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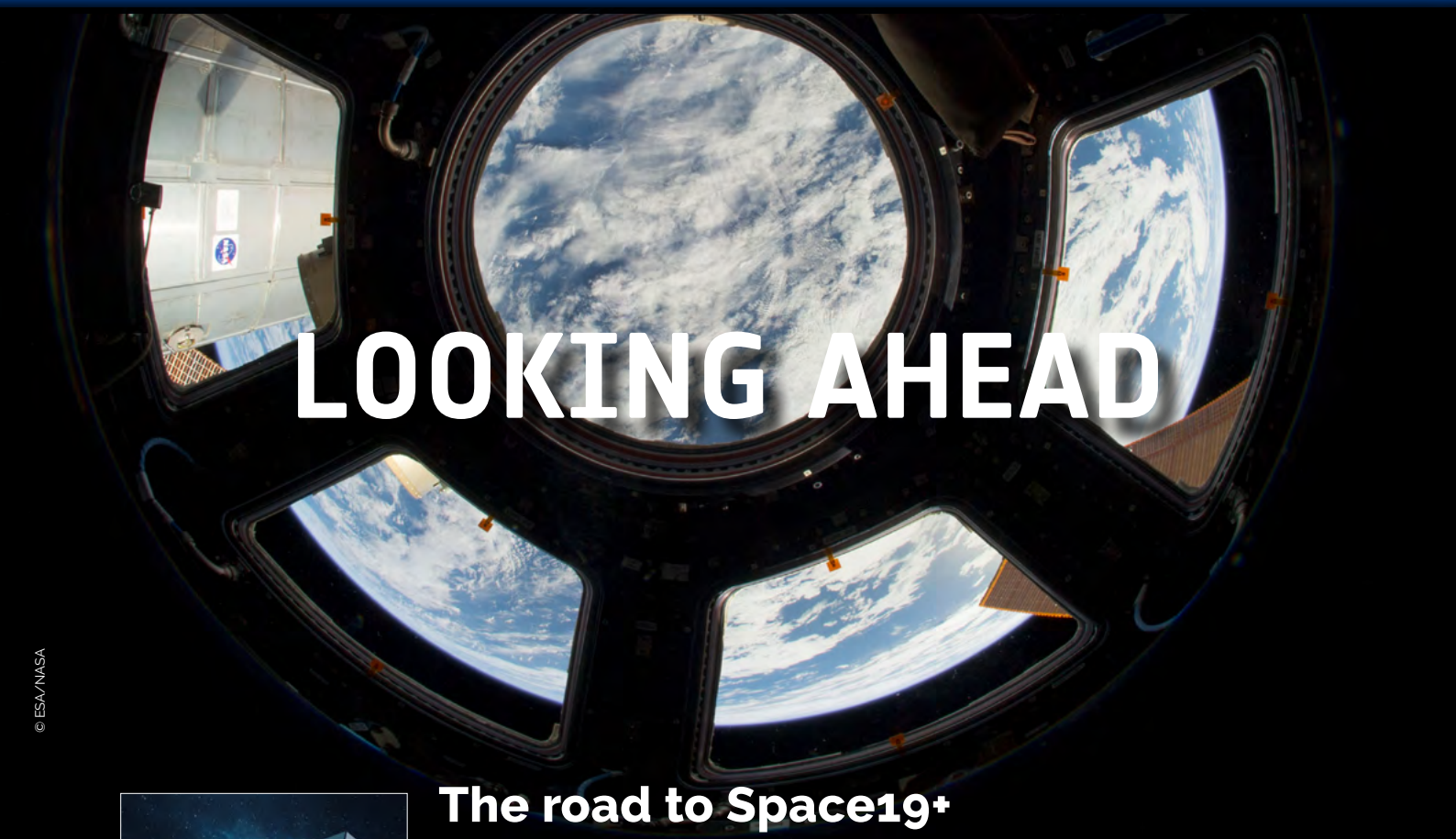
Council of European Aerospace Societies

BULLETIN AEROSPACE EUROPE



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LOOKING AHEAD

The road to Space19+

ESA COUNCIL MEETING AT MINISTERIAL LEVEL
27_28 NOVEMBER 2019, SEVILLE (SPAIN)

Space19+ will be an opportunity to direct Europe's 'next generation' ambitions in space, and address the challenges facing not only the European space sector but also European society as a whole.

