(STARTING TO) PAVE THE WAY FOR THE FUTURE OF EU SPACE R&I

EUROSPACE FIRST INPUTS TO THE EUROPEAN COMMISSION'S FUTURE STRATEGY FOR RESEARCH, DEVELOPMENT AND INNOVATION (R&D&I)

Preamble

The elaboration of a dedicated Space R&I Strategy at EU level is very much welcome by the European Space Industry. An R&I Strategy is one of the key pillars of a much-needed technology strategy, itself part of a future European-wide Industrial Strategy for Space. In this context, the objective for the European space industry is that this R&I Strategy contributes to ensure the on-time availability of needed/advanced technologies - with the appropriate maturity and performance, the required level of non-dependence, and at competitive conditions - for risk mitigated implementation in the European institutional programmes, and in the commercial) programmes where Industry faces an increasingly harsh competition.

Indeed, as the European space sector needs to be competitive in order to be sustainable (contrary to what happens in all other space powers), Europe shall be able to bridge the current gaps and keep ahead of its competitors. This can only be achieved with appropriate funding effort, and with a stronger and sustainable commitment of all stakeholders under the industrial leadership for the definition, implementation and coordination of the activities related to its competitiveness on the open markets.

EU Space R&I actions shall be considered as part of a wider EU Space Industrial Strategy whose main goal shall be to preserve, secure and further strengthen Europe's world-class capacity to conceive, develop, launch, operate and exploit the space systems it needs for the implementation of its public policies, its security and its economic growth.

With the limited and scattered funding available for space R&I in Europe, the matter of its effectiveness is absolutely crucial: developments should be appropriately targeted and correctly performed, and shall focus on supporting EU space strategy objectives.

In other words, it is not the role of the future Space R&I strategy to define the vision for Europe in space in the future, but to define the role of EU-funded R&I programmes in order to support the EU strategy in space, including for Security & Defence.

Horizon 2040: R&D&I to clear the horizon of the EU in Space

Today, **Europe is a second-rate space power** falling behind the three space superpowers (i.e., the USA, China and Russia) in particular in the domains access to space and "sovereign applications" (situation assessment and control, intelligence, early warning *etc.*). At the same time**, Europe has demonstrated its capacity to deliver world class operational systems** for GNSS, Earth Observation and climate monitoring, and meteorology.

While a lot of attention is today drawn onto future exploration endeavours on the Moon and Mars, and the projected development of Low Earth Orbits (LEO) habitats, these areas will most likely not, even twenty years from now, be the more immediately contested in the space domain, or the ones with the most important economic or societal impacts.

If the projected growth of commercial (and military) constellations promoted by both US and Chinese actors are fully realised, with tens of thousands of active satellites in LEO (i.e., one, maybe two, orders of magnitude more than today), **essentially any space operation will become increasingly challenging and risky**, especially for smaller scale players, and will be constrained by the largest powers and operators.

There are still uncertainties on whether mega-constellations will economically be sustainable and durable; but the incredible proliferation of satellites in LEO is already underway. This is creating **increasing concerns due to**

orbital as well as frequency congestion, with more collision risks, and more debris and space-related pollution in general.[1]

The **capacity to preserve European interests in space in the long term should not be taken for granted, and therefore shall not be overlooked**.

Europe is facing an unprecedented acceleration of the innovation cycles. This requires new schemes of innovation, long term investment and foreseeability for the industry. All major space powers have deployed consequent program to support innovation in space (e.g., SDA in the US). We need to go faster in the process and ensure consistency of the different sources of budget to support innovation.

