



Ukrainian space industry – challenges and prospects

Volodymyr Mikheev, Deputy Head of the State Space Agency of Ukraine

Ukraine's heroic fight against the treacherous full-scale military invasion of the Russian federation has been going on for more than five hundred days. 24 February 2022 has certainly changed life of every Ukrainian and the whole country. Tens of thousands of killed and injured Ukrainians, millions of refugees, destroyed businesses and whole cities, a transport blockade – these are the current circumstances we live in as well as in which the Ukrainian economy and each of its sectors operate. We share in this article how the Ukrainian space industry is functioning during this extremely challenging period, and our plans for a peaceful future.

At the outset, the space industry has traditionally been a very promising, scientific, high-tech, modern, expensive and, of course, interesting and attracting field of activity, which has always involved specialists who are truly dedicated to this area. Modern Ukraine happened to inherit strong basic science schools, research institutes and testing facilities, a huge and powerful production complex, as well as large engineering and labour teams involved in various rocket engineering and space research projects.

During the first years of Ukraine's independence, many scientific developments and practical works faced great challenges. They were primarily related to the conversion from the production and testing of strategic ballistic missiles with nuclear warheads to a non-military space business. Nevertheless, we managed to preserve the industry's potential, reorient it to new needs and find our place in international cooperation that always was very competitive.

Due to its unique competence in rocket

and space technology, high quality products and in-depth scientific research, the Ukrainian space industry has realised its potential in a number of international launch service projects. The most prominent of these are Sea Launch, Land Launch and Dnipro. These projects were implemented within the framework of historically close cooperation with the leading states in the field of peaceful use and exploration of outer space. They enabled the establishment and development of commercial relations with many Western space companies. After the termination of space cooperation with Russia, an obvious consequence of the temporary occupation of the Autonomous Republic of Crimea and the City of Sevastopol in 2014, we have only strengthened international cooperation with other states, mainly with European and North American countries.

The Ukrainian space industry is developing in a sustainable manner, providing equal conditions and opportunities to both state and private enterprises, which have approximately equal shares in the

overall range of space projects and activities. The main areas of competence traditionally include the design and manufacture of launch vehicles, their preparation and launch, the design and manufacture of space and onboard equipment, spacecraft control, orbital services, receiving and processing information from spacecraft, control of space objects as well as scientific space research.

24 February 2022 has certainly caused major changes to all previous plans for the development of the industry. That's why we had to focus on more urgent and pragmatic goals for a while – firstly, ensuring the safety of personnel and, secondly, continuing uninterrupted operations.

Some of the companies suffer from the attacks of Russian cruise or ballistic missiles. Others, particularly those in Kharkiv, also sustain significant damage from artillery fire and air strikes. But we managed to fulfil our most important priority – to save our people's lives – not only because it is difficult to find a replacement for the highly skilled personnel that the space industry needs, but because we strongly



Left: the signing of the Joint Declaration between SSAU and NASA, April 2023. Right: Volodymyr Mikheev, Deputy Head, State Space Agency of Ukraine.

value all and each human life. **Overall, Ukrainian companies have continued their work in all areas of activity, including the implementation of relevant international treaties and foreign economic agreements.**

For instance, after the beginning of the full-scale Russian invasion, the American company Northrop Grumman conducted two successful launches of the Antares rocket. The first stage of the rocket was designed and manufactured by the Ukrainian state enterprises Pivdennyi Machine-Building Plant and Pivdenne Design Office in cooperation with a number of other Ukrainian companies that were also involved in the preparations for the launch of the rocket.

Despite the ongoing military actions, all deliveries and works were carried out by the Ukrainian side on time and according to the required standards. As a result of the Russian blockade of the Black Sea, we had to change the transport route for the first stage of the rocket from Dnipro, Ukraine, where it is manufactured. Whereas previously this product, which is over twenty metres long and almost four metres in diameter, had been shipped from the Ukrainian port of Mykolaiv to the United States, for the recent launches it had to be transported by road to a European port.

Unfortunately, on 2 August 2023, the last Antares launch took place in the former 230 configuration. In the future, Northrop Grumman plans to produce the rocket in the 300 configuration, replacing the Ukrainian first stage by another technical solution and abandoning Russian engines, thereby fully relying on American suppliers.

In addition, after 24 February 2022, two launches of the European Vega-C rocket took place, for which Ukrainian companies supply the fourth stage main engine

and some carbon components. Ukrainian companies are currently working on engines for the next launches, scheduled for 2024.

An example of successful international joint projects in the space sector is the ongoing work with the Canadian company Maritime Launch Services Inc (MLS), which is building a space launch site in the province of Nova Scotia. The Ukrainian state enterprises Pivdennyi Machine-Building Plant and Pivdenne Design Office are the main designers and manufacturers of the MLS launch vehicle. They are working to create a proven, low-risk launch vehicle capable of delivering payloads weighing 3,350 to 5,000 kg to various low Earth orbits, including polar and sun-synchronous orbits. Cyclone-4M is a two-stage monoblock medium-class rocket for commercial space launches. Its unique and reliable design is based on the proven technical solutions of the Pivdenne State Design Office used in many other space rocket systems.

We believe that this project is very promising both for Canada, which will gain the ability to conduct space launches (an important competence for a space

power), and for Ukraine, which needs to maintain and further develop its competence in the design and manufacture of launch vehicles.

I would like to highlight **the outstanding successes of young Ukrainian scientists in space exploration.** For example, during the IAC2022 in Paris last September, the MLS and Nanorack companies announced an initiative, supported by the Canadian Space Agency, to launch 16 CubeSats created by Ukrainian student teams into orbit during the first launch of the Cyclone-4M rocket.