INTERVIEW WITH JAN WÖRNER, DIRECTOR GENERAL

OF THE EUROPEAN SPACE AGENCY

CEAS

The Council of European Aerospace Societies (CEAS) is an International Non-Profit Organisation, with the aim to develop a framework within which the major European Aerospace Societies can work together.
It was established as a legal entity conferred under Belgium Law on 1st of January 2007. The creation of this Council was the result of a slow evolution of the 'Confederation' of European Aerospace Societies which was born fifteen years earlier, in 1992, with three nations only at that time: France, Germany and the UK.

It currently comprises:

- 12 Full Member Societies: 3AF (France), AIAE (Spain), AIDAA (Italy), AAAR (Romania), CzAeS (Czech Republic), DGLR (Germany), FTF (Sweden), NVvL (The Netherlands), PSAA (Poland), RAeS (United Kingdom), SVFW (Switzerland) and TsAGI (Russia);
- 4 Corporate Members: ESA, EASA, EUROCONTROL and EUROAVIA;
- 8 Societies having signed a Memorandum of Understanding (MoU) with CEAS: AAE (air and Space Academy), AIAA (American Institute of Aeronautics and Astronautics), CSA (Chinese Society of Astronautics), EASN (European Aeronautics Science Network), EREA (European association of Research Establishments in Aeronautics), ICAS (International Council of Aeronautical Sciences), KSAS (Korean Society for Aeronautical and Space Sciences) and Society of Flight Test Engineers (SFTE-EC).

The CEAS is governed by a Board of Trustees, with representatives of each of the Member Societies. Its Head Office is located in Belgium: c/o DLR – Rue du Trône 98 – 1050 Brussels. www.ceas.org

AEROSPACE EUROPE

Besides, since January 2018, the CEAS has closely been associated with six European Aerospace Science and Technology Research Associations: EASN (European Aeronautics Science Network), ECCOMAS (European Community on Computational Methods in Applied Sciences), EUCASS (European Conference for Aeronautics and Space Sciences), EUROMECH (European Mechanics Society), EUROTURBO (European Turbomachinery Society) and ERCOFTAC (European Research Community on Flow Turbulence Air Combustion).
Together those various entities form the platform so-called 'AEROSPACE EUROPE', the aim of which is to coordinate the calendar of the various conferences and workshops as well as to rationalise the information dissemination.
This new concept is the successful conclusion of a work which was conducted under the aegis of the European Commission and under their initiative.
The activities of 'AEROSPACE EUROPE' will not be limited to the partners listed above but are indeed dedicated to the whole European Aerospace Community: industry, institutions and academia.

WHAT DOES CEAS OFFER YOU ?

KNOWLEDGE TRANSFER:
- A structure for Technical Committees

HIGH-LEVEL EUROPEAN CONFERENCES:
- Technical pan-European events dealing with specific disciplines
- The biennial AEROSPACE EUROPE Conference

PUBLICATIONS:
- CEAS Aeronautical Journal
- CEAS Space Journal
- AEROSPACE EUROPE Bulletin

RELATIONSHIPS AT EUROPEAN LEVEL:
- European Parliament
- European Commission
- ASD, EASA, EDA, ESA, EUROCONTROL, OCCAR

HONOURS AND AWARDS:
- Annual CEAS Gold Medal
- Medals in Technical Areas
- Distinguished Service Award

YOUNG PROFESSIONAL AEROSPACE FORUM SPONSORING

AEROSPACE EUROPE Bulletin

AEROSPACE EUROPE Bulletin is a quarterly publication aiming to provide the European aerospace community with high-standard information concerning current activities and preparation for the future.
Elaborated in close cooperation with the European institutions and organisations, it is structured around five headlines: Civil Aviation operations, Aeronautics Technology, Aerospace Defence & Security, Space, Education & Training and Young Professionals. All those topics are dealt with from a strong European perspective.
Readership: decision makers, scientists and engineers of European industry and institutions, education and research actors.