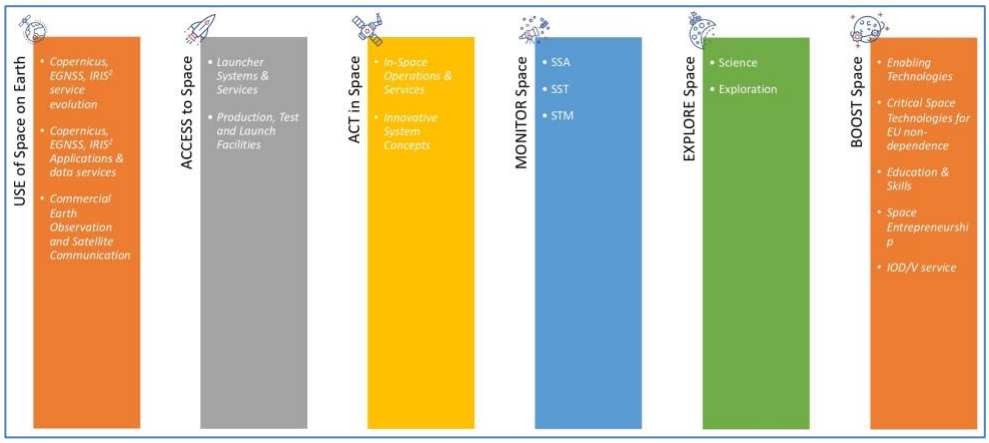
In parallel, the **militarisation of space** is also a trend to be recognised, as shown by military systems deployment (particularly from the US and China) that have accelerated in recent years. With the crystallisation of sovereign foreign space interests hinging on military and defence applications, the **EU will have to enhance its capability to maintain critical infrastructures in orbit**, and avoid leaving a wider gap with its partners and competitors in space.

Europe shall be able to position itself with means to independently monitor the orbit and the space environment, with the ability to call out "rogue" behaviour and promote responsible use. Moreover, European programmes should have the capacity for **enhanced manoeuvrability and resilience** to navigate an increasingly congested/contested orbital environment. And of course, Europe shall devise a **long-term strategy for sustainable access to the Earth orbit**.

Finally, Europe has an opportunity to position as a leader in the decarbonisation of space activities. In the quest to ensure carbon neutrality by 2050, we can expect an intensified scrutiny on space industry emissions. Anticipation of durable and low emission manufacturing and architectures will not only become mandatory but could also become a differentiator with respect to international competitors. This effort is already ongoing but will have to be intensified, and may have to influence programme choices and system design and architectures.

Prioritising our efforts in a limited funding context...

The European Commission identifies **six main building blocks for EU Space R&D&I** (see below), aiming at tackling the full panorama of space research.



[1] *The impact of the acceleration of space activities on the Earth environment itself being very much an uncharted territory today.*

The **high ambitions of the European Commission towards space research** are very much supported by the European space industry. The EU has already set a high level of ambition in space during the current Multi-Annual Financial Framework and it is likely to steer the space agenda in the upcoming years (e.g., modernisation of EU space flagships, development of a new space infrastructure such as IRIS², implementation of the EU Space Strategy for Security and Defence...). With the EU Space Law, the European Union will aim at creating the conditions for fair competition between European and non-European players.

Unfortunately, as recognised by the latest Opinion of the European Economic and Social Committee (EESC) entitled "*Towards a more resilient, competitive and sustainable Europe*"[2], "the funding gap with the US and China for space is widening. European space budgets are six times lower than those in the US, and the budgets available within the EU are mostly uncoordinated, while American space doctrine has made space a key instrument for its supremacy and independence in this domain".

With the **relatively limited funding available for space technology development in Europe, the matter of its effectiveness is absolutely crucial**.

The EU shall therefore not ambition to cover consistently all areas and applications of space (in particular in areas where the EU is not pursuing any programmatic goal) but to focus on the evolution of European "policy-driven" space infrastructures, on Industry competitiveness on the global markets and on the preparation of future large-scale European flagship programs, in the continuation of IRIS², Galileo or Copernicus.

The need to consolidate and strengthen the European supply chain

The six pillars identified by the European Commission are probably not sufficiently addressing the **consolidation and strengthening of the European supply chain** (with an insufficient focus today on key products and baseline or enabling technologies).