Despite the war, Ukrainian universities are continuing their satellite programmes. In particular, undergraduate and PhD students of the National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute" (KPI) created the PolyITAN-HP-30 nanosatellite, which was launched into orbit by a SpaceX Falcon 9 rocket on 3 January 2023. The purpose of the dual-mode CubeSat is to conduct an experiment to study the efficiency of heat pipes of different designs as the main element of spacecraft thermal stabilisation systems. The launch of PolyITAN-HP-30 became possible due to the support of

Antares

Antares is a two-stage rocket with an optional third stage, manufactured by Northrop Grumman, capable of launching payloads up to 8000 kg into low Earth orbit. The launch vehicle is primarily used to support a contract with NASA under the Commercial Resupply Services programme. Since 2013, 18 launches have taken place, 17 of which were successful.

Vega

Vega is a disposable launch system operated by Arianespace and developed jointly by the Italian Space Agency and the European Space Agency. Vega is designed to launch small payloads into low Earth orbit. Development began in 1998 and the first launch took place on 13 February 2012 from the Space Launch Centre in Guiana. A total of 22 launches have taken place, of which 19 have been successful.



LV VEGA launches



our partners, notably Delft University of Technology.

As of today, KPI is implementing its own satellite programme, which includes the development of a number of nano- and micro-satellites. Some of these could be launched as early as the beginning of next year.

The launch of the Falcon 9 rocket on 3 January this year also carried into orbit EOS Data Analytics' EOS SAT-1 optical satellite for agricultural land monitoring. The satellite was built by Dragonfly Aerospace, a Ukrainian-South African space optics and satellite manufacturer, and is equipped with two high-precision DragonEye cameras.

It is worth mentioning the National Youth Aerospace Education Center in Dnipro, Ukraine, an institution aimed at promoting theoretical knowledge and relevant practical skills in space activities among young people. After the beginning of the full-scale war, the Center did not stop its work and continues to operate actively.

Despite the war, space law is becoming increasingly relevant in Ukraine. In particular, in Dnipro, the "space capital" of Ukraine, one of the leading educational institutions, namely Oles Honchar Dnipro National University, has introduced a compulsory course entitled "Legal Regulation of the Protection, Use and Commercialisation of Outer Space". The innovation of this discipline is that it is studied not only at the Faculty of Law, but also by students of technical specialities. This allows future space engineers to look at technical issues from the perspective of the legal aspects of space activity regulations.

Also at the end of 2022, a team of authors-scientists from Dnipro published a textbook entitled "General Theory of Space Law". I strongly believe that the number of scientific researches would have been even higher if not for the difficult circumstances of the war – in particular, man-made blackouts and missile attacks by the aggressor state.

We have ambitious plans for international cooperation, which remains an integral part of the space industry development. One of our top priorities is to become a member of the European Space Agency (ESA). Over the past year, we have initiated a promising bilateral dialogue, identified and detailed potential cooperation projects, and continue to work on the relevant financial aspects.

ESA has already offered the State Space Agency of Ukraine a joint internship programme for young Ukrainian scientists. We are currently finalising the selection of candidates and it is possible that by the time this interview is published, the winners will already be working on their research projects at ESA centres.

We are certainly continuing to work in many areas with the purpose of progressively joining the components of the EU Space Programme, some of which we have been working on for a long time.

In particular, within the framework of the Copernicus programme, agreements

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were signed with the European Commission and ESA in 2018 and 2019 respectively. As part of their implementation, in December 2019 the State Space Agency of Ukraine (SSAU) created the main data access point of the Copernicus Regional Mirror Site based on the National Space Facilities Control and Testing Centre. At the same time, images of the territory of Ukraine received by the Sentinel spacecraft were made freely available.

In the field of satellite navigation, we are also continuing the relevant negotiation process to prepare a draft agreement between Ukraine and the EU on the extension of the European Geostationary Navigation Overlay System (EGNOS) to the territory of Ukraine.

I believe that under the current circumstances, SSAU is engaged in a successful dialogue with the European Commission to deepen its participation in the above-mentioned components of the EU Space Programme and to join others.

We recognise the importance of develo-

ping cooperation with European countries. Our key partners are currently the Polish Space Agency, the Italian Space Agency and the Portuguese Space Agency. Recently, we have intensified the dialogue on deepening our partnership with the Slovak Space Office. We believe that Ukrainian-Dutch cooperation in the space sector also has significant prospects.

NASA is another important partner of SSAU. This April, SSAU and NASA signed a joint statement on cooperation in the field of peaceful space, which provides for the development of cooperation primarily through the Artemis programme. SSAU and the National Academy of Sciences of Ukraine have a number of proposals for projects to explore Moon and Mars. We are looking forward to the support of NASA and other international partners in this area.

We are already thinking about new plans and ideas, because the development and recovery of the state after Ukraine's victory in the war against the aggressor

will affect all spheres of life – the space industry, environmental renovation and many others. We incorporate the relevant approaches into special laws and key programme documents for the development of the space industry.

We remain ready to deepen cooperation in the scientific, technical and industrial fields. We are convinced that the space sector of Ukraine will maintain its investment attractiveness by preserving competencies, developing science, engaging young people and deepening relevant international cooperation with key partners.

In conclusion, our principal values mean to continue all activities we do for the benefit of humanity, for peace rather than war, for the triumph of technological progress rather than devastating destruction, and ultimately for the preservation and improvement of human life and prosperity.