



## Space 4.0 A guiding vision for ESA

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*Space 4.0 has been coined as the motto of the current space age and is a guiding vision for ESA as an analogy to the concept of Industry 4.0 on Earth. Building on the earlier eras of astronomy, competition and cooperation, a 4<sup>th</sup> era is emerging that should see more and more programmes done in participation around the world. ESA programmes and activities in the frame of this Space 4.0 age resonate with the actions to Inform, Innovate, Interact and Inspire, “Space 4.0i”.*

### 1 Space 4.0 concept

#### 1.1 The two new guiding visions for ESA

Two guiding visions have recently been elaborated to support the daily activities and the elaboration of future programmes of the European Space Agency: Space 4.0 and United Space in Europe. “United Space in Europe” stands for the integrative cooperation between European actors to achieve our common goals, ensuring a successful Europe in space, for the citizens, for society and for industry.

#### 1.2 The Space Eras

“Space 4.0”<sup>1</sup> represents the characteristics of our space age, defined as a 4<sup>th</sup> chapter in our exploration and use of outer space:

- Space 1.0 was the age of early **Astronomy**, before the first satellites, when outer space could only be considered by the means of astronomy or even astrology;
- Space 2.0 was the age of **Competition** with spacefaring nations engaged in a space race that led to the Apollo era;
- Space 3.0 was the age of **Cooperation** with the emblematic project of the International Space Station that sees major space nations or organisations joining forces and resources for one project;
- Space 4.0 has now started with what can be called the age of **Participation**, characterised by a multiplication of actors and interactions.

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[http://www.esa.int/About\\_Us/Ministerial\\_Council\\_2016/What\\_is\\_space\\_4](http://www.esa.int/About_Us/Ministerial_Council_2016/What_is_space_4)

More and more nations are becoming space nations, starting in many cases with a micro-satellite, or acquiring data from partner nations, learning how to use it for the benefits of their citizens and of the development of the country. In parallel, space is less and less the exclusive playground of governments, as private actors have emerged and are taking increasing shares of the world market, even in the most complex endeavours, such as the preparation of human spaceflight. They might still be supported by government contracts, alleviating the need for private funding, the business model attached is, however, quite new.

### 1.3 Space 4.0 and Industry 4.0

Space 4.0 has been defined in an analogy and in combination with "Industry 4.0", referring to the ongoing fourth industrial revolution.

Industry 1.0 corresponded to the introduction of water and steam powered manufacturing; Industry 2.0 to the electrically powered mass production and Industry 3.0 to the electronics and IT supporting automation. Industry 4.0 includes the utilisation of contemporary automation, big data, data exchange and manufacturing technologies, and builds strongly on innovation on all levels.

The space sector uses all innovation tools of the industry sector, whether they concern the design, the production or the management approaches, as space is "just" another sector of industry.

And industry is "feeding" space with new tools, like artificial intelligence, advanced robotics or 3D printing (one is installed in the International Space Station for example). At the same time industry benefits from specific developments characteristics of space projects like system approaches, extreme reliability or remote operations in harsh environments etc.

## 2 Space 4.0 Motto

In order to better define what is behind Space 4.0 and how it is implemented at ESA, four specific actions have been identified along the Space 4.0i: to Inform, Innovate, Interact and Inspire.

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<sup>2</sup> [www.esa.int](http://www.esa.int)

### 2.1 ESA informs

A duty of ESA is to disseminate the value and knowledge generated by space activities, thereby ensuring the availability of data for their use by potential stake- and shareholders, such as decision-makers in various sectorial areas and at all levels in States, but also industry or society at large.

ESA activities concerned include for example web pages for the general public<sup>2</sup>, specific thematic pages and reports on programmes, information pages for industry, the organisation of or participation to conferences or workshops.

### 2.2 ESA innovates

ESA supports European industry to develop its expertise and strengthen its competitiveness on the world market. As research & development agency for its Member States, ESA manages a series of programmes built to ensure a seamless grid of innovation from the initial analysis of a new idea to the in-flight operations of the satellites.

Innovation measures include also spin-off activities, for example with the Technology Transfer Programme<sup>3</sup> and its network of brokers, spin-in, in order to benefit from the most interesting innovations made on the ground, and co-development activities, or spin-along, when space and another sector can benefit from joint development. Incubators are put in place in more and more Member States with today more than 500 start-ups supported.

Since innovation occurs not only in technology, but also in processes, ESA explores also new funding schemes, for example public-private partnerships for telecommunications programmes or co-funding for many of the applications programmes, and it can support private activities and plans to operate space traffic management for Europe.

### 2.3 ESA interacts

Since its inception, ESA has been cooperating with international partners, the emblematic project being the International Space Station, but also many of the astronomy or planetology projects. Beyond all the major space players, interaction is

<sup>3</sup>

[http://www.esa.int/Our\\_Activities/Space\\_Engineering\\_Technology/TTP2](http://www.esa.int/Our_Activities/Space_Engineering_Technology/TTP2)

also built with many other smaller (in terms of size of the space programme) States on all the continents. The reliability of ESA as a partner is recognised, as well as the quality of its programmes.

Interaction can be at programme level, as well as at data provision, applications, technical support or training levels. It can be with governments, local authorities, companies, universities, scientific communities or industry (space and non-space). More and more also interaction is built with society at large to infuse to the citizens, get their opinion and make sure they are aware of the benefits space programmes are bringing to their daily life.

## 2.4 ESA inspires

Going beyond interaction, space has a very high potential for inspiration, the 4<sup>th</sup> "i". Since the very beginning of the space age, space programmes inspire in particular the young people through challenging endeavours. It has led generations of children, teenagers and young adults to choose a scientific career or work in the space sector. The examples of astronauts, but also the superb successes of our missions in the solar system

make all of us dream and look forward to being part of the adventure.

In order to further support this inspirational dimension, events are organised, web sites for kids<sup>4</sup> and teachers<sup>5</sup> developed, exploration programmes proposed, and concepts such as the Moon village developed.

Beyond this direct inspiration coming from the exploration as such, space activities are used and perceived as a powerful societal driver, allowing all to be inspired and benefit from space spin-offs. In particular, the benefits of space activities for sustainable development<sup>6</sup> gain more and more attention and can often make the difference.

## 3 Way-forward

Space 4.0i, and its components allow ESA to emphasise the main features we are pursuing in our programmes, based on the mandate given to ESA by its Member States over the years. It embodies the vision of ESA as THE space agency for Europe, an institution that constantly innovates, inspires, informs and interacts for the benefit of the European citizen, society and economy.

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<sup>4</sup> <http://www.esa.int/esaKIDSen/>

<sup>5</sup> <http://www.esa.int/Education>

<sup>6</sup> See the catalogue of ESA activities supporting the United Nations Sustainable Development Goals on [www.esa.int/SDG](http://www.esa.int/SDG)

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Short title: "Voices from the Space Community" No. 80  
Published in: November 2017  
ISSN: 2519-5247 (Online), 2519-5239 (Print)

Editor and publisher:  
European Space Policy Institute, ESPI  
Schwarzenbergplatz 6 • A-1030 Vienna • Austria  
Tel: +43 1 718 11 18 -0 / Fax: -99  
Email: [office@espi.or.at](mailto:office@espi.or.at)

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