

Towards an ambitious ESA ministerial Council 2019 – Eurospace views

Executive summary

The proposals set out in this paper in view of next ESA ministerial Council in 2019 follow from a wide consultation process of the European space industry, and the resulting priorities were recommended on the basis of a wide context analysis.

Industry believes that initiatives being currently under consideration at ESA are generally providing a sound bulk in substantial continuity with respect to the past, to which should be eventually added a set of challenging and large size initiatives, being each a sort of ESA flagship programme, namely:

- In **Science and Exploration**: an overall 5.9b€ subscription package is recommended. Flagships should be a new Lunar and a Mars exploration initiative, both fully autonomous and open to international cooperation;
- In **Applications**: an overall 3.8b€ subscription package is recommended. It should encompass a demonstration mission of space-based flexible digital VHTS telecommunication services in an integrated multi-technology 5G perspective, and in Earth observation an increased budget addressing in particular: expansion of Copernicus at the service of EU policies and preparation of future meteorological programmes and Earth Explorers;
- In **Enabling and Support**: an overall 3.6b€ subscription package is recommended. As regards Access to Space, it should encompass an optimised combination of accompaniment and development programmes including in particular the transitions to Ariane 6 and Vega C, their evolution programmes and in particular a reusability demonstrator, developments for small launchers, re-entry vehicles including Space Rider, as well as a contractual framework based on European launchers for European institutional programmes, aggregating the corresponding needs of European institutional customers;
- In **Space Safety and Security**: an overall 1.6b€ subscription package is recommended. It should encompass, in addition to SSA activities: In-Orbit-Servicing (IOS) demonstrations missions (in both LEO and GEO) and related technological developments aiming at creating a European worldwide-level leading capacity, a planetary defence demonstration mission, and a space weather mission.

The overall set of proposals would demand at next ESA ministerial Council an increase of subscriptions from member States with respect to recent ones, leading to an annual ESA budget, not including EU contributions, reaching a relatively stable level of about 5b€ per annum (5b€/a).

1. Introduction

The actors of the European space sector are facing unprecedented changes in markets and applications, characterised by a progressive consolidation of disruptive technologies, which may threaten the position of Europe within the space-faring community. New space powers and private actors have entered the field, both complementing and challenging existing industry and institutions. ESA and its member States have a huge opportunity to react in this highly dynamic global context reinforcing European industry's competitiveness, to the benefit of the whole industry chain as well as of space users (see annex for more details on context analysis).

The proposals set out in this paper would require an increase of subscriptions from ESA member States at next ministerial Council with respect to recent ones, leading to an annual ESA budget, not including EU contributions, reaching a stable level of about 5b€ per annum (5b€/a).

2. Recommended priorities towards an ambitious ESA ministerial Council in 2019

In Science and Exploration: an overall 5.9b€ subscription package is recommended. Flagships should be a new Lunar and a Mars exploration initiative, both fully autonomous and open to international cooperation. This would include European participation in programmes such as e.g. ESPRIT and HABITAT modules of the US-led Lunar Orbit Platform Gateway. Such an initiative could also be utilization-focused, targeting both the Moon and the cis-lunar environment, and consist e.g. of an Earth-Moon orbit cargo transfer vehicle, moon landing/ascending missions and related propulsion developments, installation of initial moon surface elements towards a moon village concept aiming at providing logistic services and exploitation of lunar resources, and necessary telecom infrastructure, with ESA also eventually playing the role of an anchor tenant role by purchasing recurring transportation/communications services.

This would have to be complemented by continuation/enhanced programmes, in coordination and complementarity as appropriate with national initiatives:

- In Science, a further area for ESA flagship programmes, addressing inter alia: LISA and ATHENA missions, medium-sized missions such as ARIEL and smaller/faster missions, with a very significant increase in the Science part of the Level of Resources;
- In Exploration, addressing inter alia within the European Exploration Envelope Programme (E3P): a) a contribution to an international – discovery-focused – exploration programme to return a sample from Mars (MSR), aiming at self-standing items; b) a renewed - expansion-focused - effort for life in LEO committing to the ISS until 2028 on the current spending level, pursuing cost reductions in favour of larger funding for utilization, and also exploring innovative ad hoc business models; and c) related space transportation.

In Applications: an overall 3.8b€ subscription package is recommended. It should in particular encompass a demonstration mission of space-based telecommunication services in an integrated multi-technology 5G perspective. This could be focused on flexible digital VHTS satellites technologies for 5G and an operational SatCom and terrestrial integration programmes, in PPP.