As the space industry is one of the most research-intensive sectors in Europe (notably due to the high technological constraints of space systems), **space technology and product development require important investments** in industrial equipment (including test equipment), software, design & modelling tools and protocols development & maintenance, not to mention the scientific and technological competences required within industry, agencies, research centres and laboratories.

In 2024 and beyond, **European equipment are expected to support new challenges for space markets**, in particular:

- Shorter lead times;
- Adaptability to swift market evolutions;
- Production in larger series or batches (e.g., for COTS equipment), with global quality control;
- Higher potential for re-use, considering interfaces, standard designs and applicability across a variety of systems, missions and applications;
- New requirements and regulations supporting sustainability, lower environmental impact, autonomy, reparability.

EU research should therefore **aim at strengthening the European supply chain**, by addressing two main areas:

[2] *https://www.eesc.europa.eu/en/our-work/opinions-information-reports/opinions/towards-more-resilient-competitive-and-sustainable-europe*

- **Incremental R&D&I**[3], aiming at the adaptation, verification and qualification of incremental improvements to existing equipment and functions for spacecraft, launcher and ground systems (including the progressive integration of newly-developed components and building blocks);
- **Innovation or disruptive R&D&I**[4], aiming at the introduction of more radical innovations in technology and/or processes in the equipment supply chain for spacecraft, launcher and ground systems.

... and in a challenging context

The **absolute criticality of space** as a key asset for the independent and informed decision-making and action-taking of European policymakers has **long been recognised**. Regrettably today, the **current challenges and threats to the European space sector are not seriously assessed, nor addressed**.

Despite a very strong position in the global market and an expertise recognised globally, the whole European space value chain is **disrupted** and its **sustainability is threatened** by **geopolitical** and **economic & industrial threats**.

Geopolitical and regulation-related threats

In an increasingly polarised world and where a certain national "protectionism"[5] tends to be observed, the **challenge for European actors is to exist** i.e., be very active on the very small segment of open and export markets, with the American one remaining the main market in the coming decade.

With a limited budget, it is important to define **limited areas on which Europe wishes to be strategically independent** and establish clear priorities.

Europe remains **dependant from non-European countries** for a number of components, technologies, equipment, and raw materials. In a geopolitical context of growing conflicts, this dependence can be used as a **weapon to slow down European space projects and restrict their marketability**.

Finally, **unregulated or low-regulated space represents a danger in the long-term for the European space industry**. The Earth orbit is today populated by a large amount of space objects (whether they are operational satellites or space debris). The trend towards an increase of space activities (e.g., CubeSats, deployment of large constellations in LEO) will eventually lead to a congestion of the space environment, thus increasing collision and interferences risks and the complexity of decision-making processes concerning the evasion and collision avoidance manoeuvres. Some countries (i.e., the US) have already paved the way for a national STM regulation that will eventually have an **impact on European actors** and **jeopardise European sovereignty** as an overarching objective of the EU for space.

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[3] *Incremental R&D&I is key in particular for demonstration (that will qualify the product as "flight-proven"), which is required by the market. Indeed, time-to-market being critical, this can accelerate the visibility of European players on the global market.*

[4] *Innovation or disruptive R&D&I should focus on "enabling technologies" that are required to enter the market in a long-term perspective.*

[5] *Space markets worldwide are characterised as captive markets: Space markets, due to various restrictions that fall within the ambit of several political, economic, social, and technological barriers are often not accessible at the same level to all suppliers. It is the case in the USA, Russia, India and Japan where all institutional needs are exclusively served by their own national players, thus making them benefit from a strong competitive advantage and having a direct consequence for the European space industry on the export market.*

Economic & industrial threats

The issue of the **fragmentation of the demand and of the offer**, the **low volume of the European institutional markets**, the rapid **disappearance of a significant part of the traditional space commercial market** and the continued **decrease of industry's profitability** are threatening the sustainability of the supply chains, the retainment of expertise and, ultimately, Europe sovereignty.

