Russia	
Stationary and mobile presidential satellite communications system based on 2 spacecrafts (Ekspress–AM33/AM44)	208
Gonets multifunction satellite communications and data transfer system (12 spacecrafts)	53
Satellite TV broadcasting complex based on 2 spacecrafts (Ekspress–AT1/2)	215
Stationary satellite communications system based on 5 spacecrafts (Ekspress–AM4/5/6/7/8)	573
Geostationary hydrometeorology complex based on 2 Elektro spacecrafts	77
Hydrometeorology complex based on 3 spacecrafts (one Meteor–3M and 2 Canopus–B)	207
Resurs–P optic and electronic segment of the ERS system (2 spacecrafts)	102
Arkon radiolocation system (2 spacecrafts)	78
Spektr–UF space astrophysical observatory	45
Terion–F2 space port for ionosphere and thermosphere studies	16.2
Angara heavy booster complex	93
Modernisation of DM and Fregat upper stages and new oxygen–hydrogen upper stages	213
Reusable boosters and liquid–fuel power packages for them	209
Modernisation of launch and technical areas of Proton and Soyuz booster complexes	89
Modernisation of launch and technical areas of Zenit and Tsiklon booster complexes	14
Modernisation of auxiliary facilities and fuelling and neutralisation areas at Baikonur	49
Modernisation of the measuring complex at Baikonur	10
Yamal–GK geostationary satellite communications and broadcasting system based on 8 spacecrafts	705
Group of 4 geostationary Ekspress–MD spacecrafts	93
SMOTR gas industry monitoring system based on 4 spacecrafts	523
Kondor–E radiolocation system based on 6 spacecrafts	164
Modernisation of the Zenit booster complex	10
Air Launch aerospace port	200

Annex 2. Major Ongoing Space Projects in the CIS as of January 1, 2010

Project	Cost ($ million)
Ukraine	
Space system for monitoring natural and man-made disasters	24
Space weather monitoring system	2
Ultraviolet space astrophysical observatory	8
Space system for optical Earth observation	24
Environmental monitoring satellite	6
Space segment of the national satellite communications system	140
National coordinate, time and navigation system based on global satellite navigation systems	5.1
Light booster complex at the Alkantara launch site	18

Sources: official websites of Roskosmos, Kazkosmos and the NSAU

Journal of Eurasian Economic Integration

The Journal of Eurasian Economic Integration is a quarterly academic and analytical journal published in Russian by the Eurasian Development Bank. The members of Editorial board and Advisory council are distinguished academicians, practitioners and experts in regional integration. Eurasian Economic Integration brings together academic and analytical articles, reviews of books relating to regional integration, interviews and quarterly chronicles of regional integration. With its focus on economics, the journal is a rich source of material addressing a broad range of issues specific to Eurasian integration. These include integration theory and its relevance to the development context; economic integration (trade, investment, financial institutions); institutional integration; cooperation issues in the post–Soviet space; and international experience of regional integration. The first issue was published in the third quarter of 2008.

Requirements for submissions. Papers should be sent by e–mail to editor@eabr.org for blind review. There are no strict limitations on the length of articles. However, the Editorial Board recommends authors to adhere to 6000–8000 words or 30000–40000 characters. In addition to the main text, authors must supply a brief author(s)' biography (100–150 words), executive summary (100–150 words) and bibliography. These materials must be attached in a separate file.

EDB Eurasian Integration Yearbook

Eurasian Integration Yearbook publishes a wide range of articles and other materials in English on theory and practical aspects of Eurasian integration. The major part of the annual Yearbook consists of English versions of selected articles published in the Journal of Eurasian Economic Integration and other analytical publications of EDB. These are supplemented by integration chronicles for the respective year. The Yearbook improves access of the world community to the best papers on various issues of regional integration published in Russian. Apart from papers published in the Journal of Eurasian Economic Integration, papers written specifically for the Yearbook are also welcome (submission in English or Russian).

Sector reports

As of today the following Sector reports have been published and distributed:

- Nuclear Energy Complexes in Russia and Kazakhstan: Prospects for Development and Cooperation
- Water and Energy Resources in Central Asia: Utilisation and Development Issues
- CIS Common Electric Power Market
- Eurasian Development Bank's Investment Policy and Environment
- EurAsEC's International Transport Corridors
- Effects of Climate Change on Water Resources in Central Asia
- Economic Cooperation in Agricultural Sector of CIS Countries

http://www.eabr.org/rus/publications/AnalyticalReports/

Consultancy

The Bank provides consultancy services to its strategic partners and clients. The Bank's Strategy and Research Department has in–house expert resources and can involve specialists from other departments, such as project managers, corporate financing, treasury, legal department. External experts from the extensive pool of the CIS countries' experts could be mobilised to work on consultancy projects.

Areas of expertise:

- Analysis of a current status and dynamics of development in selected sectors in the member states of the Bank and other EurAsEC countries;
- Financial markets' analytical reviews in the EurAsEC countries;
- Economic and legal analysis of integration agreements and institutions in the Eurasian space;
- Development banks' operations and activities in the CIS countries and issues of cooperation.

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