

Towards an ambitious ESA ministerial "Space19+" – Eurospace views, 2019

Executive summary

The proposals set out in this paper in view of next ESA ministerial Council in 2019 are a refinement of the 2018 version, elaborated via a wide consultation process of the European space industry, with resulting priorities being 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 6b€ subscription package is recommended. Flagships should be in Science LISA and ATHENA missions, and in Exploration new Lunar and Mars initiatives, both fully autonomous and open to international cooperation;
- In **Applications**: an overall 4.4b€ subscription package is recommended. It should encompass a demonstration mission of space-based flexible digital VHTS telecommunication services in an integrated multi-technology (including in particular optical) 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 3.7b€ subscription package is recommended, with a particular focus on digitalization of infrastructure and processes. 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 1.9b€ subscription package is recommended. It should encompass, in addition to situation awareness and cyber-resilience activities, a series of new safety activities, such as: 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 package should also include space security and safety applications.

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, growing from the current level of about 4.1b€ per annum towards a relatively stable level of not less than 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).

In this current context, the investments in Space19+ programs should particularly target programs which are reinforcing the European autonomy in Space, fostering competitiveness of the European Space industry and have a lever effect on creating jobs and promoting the outreach of space industry and technologies throughout the World. Furthermore, recent developments in the US ambition for Space Exploration are opening new opportunities for European exploration; it is up to ESA to choose international partnerships procuring sustainable activities from European industry and giving to Europe a strategic place in the international exploration framework.

Last but not least, the industrial policy of ESA shall align to the current challenges and propose the necessary flexibility for programs addressing competitive markets. The georeturn shall be used as a collective strength, not as a weakening constraint.

Therefore, with regards to this level of ambitions, 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, growing from the current level of about 4.1b€ per annum towards a stable level of not less than 5b€ per annum (5b€/a).

2. [Recommended priorities towards an ambitious ESA ministerial Council in 2019](#)

In **Science and Exploration**: an overall 6b€ subscription package is recommended. Flagships should be in Science LISA and ATHENA missions, and in Exploration new Lunar and Mars initiatives, 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 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 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 that towards icy planets, smaller/faster missions and support to payload development, with a very significant gradual increase in the Science part of the Mandatory Activities, accompanied by persistent inflation compensation ;
- 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 perspective.

In **Applications**: an overall 4.4b€ subscription package is recommended. It should in particular encompass a demonstration mission of space-based telecommunication services in an integrated multi-technology (including in particular optical communications) 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 1.7b€, 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; a package devoted to telecom-based applications for space safety and security should be included.
- In Earth observation, overall worth about 2.6b€, 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 – including in particular security applications - 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, overall worth about 0.1b€, 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 3.8b€ subscription package is recommended.

The package includes two main programmatic domains. Access to space, for which a total of 2,9B€ should be the target, and continued funding for Basic Activities, with a target of 0,8B€, to support in particular technology preparation activities.

As regards Access to Space, the investment for Space 19+ should reach 2.9 b as the European launcher industry will enter a transitional period, with the end of Ariane 5 exploitation. The expected launches of FM1 of Vega C and Ariane 6 are scheduled in 2020 followed by a progressive ramp-up of the new generation of launchers until the Full Operational Capacity. The unpredictability of the evolution of the launch service market and the harsh competition at international level, are requesting to enhance competitiveness and agility in European launchers. Therefore a comprehensive set of evolution programs has to be started, enabling further improvements allowing to increase competitiveness and enabling development of new services. This should include recovery and reusability demonstrators, preparation of future technologies and processes, support to the development of small satellites launch services including Microlaunchers as well as for return-from Space vehicles, such as Space Rider.

In addition, there is an essential need for the aggregating European institutional launch service needs (EU, ESA, Eumetstat and national missions) through a contractual framework, thus 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 with an international competition strongly sustained by national captive domestic markets.

This would have to be complemented, in addition to continuing funding Basic Activities, with increased 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, non-dependence and digitalization of infrastructure and processes.