The situation is likely to be further aggravated by the rapid progresses observed in many non-European countries that are developing a sound, exhaustive and well-funded vision of their space ambition (including in innovative domains where business cases have not yet been fully proven e.g., in-space operations, refuelling, innovative transport layers, miniaturisation of sensing missions).

Finally, the **acceleration of the innovation cycles** that requires new mechanisms to deliver, de-risk and develop faster, associated to a **limited supply chain** (especially within electronics with heavy dependence on the US but also other countries around the world), is another barrier to overcome.

Drive forward EU Space capabilities and services

It is therefore vital that Europe's growing reliance in space-based services is **accompanied by measures aiming at enhancing and driving forward its space-based capabilities and services**, that would follow four main objectives:

- **Ensure European technological sovereignty over its domestic market**:
  - Non-dependence for key technologies and critical infrastructure.
- **Ensure European competitiveness internationally**:
  - Through a dynamic European supply chain with efficient products that shall be made available at any time and be less expensive by reducing constraints and easing requirements (i.e., norms and standards).
- **Anticipate disruptions and generate our own European-led ones**:
  - Lead a harmonised usage of space, exploiting the convergence of multiple new technologies (e.g., Artificial Intelligence, automatization, cloud-based data access and distribution, real-time tasking enabling technologies) which will support new services or allow to develop new products for the benefits of end-users (e.g., emergency, health, financial services, telecom, sustainable usage of natural resources);
  - Fund a larger number of initiatives to validate the concept of innovative space systems where Europe could take the lead; then, past the validation of concept, increase quickly the support to concepts likely to create new markets;
  - Align investments with sustainability objectives, so as to reap the benefits from sustainable space activities (both in space and on Earth).

A secured and ambitious R&D&I support through the European Union's Framework Programme (and European Defence Fund)…

Today's investment in innovation will be the driver of tomorrow's competitiveness for the European space sector: maintaining Europe's leadership in space implies indeed the availability of a first-rank domestic industry, able to design, deliver and exploit state-of-the-art space systems, required by public and private customers worldwide.

EU funding in R&D&I is needed to boost European competitiveness and innovation, and contribute to job creation and growth. From this standpoint, the implementation of EU Framework Programmes, via relevant

budgets, adequate tools and appropriate priority areas, shall ensure that Europe consolidates its leading position, and serve above-mentioned four main objectives.

The quality of the funding should be measured by key characteristics:

- **Consistency and predictability**: an ambitious and efficient R&D strategy, aiming at supporting European Industry competitiveness, maintaining the technological readiness of the EU-owned strategic infrastructures and preparing the development of the new components of the EU space programme has to ensure consistency, coordination and harmonisation among the various sources of funding for space R&D&I at national and European level (European Defence Fund, Horizon Europe, European Defence Agency and ESA funded R&D);
- **Persistence**: the European space sector needs the presence of a stable, reliable, persistent (i.e., long-term) investment plan to support any serious ambition;
- **Efficiency**, by:
    - Focussing investments;
    - Fast decision-making, agility and opportunism when needed;
    - Adapting the procurement rules so as to focus expenditure on the actual activities related to the targeted breakthroughs and avoid spreading investments over a large number of actors in the same area of expertise;
    - Supporting technology building blocks linked to competitive and mature technologies that have demonstrated their commercial viability on the market.
- **Balanced positioning** in the global ecosystem: technological and component-level non-dependency shall be pursued to enhance European autonomy. At the same time, Europe should find niche key infrastructure and capabilities that are much sought-after and therefore valuable on the global market;
- **Specific coordination and synergy with ESA** on key infrastructure and services, and commercialisation policies.

... serving a number of technology priorities...

In the short to mid-term

EU Space R&D&I should first and foremost strengthen the areas in which the European space industry is already well positioned.