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EDITORIAL

Jean-Pierre Sanfourche,
Editor-in-Chief

ON THE WAY TO THE UPCOMING ESA COUNCIL MEETING AT MINISTERIAL LEVEL

At the end of November the meeting of the ESA Council at Ministerial Level will take place in Seville. It intervenes at a time when the space sector is crossing major economical, technological and geopolitical transformations at worldwide scale. New private actors such as Space X and Blue Origin in the USA, but also state actors as China and India, are emerging, developing new technologies capable of competing with the space historical actors. Their ambitions are very high.

In this context, the European space sector which is facing difficult challenges is determined to expose its own 'next generations' ambitions.

A large part of the present CEAS bulletin is devoted to this subject, including an interview with Jan Wörner, Director General of the European Space Agency, the point of view of the Air and Space Academy on the future of European launchers and the views expressed by ASD-EUROSPACE, the Space group in ASD (AeroSpace and Defence industries association in Europe).

THE INTERVIEW WITH ESA'S DIRECTOR GENERAL

This interview was the occasion to review in detail the four pillars of the ESA 'Road to Space19+' which will be the reference document for the Council meeting:

- Science and Exploration, with the aims to explore the Solar System and to unlock the screts of the Universe;
- Space Safety and Security, including space monitoring and Earth's environment protection;
- Applications using space to benefit citizens and meet future challenges on Earth (Earth Observation, telecommunications, navigation, downstream);
- Enabling and Support, covering access to space, operations and development of technologies for the future.

Europe must keep its first-class ranking in Space: Exploration should attract young engineers and scientists; Competitiveness is an absolute imperative; Responsibility must be broadly installed.

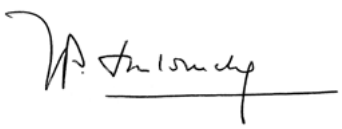
THE AIR AND SPACE ACADEMY

Concerning the launchers, the Air And Space Academy considers that the reusable first stage is one of the most visible aspects of the present international competition. It expresses five recommendations among which: "Reach a consensus at the hignest political level as to the urgent need for a European strategy for access to space capable of matching scenarios of disruptive innovation introduced by SpaceX and Blue Origin in particular".

ASD-EUROSPACE

Industries consider that the ESA proposals are providing a sound basis, to which could be added some large size initiatives of each of the four components of ESA 'Space19+': Science & Exploration, Space Safety & Security, Applications and Enabling & support. This package of proposals would necessitate an increase of the annual ESA budget, not including EU contributions, from the current level of 4.1b€ to not less than 5b€.

It is now to be ardently hoped that the set of the ESA Council meeting's decisions will allow place Europe as a competitor on commercial markets, as a first rank partner in international endeavours and as an actor in outer space that is at stake.



CONTENTS

PRESIDENT'S MESSAGE

Zdobyslaw Goraj
CEAS President

MAKING THE CEAS BETTER KNOWN

I just come back from Australia where I successively participated in the ICAS Programme Committee meeting, the ICAS Emerging Technology Forum and the ISABE Conference, three occasions for me to make the CEAS better known and also to give me a number of ideas for improving the quality of its achievements.

ICAS PROGRAMME COMMITTEE AND ENERGY TECHNOLOGY FORUM: MELBOURNE, 8-13 SEPTEMBER

The 32nd Congress of ICAS – ICAS2020 - will be held in Shanghai, China, on 14-18 September 2020. The ICAS Programme Committee, whose I am member, met in Melbourne from 8 to 13 September for selecting the presentations. Between the launch in March 2019 and the closure in July 2019 of the call for papers, more than 950 abstracts from 32 countries were received. The PC experts, divided into 13 panels, selected 450 papers for oral presentation, some of them for interactive presentations, and a few for keynote lectures.

In connection with the Programme Committee, a two-day workshop called *Emerging Technologies Forum* (ETF) took place, as it is the use from 2015, with the aim to review the hot aeronautical topics. This year it was devoted to the central theme *Digital Transformation in Aerospace*. It comprised four sections: Cyber-Physical Systems, Digital twin Concepts, Digital Factory and advanced manufacturing, Digital Twin Concepts and Digital Product Operations & Sustainment.

State Government reception in Victoria Investment Centre offered to the attendees of ETF and ICAS PC on 9 September.