This would have to be complemented by continuation/enhanced programmes:

- In telecom, overall worth about 1.6b€, addressing inter alia: technology developments in digital technologies, active antennas, optics and photonics, ground segment, cybersecurity, cybersecure optical communications and quantum cryptography, low-cost production for next generation constellations, a GovSatCom technological preparation and pilot;
- In Earth observation, overall worth about 2.1b€, including an increased budget addressing inter alia: continuation and expansion of Copernicus (as space component within a multi-technology system of systems devoted to applications of EU interest such as e.g. border or maritime surveillance, monitoring of Arctic, as well as climate change monitoring), preparation (in EOEP Next) of future meteorological programmes and Earth Explorers;
- In Navigation, addressing a vision for enhanced applications and innovation in view of expected hybridization of various systems and sensors;

- In transversal areas, addressing - in complementarity to satellite capability – HAPS (for which interest is growing in user communities), with in particular HAPS-based demonstrations in different domains such as telecom and EO for in-flight validation, and data processing technologies allowing for optimization of combined usage of satellites and HAPS.

In **Enabling and Support**: an overall 3.6b€ subscription package is recommended. As regards Access to Space, it should encompass:

- an optimised combination of accompaniment and development programmes, including in particular the transitions to Ariane 6 and Vega C, Ariane 6 and Vega C evolution programmes including reusability demonstrator, preparation of future technologies and processes, developments for Mini Launch Vehicles and market of small size satellites, as well as for re-entry vehicles, including Space Rider, while addressing as well innovative and more automated and efficient manufacturing methodologies;
- a contractual framework based on European launchers for European institutional programmes, aggregating corresponding needs of European institutional customers (EU, ESA and national missions), so to provide the launcher sector with a guaranteed minimal critical volume of orders suitable to sustain the leading position in the commercial market and move towards the establishment of a level-playing field.

This would have to be complemented, in addition to continuing funding Basic Activities, with more resources in particular for the DPTD - by continuation/enhanced technology programmes higher budget lines, e.g. for GSTP and ARTES, focusing on the preparation of technologies in support to industry competitiveness and public demand, i.e. in areas such as: manufacturing and assembly in orbit and related robotic developments and IOD, high-resolution imagery optical /radar, active antennas, processing/storage capacity, on-board autonomy power supply, higher GNSS systems accuracy, higher data rates using laser communication, small satellite missions and non-dependence.

In **Space Safety and Security**: an overall 1.6b€ subscription package is recommended. It should encompass:

- In-Orbit-Servicing (IOS) demonstrations missions (in both LEO and GEO) and related technological developments, aiming at creating a European world-leading capacity, suitable for further business development also in PPP and/or on commercial basis (e.g. building on concepts such as Space Tug, Multi-Purpose Vehicle aiming at serving multi-applications in-orbit such as re-fuelling, re-positioning, re-purposing, disposal of space assets and debris removal); and
- A space weather precursor mission and an opportunity mission at Lagrange Point 5, which would provide unique observations to form the basis of European service operations.

This would have to be complemented by continuation/enhanced or re-adapted programmes:

- SST: implementing a programme complementary to - and commonly shared with - the EU SST programme, so as to develop a European autonomous capability for Space Traffic Management, including optical & radar technologies (also in the perspective of civil-military synergies);
- Planetary defence: developing a demonstration mission of asteroid deflection (HERA), re-adapting the AIM concept not subscribed at last C/M.

Budgetary recommendations – The above recommendations are summarised in the table hereafter.

Programmatic pillars	Recommended budgets (b€)
• Science and exploration	5.9
• Applications	3.8
• Enabling and supporting	3.6
• Space safety and security	1.6
Total	14.9

Annex - Context analysis

The space sector in support to global policies – From space it is possible to study and explore outer space, investigate science in space, provide services to our planet. This latter dimension has grown significantly worldwide in the last decades, and several are the EU policies taking today advantage of space infrastructure and services: transport, environment and climate change monitoring, connectivity and innovation, security and defence, agriculture and forestry management, fishing and aquaculture, land and sea monitoring, etc., resulting in a constantly growing customer/user driven dimension for the space sector.