It is also key to identify the **enabling technologies that will become essential or even critical**, e.g.:

- Increased support to the evaluation of new mission concepts towards a European flagship program (IoT, connected cars, servers in space, quantum communication…)
- Active antennas;
- Integrated photonics;
- On-board computing using AI;
- Fusion of Space surveillance data (radar/optics/RF) including fusing space-based and ground-based origins;
- Digitalisation;
- Autonomy of satellites;
- Active cooling in space;
- Solar generators;
- Ultra-Deep Sub-Micron technology for efficient FPGA and ASIC solutions and System-in-Package;
- Smart structure skins (resilience to debris and aggressions);

- Space cloud infrastructure[6], able to process data from large distributed systems, integrating terrestrial and ground infrastructures.

Within a ten-year timeframe

The major priorities identified for the next 10 years are:

- A more sustained investment in **European sovereign capabilities** to reduce the gap with Europe's main competitors. This would also enable regular IOD/IOV missions that are vital to increase the readiness of European solutions;
- **Affordable, robust and sustainable access to space**, building on cooperation and European interdependence to achieve fully independent orbital access for all European programmes;
- **Space Situational Awareness** via SST-enhanced sensor network, improved and interoperable database and added value services;
- Modernisation and expansion of **Copernicus & Galileo** constellations and services;
- **Governmental satcom** added-value services for different use cases;
- **Multi-layered (GEO, MEO, LEO, VLEO) satcom constellations** and **enabling technologies** (propulsion, structures, cyber, intersatellite links, orchestration traffic distribution etc.), paving the way to the future interconnection of missions in space;
- Building significant **European capabilities for in-orbit related operations**, recognising the potential of adverse use of these capabilities and the need to protect European infrastructures and interests in space (market-driven servicing, in-orbit manufacturing and assembling, self-protection, debris removal, reusable in-orbit vehicles, in-orbit repair, observation and mitigation of threats);
- **Reducing costs and speeding up production times for mass-produced satellites** with new, more digital and faster production and testing methods;
- **Up-to-speed ground segment operations** with technology innovation and maturation allowing to handle high data rate with stronger security requirements and develop *Software as a Service* (SaaS) with an open and flexible architecture available on cloud;
- **Cybersecure space supply chains** (i.e. in a large number of products and services including chip components and modules/sub-systems used in satellites and other payloads, applications, communication, backend systems and cloud platforms, on the ground and in space).

... leveraging on European and international collaboration

A **common agenda and priorities shall be agreed at EU, MS and ESA level** and give to the different actors the appropriate mandate to build the programmes coherently with the agreed objectives.

A **common line for key areas** shall be defined, implemented and progress monitored. A **stronger coordination between the actors** is very important to maximize synergies, achieve non-dependence and have a strong and healthy European market. The roles of the different actors should be clearly defined, **including the role of industry** in the different cases.

The **Joint Task Force on Critical Technologies for Non-Dependence** revealed a list of needed actions worth a budget significantly bigger than what has been attributed to it so far, by several orders of magnitude. With a number of important improvements needed to improve the process and to facilitate the prioritisation of topics, the collaborative approach between ESA, EDA and EC is welcome and should be continued but Industry insists

[6] *The AI and data centre industry is highly dynamic, on a trajectory leading to the consumption of 7 to 20% of the European energy by 2050. Transferring some capacity in space where energy could be less CO2-intensive could contribute to sustainable energy solutions, while being commercially viable and an immense accelerator in European space technology capacity such as green access to space, on-orbit robotics and assembly, for a leading future European space ecosystem.*

to be involved in a transparent and coordinated way as a fourth partner around the table, as dependence issues are as much a concern for institutional programmes as for commercial ones.

The case of the Co-Programmed European Partnership on Globally Competitive Space Systems

Eurospace has been at the origin of the idea of a **Co-Programmed European Partnership with the private sector called Globally Competitive Space Systems (GCSS)**.

At the very basis, the idea of a partnership is to allow the private sector to be in the driving seat when it comes to defining the R&D&I areas where investments are needed to support the competitiveness of the space sector. The rationale is very simple, **if the EU has the political objective of supporting the space sector competitiveness, then it is a good idea to listen directly to the entities that are actually in competition and have a detailed knowledge of the expectations of the markets**.