Two friends and at the same time the competitors for 2021: T. Goetzendorf-Grabowski (President of PSAA), left and Kenichi Rinoie (Chair of Aircraft Design panel) – before presenting Gdansk and Kioto – the candidates for PC meeting and ETF in 2021.

Both ICAS PC and ETF had been perfectly organised and hosted by the Royal Melbourne Institute of Technology with the support of the RAeS – Australian Division.

An executive summary report of the ETF will be published in the issue 1-2020 of our bulletin.

2019 ISABE (INTERNATIONAL SOCIETY for AIR BREATHING ENGINES) CONFERENCE

The 2019 ISABE Conference was held in Canberra from 22 to 27 September, including 70 sessions with in total 166 presentations, attended by more than 500 scientists, engineers and students coming from a high number of nations all over the world. A very special feature of ISABE is to invite a many distinguished speakers for keynote lectures. This year twenty-three were present, who represented the biggest air breathing engines industry and research centres.

From left to right: Z. Goraj (CEAS), J. Parker (ISABE President), Mrs J. Parker, Mrs W. Wang and W. Wang (DST Brisbane). Photo taken during the dinner sponsored by reaction Engines at Australian War Memorial.

An executive summary report of this conference will be also published in the issue 1-2020 of AEROSACE EUROPE.

TOWARDS A CLOSE COOPERATION BETWEEN CLEAN SKY AND CEAS

During the ICAS Programme Committee meeting, I had the opportunity to talk to Axel Krein, Executive Director of Clean Sky. Following the interview he gave to CEAS in the previous AEROSPACE EUROPE Bulletin, and in view of the upcoming AEC2020 which will be essentially devoted to Green Aviation, we had a conversation about a closer cooperation between CEAS and Clean sky. Axel Krein expressed his high interest for CEAS, saying that this association might and should play an important role in European aerospace, most notably in matter of science and technology knowledge dissemination. He accepted with pleasure my invitation to participate in the next CEAS Board of Trustees meeting of 22 November in Berlin.

As a conclusion, I would to say that the ETF workshop and the ISABE Conference whose I appreciated the high level, gave me a number of ideas for giving a new impulse to the CEAS and increasing its visibility and influential power.

From left to right: S. Rémy (Airbus Toulouse), Z. Goraj (CEAS), A. Krein (Clean Sky)

INTERVIEW WITH JAN WOERNER, DIRECTOR GENERAL OF THE EUROPEAN SPACE AGENCY

By Jean-Pierre Sanfourche, Editor-in-Chief

BIOGRAPHY

Jan Woerner, Director General of the European Space Agency

***Johann-Dietrich 'Jan' Wörner** became the ESA Director General on 1 July 2015.*
Previously, from March 2007 to June 2015, he served as Chairman of the Executive Board of the German Aerospace Center (DLR).
Jan Wörner was born in Kassel, Germany, in 1954. He studied civil engineering at the Technical University (TU) Berlin and TU Darmstadt, from where he graduated in 1985.
In 1990 he was appointed as a professor of Civil Engineering at TU Darmstadt and took over as Head of the Test and Research Institute. Before being elected as President of TU Darmstadt in 1995, he held the position of Dean of the newly established Civil Engineering Faculty. Jan Wörner headed the university from 1995 to 2007 and succeeded in making it the first autonomous university of the Federal Republic of Germany.
Jan Wörner has been awarded numerous prizes and positions.

***Jan Wörner** has received honorary doctorates from New York State University at Buffalo (USA), technical universities of Bucharest (Romania) and Mongolia, the Saint Petersburg University for Economics and Finance (Russia) and École Centrale de Lyon (France). He has received the Federal Cross of Merit (Officer's cross, 1st class) of the Federal Republic of Germany for his continuous efforts regarding the next generation of scientists and Germany as a location for Science, Technology and Engineering. He has furthermore been awarded the honours of Knight of the French Légion d'Honneur.*

Jan Wörner was Vice President of the Helmholtz Association and also a member of various national and international supervisory bodies, advisory councils and committees.
Furthermore, he was appointed to the energy expert group of the German Government.