In **Space Safety and Security**: an overall 1.9b€ 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);
- Planetary defence: developing a demonstration mission of asteroid deflection (HERA), re-adapting the AIM concept not subscribed at last C/M.
- Awareness: 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) and collision risk avoidance automated systems
- 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;
- A safety and security application package

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

Programmatic pillars	Recommended budgets (b€)
• Science and exploration	6
• Applications	4.4
• Enabling and supporting	3.8
• Space safety and security	1.9
Total	16.1

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 8.8b€ in space in 2018, with 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 20,7b\$ in 2018, with growing expectations (up to 21B€ in 2020) and US DoD published budget was about 24,5b\$ (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);
- Russian civil budget has experienced an annual average growth rate above 10% in the last decade, and information on military space spending is not published;
- Chinese space budgets are not published at all, whether civil or military, but the growth of Chinese space activity in recent years has put China in the second place in terms of spacecraft produced and launched mass;
- 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 - together with space applications for defence - 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.

Annex- Key figures

European Space Budget 2018: 8 805 M€				
By source				
National Space Budget (civil+military): 7 356 M€			EU Budget: 1 449 M€	
By programme managing entity				
Military Programmes:	Civil Programmes:	Budget managed by Eumetsat:	Budget managed by ESA:	Budget managed by DG GROW (H2020):
1 070 M€	2 332 M€	261 M€	5 082 M€	61 M€

Source: Eurospace analysis

Facts and Figures press release (data DRAFT)	
Direct industry employment: 43 454 FTE	
European Space Industry sales by main customer segment	
Final sales worth: 8486 M€	
Final sales to Europe Institutional: 5 432 M€ (64%)	Final sales Commercial Europe + export: 3 054 M€ (36%)
ESA programmes: 2 812 M€	Launcher systems: 928 M€
EU programmes: 797 M€	Spacecraft and Ground segment: 2 015 M€
Eumetsat Programmes: 225 M€	<i>Commercial: Main trend export market strong decrease</i>
National Civil Programmes: 938 M€	Other & unknown: 111 M€
National Military Programmes: 661 M€	

Source Eurospace facts & figures 2019 edition

Global Space Budget Figures (in US Dollars) average order of magnitude

USA: 44 000 M\$ (1st)	Japan: 3 000 M\$
Europe: 9 000 M\$ (2nd)	Russia: 1 500 M\$
China: 8 000 M\$ (3rd)	India: 1 500 M\$

For comparison below, the mass launched for institutional programmes

Spacecraft mass launched in 2018 for institutional programmes (by customer)

USA: 90 t (1st)	Japan: 20 t (4th)
Russia: 70 t (2nd - includes ISS crew for NASA)	India: 10 t (6th)
China: 60 t (3rd)	Europe: 16 t (5th)

Source The Space Report 2018 and Eurospace LEAT database

Global Space Activities: Total mass launched in 2018: 392,8 t (in line with annual averages of the decade)

Mass launched by launch site country

USA: 152 t	<i>Mass launched decrease a bit since 2017 (1st since 2016)</i>
China: 78 t	<i>Mass launched increase (4th in 2015, 3rd in 2016 and 2017)</i>
Ex-USSR: 67 t	<i>Mass launched decrease (1st in 2015, then 2nd until 2017)</i>
Europe: 57 t	<i>Mass launched decrease (3rd in 2015, then 4th since 2016)</i>
Japan: 27 t	<i>Mass launched increase, ranking stable</i>
India: 12 t	<i>Mass launched increase, ranking stable</i>
Others: 0,098 t	

Spacecraft mass launched by SC manufacturer country

USA: 130 t	<i>Mass launched decrease since 2016 (1st since 2015)</i>
China: 76,5 t	<i>Mass launched increase (4th in 2015, 2nd in 2016, 4th in 2017)</i>
Ex-USSR: 65 t	<i>Mass launched decrease compare to 2017 (2nd in 2015 then 3rd)</i>
Europe: 59,5 t	<i>Mass launched decrease compare to 2017 (3rd in 2015, 5th in 2016, 2nd in 2017)</i>
Japan: 38,8 t	<i>Mass launched increase, ranking stable</i>
India: 16 t	<i>Mass launched increase, ranking stable</i>

Spacecraft mass launched by mission

Telecommunications: 131 t	<i>Mass launched decrease since 2017 (1st since 2015)</i>
Remote sensing: 94,8 t	<i>Mass launched increase (3rd since 2015)</i>
Human activities: 92,6 t	<i>Mass launched decrease (2nd since 2015)</i>
Navigation / Localisation: 42,5 t	<i>Mass launched increase</i>
Technology tests / IOD: 9,8 t	<i>Mass launched increase (6th since 2015)</i>
Science: 7,4 t	<i>Mass launched decrease (5th since 2015)</i>

Source: Eurospace LEAT Database