Very concretely, this co-programmed partnership enables the private sector and the Commission to co-create a development plan for implementation through the Horizon Europe Work Programmes. Today, the private stakeholder community involved in the partnership is composed of the members of the 5 founding associations, covering the full supply chain for space systems in Europe (EASTRO, EASN, ESRE, Eurospace, SME4Space).

Even if Eurospace regrets the very low budget allocated to the partnership (150M€ for three years) and is much worried that this budget reduction reflects a reluctance, by Member states to support Industry competitiveness at European level, **Eurospace thanks the European Commission efforts to launch this partnership**.

Eurospace strongly believes that a co-programmed partnership is key to **accelerate innovation**, provide **more focus**, **more agility** and **more budgets** for research through a coordinated approach to achieve competitiveness goals because the investment by industry will be leveraged by the Union.

This is why, Eurospace recommends to continue the exercise beyond the current MFF, with stronger ambitions (full coverage of FP10 Space priorities) and budget.

Going beyond R&D&I: the need for a European industrial strategy for space

There is an **ever growing need to ensure that the public authorities have an unrestricted access to the space-based capabilities they need in order to implement public policies and enable the expected services, with the required level of independence**; meaning that these critical capabilities can be consistently sourced in Europe and under the control of European entities.

Hence, with the ambition to build a globally competitive and sovereign European space economy in a highly challenging international market, **the European industry urges decision-makers at EU and Member States level to devise a coherent, European-wide, industrial strategy for space**. Such a strategy shall aim first at tackling the issues of the **fragmentation of the demand and of the offer**, the **dependence on critical technologies and systems**, and the **drop of industry's profitability that hampers the capacity for further own investments and full realisation of PPPs**. Based on large world-class space programmes, the strategy will **contribute to guarantee the robustness and the excellence of European space industrial supply chains.**

Finally, and following the recommendations of the EU Space Strategy for Security and Defence, there is a real **necessity to leverage the complementarity and to exploit synergies between defence and civil capabilities** to develop new technologies to be used for both civil and defence needs.

The European space industry also highlights the necessity for Europe to **reinforce the demand**, and be able to establish **long term purchase commitments** or **recurrent procurement** through innovative processes. Such new ways of procuring will require developing solutions that are tailor-made to the different markets and actors, whether they are big, mid or small.

A future space industrial strategy shall also encourage the **commercialisation of new services**, in areas where credible viable markets have been identified:

- The EU and MS indeed have an important role in **creating sustainable business** by nurturing a new market or business model buying services, especially acting as anchor customers guaranteeing business in the early stages when the new business model or market is being developed;
- **EU standardisation** can act as a strong enabler for market uptake, but taking into account possible risks of worldwide competitiveness and therefore facilitating a larger adoption as much as possible;
- **End-to-end IOD/IOV missions** with an open interface to foster innovation and early testing capabilities in Europe needs to be continued and well-funded, with the European Commission prioritising access to the service to the most mature and impactful deliverables;
- **Reconfigurable laboratory satellites** could allow experimentation and rapid acquisition of "flight-proven qualification".

In order to remain competitive on the international scene, industry also insists that a future space industrial strategy will need to **help Europe keep a level playing field with other partners**. Such strategy for space will therefore be instrumental to reinforce European positions on the international scene and to promote European standards and rules of behaviour, in particular for sustainability and environmental impact mitigation, which can, in a reciprocal way, enhance industry competitiveness.

Finally, industry emphasises the necessity to **better coordinate efforts among European space stakeholders – EU, ESA, their respective Member States and industry – in order to reinforce and leverage their contributions**. It is more than time, for the European Commission and ESA and their Member States, based on their respective competences, to devise now key common principles for a future industrial strategy for space and to identify and reflect about the most efficient instruments they have at their disposal to implement it. **There is no "space power" in the world without an industrial strategy to implement its space policy**.