Before joining ESA as Director General, Jan Wörner was head of the German delegation to ESA from 2007 to 2015 and served as Chairman of the ESA Council from 2012 to 2014.

Jean-Pierre Sanfourche: **In view of the upcoming meeting of the ESA Council at Ministerial Level on 27-28 November in Seville, I would like to review with you the different topics of the ESA multiannual programme which will be presented and discussed.**
First, the Access to space: Space X is succeeding in operating the reusability concept consisting in bringing back to Earth the elements of the first stage (engines and tanks) after each launch – which represents major part of the cost of the complete rocket – in order to refurbish it in view of a next launch. This technology is presently mastered. Blue Origin and China are actively developing similar technologies. The objective is double: cost reduction and possibility to launch frequently.
What is your position on this matter and what are the initiatives ESA is undertaking regarding studies and developments of a future European reusable launcher, in parallel with the completions of Ariane 6 and Vega C developments?
Jan Wörner - First of all, I would like to bring your attention to the fact that if 'Access to Space' constitute a high-level priority for France, even is the priority number one, it is not the same in the other nations of the European Union. As Director General of ESA, I fully endorse the French position: Access to Space is a matter of European sovereignty. In fact, European autonomy for Access to Space had been unambiguously expressed at the ESA Council meeting at ministerial level which was held in 2014 in Luxembourg.

And in 2016, an ESA statement was officially signed by the EU, declaring that Access to Space is an important European value.
As regards reusability, ESA has been working on this topic for a long time studying aerodynamic and powered re-entry. Today when we are talking about reusability we mainly look at the recovery and refurbishment of the first stage But there are other options, like a winged vehicle like the Space Shuttle for instance. The launch rate is the decisive element for the decision to engage in reusability. If the number of launches per year remains in the same range as today, i.e. about 12, the reusability concept is not really interesting from a financial point of view. In this case the use of smaller launchers to send small satellites into space is the right way, at least at short and mid-term time horizon.
But again, preparing for the future, R&T studies on reusable launchers have to be actively pursued at ESA in parallel with the completion of Ariane 6 and Vega C.
***JPS*: what about 'New Space'? The "New Space" movement expresses the growing place of the private sector in the space domain, with respect to the traditional**

public sector. Space X founded by Elon Musk and Blue Origin, founded by Jeff Bezos, RocketLab, Planet and Oneweb are the most notable examples. In parallel, more and more start-ups are being created to propose new services, thanks in particular to new low cost small satellites (such as nanosatellites photographing every day the totality of the Earth). Those start-ups constitute the future "GAFA" (Google, Apple, Facebook, Amazon) of space. They are rapidly growing in the USA and in China.
In Europe, start-ups working in space activities are numerous: several hundreds, which are supported by public or private initiatives. But so far the results obtained are too weak.
I know that 18 incubators of ESA have created about 700 start-ups: do you foresee an increase of your efforts in this area? Do you foresee new initiatives to enable the creation of new private actors in Europe thanks to optimised public-private-partnerships?
More generally speaking, what is your position regarding the New Space movement?
JW – What is "New Space"?
"New Space" has multiple facets; non-space companies entering the space business or space means being used for a multitude of non-space applications, i.e, global positioning, mapping, meteorology; climatology, etc. Today space is everywhere. Space is an infrastructure, sometimes hardly perceived by the end-user.

In Europe as well non space companies are entering the space sector. One example, recently Zeitfracht , a logistics service provider, bought the space start-up Part-Time Scientists. Other companies like Red Bull, Vodafone, Audi are engaging as well. The space environment is changing and offering dynamic engineers and technicians many "boulevards" of new activities. In a similar way, ESA has been engaged for a long time in Public-Private-Partnerships (PPPs) and the Business Incubation Centres supported by ESA led to the creation of more than 700 start-ups, which I find rather considerable.
Other actors in Space like ArianeGroup and CNES for example have created the "ArianeWorks" think tank encouraged by ESA to boost innovation for future launcher development.
-ESA is welcoming, encouraging and supporting new ideas via with its Business Incubation Centres and its Downstream Gateway.
Consequently, I would say ESA is far from being passive in the New Space movement.