Positioning of European space industry – Recent data show that European space industry, with only 4% of worldwide workforce is manufacturing about 18% of spacecraft mass worldwide, with about 16% of satellites in orbit and commercial market representing around 40% of its sales. Institutional funding and market were key in establishing this position; they will remain a prevalent driver in a challenging global context for industry competitiveness, of the reinforcement of which the whole space sector supply chain would benefit.

Trends at international level in institutional budgets - Europe invested 7.7b€ in space in 2017, in a moderate growth trend, and European industry has been requested in various cases to provide co-funding of R&D activities & programmes. On the other hand, space budgets in other space powers have been experiencing more significant growth at the benefit of their industry, generally without mandatory co-funding rules:

- NASA budget amounted to 19b\$ and US DoD published budget was about 24b\$ (the latter under-representing the actual institutional investment); in addition, such amounts do not include resources from private investors coming e.g. from the ICT sector). NASA budget recently awarded for fiscal year 2018 even exceeded requests, overcoming for the first time 20b\$ (namely 20.7b\$);
- Russian budget has experienced an annual average growth rate above 10% in the last decade;
- Chinese space activities kept growing regularly in all application areas and exploration, as e.g. explicitly shown by launched mass in 2016 being about twice launched mass in 2014;
- India launched recently a very ambitious space strategy, expected to be supported by commensurately growing financial resources in the years to come.

Global asymmetries - While Europe has been essentially securing a captive market only to space R&D, other space powers have been always securing their captive space market to all their industrial national champions, whenever having at disposal the needed technologies. This has created asymmetries in market access, both in the domains of satellites and access to space. In particular in the latter, some competitors of European industry benefit in their captive market of much higher prices than those applied in the commercial market (so adding heavy market distortion leverage to absence of reciprocity in market access).

Applications - The dynamic market for space applications demands innovation both in technology and business models, this being acknowledged and implemented by ESA also through the adoption of PPP schemes and other mechanisms. While public support remains essential and unreplaceable, it is key that this commercially driven innovation may continue in Europe, allowing market access and development through relevant combinations of institutional, commercial and private funding in all relevant domains: telecommunication, Earth observation and navigation.

Satellite communications & ICT hybridization - The space sector is undergoing a “revolution”, with a fast acceleration of innovation cycles and risk taking, and an increasing proximity between space and the digital world. In this context, efforts from the EU to accelerate the transition towards a data-driven economy cannot be decoupled from Europe having a sufficient control on its capacity to access and disseminate information; key enablers to success are therefore renewed public strategies, in particular for the upstream. Space can

contribute in the digital era to spread the benefits of space-based applications to society; space is above all a critical infrastructure of a digitalised society in a globalised world. Space is capable – in particular in the context of the future 5G network, and its incoming standards - to ensure required uninterrupted connectivity everywhere, unobtainable without the use also of satellites. Nevertheless, today, satellites are not yet fully integrated with other technologies in the 5G perspective, even if trends show orientation towards multilayer end-to-end communication systems integrating terrestrial telecommunications with satellites and constellations as well as UAS and HAPS.

Security & defence - There is an undisputed need for Europe to secure the resilience of its critical infrastructures – including in space – and mitigate threats on Earth or in the space environment (i.e. space weather, near-Earth objects and debris). In addition, Europe is still the only space-faring power with limited defence-related space programmes, even though this capability is by nature a key element of independent decision-making and action. Security of European assets in space and security from space are expected to be central in the ongoing security/defence-related initiatives being under discussion in the EU frame.

Science and exploration - Science missions continue to foster and support world leading scientific research, providing a deeper understanding of the universe and the planet Earth, and inspiring generations. Exploration missions help discovering the unknown and pave the way for innovative technology developments with important fall-outs beyond the space domain as well as for the utilization of resources in extra-terrestrial locations. These missions are necessary to keep European science and scientists at the leading edge of knowledge and competence, and are at the very heart of ESA mission, especially when of large ambition and size.

Challenges and opportunities – The space Industry is facing a fast acceleration of innovation cycles and risk taking, to which it is called to reply with a deep transformation: the most pressing need is to be able to adapt as quickly as possible to significant disruption in design, development, production, qualification and validation processes, for both space infrastructure and transportation. In this context, the European space industry demands a multi-fold public role:

- As “Regulators” as well as “Customers” (the latter meant as users of space capabilities), in order to contribute to the improvement of the level-playing field;
- As “R&D Sponsors” in order to improve competitiveness and non-dependence, moving towards the target of achieving unrestricted access to the state-of-the-art critical technologies at reasonably affordable economic conditions.