JPS: **Exploration. Robotic exploration of the Moon and Humans at the Moon. There is a spreading belief in the opinion that a big project able to foster enthusiasm and dream, is currently missing. Don't you think that the return to the Moon could play this role? Is ESA's participation in NASA's Moon programme (scientific experiments, robotic, lunar exploration technologies' developments, elements of the Lunar Orbital Platform, Service Module for Orion, etc.) sufficiently promoted? Maybe ESA appears as a follower rather than playing a leading role?**
JW – I can tell you that this impression is wrong. The first pillar of Space 19+ is Science & Exploration. Science focuses on the Solar System and the Universe related studies. This is the "Scientific Mandatory Programme' 100% driven by ESA and often implemented in cooperation with other partners. As regards Exploration it is totally different: as a matter of fact the projects are conducted within the framework of international partnerships.

You said "Back to the Moon" in your question, I prefer the wording "Forward to the Moon" . Back to the Moon implies a remake of Apollo (1969 to 1972). This is not the case. Today Europe is wishing to cooperate –like other international partners- to the US-led Gateway project with key elements, the European Service Module (ESM), the I-HAB and ESPRIT. I will request the funding for these at Space19+. In addition ESA is already cooperating with Russia on robotic Moon missions.
I wouldn't say that ESA is following the USA. In fact I initiated the idea of a Moon Village 7 years ago in 2014 and if approved, ESA will be providing key technology to the Gateway.

JPS: **Exploration - Human on Mars. What do you respond to the experts who think that we should frankly concentrate all efforts on 'Human on Mars', bypassing the Moon intermediate milestone?**
JW – My opinion is that it too early to envisage the possibility to send an astronaut to Mars. A two-year trip is not easily conceivable in the present technology state-of-the-art. A real launcher able to take-off from the surface of Mars is needed. And what about the means necessary to protect the astronauts from the strong cosmic radiations during two years?

So, I am personally convinced that in the future Human will walk on Mars, but not before several decades.
For the time being we must continue the robotic exploration where again, Europe is not follower but active leader with the ExoMars project conducted in partnership with Russia: the launch is currently planned for the Summer of 2020, and Europe is contributing amongst others with a rover to explore the surface of Mars and drill below the surface. At the upcoming ESA Council Meeting at Ministerial Level in Seville –Space 19+-, the Mars Sample Return project to be conducted in cooperation USA – Russia – Europe is expected to be approved. This will be quite an important decision.
JPS: **What are the most important decisions you are expecting from the upcoming ESA Council, in the different chapters of 'Space 19 +': Science & Exploration,**

Space Safety & Security, Applications and Enabling & Support? What are the priorities?

JW – There are NO PRIORITIES. **The four pillars** you mention are equally important.

Pillar 1: Science & Exploration – Exploring and discovering: exploring th Solar System and unlocking the secrets of the Universe.

Pillar 2: Space Safety & Security – Monitoring and safeguarding: monitoring space and protecting the Earth's environment: space weather, near-Earth objects, space debris, clean space, safety and security applications.

Pillar 3: Applications – Connecting and Benefiting: using space to benefit citizens and meet future challenges on Earth: observing the Earth, future of telecommunications, future of navigation, downstream.

Pillar 4: Enabling and Support – Making space accessible and developing the technologies for the future: access to space, operations, technology, basic activities.

Three axes are to be taken into consideration:

- Inspiration (Exploration and Science);
- Competitiveness (Launchers, Earth Observation, Telecommunication);
- Responsibility (Safety in Space, Climate Change)

I will request a budget of 12.5 MEuros for the next three years at Space 19+.

JPS: Climate Change. At a time when the Intergovernmental Climate Working Group is publishing worrying forecasts, what is the ESA position?

JW – ESA has been working very hard on the topic and for many years. As early as 2005 ESA's VenusExpress satellite discovered the greenhouse effect on Venus which lead to improve our understanding of climate processes on Earth.

Our works are organised around three main action axes:

- Continuous observation, with a permanently improved situation awareness resulting from more and more precise measurements, for instance sea levels;
- Development of technologies aiming at reducing the human impact on the environment (among others, optimisation of the trajectories of airplanes);
- Development of Green reflexes and uses everywhere (we do that within the ESA itself ...).

JPS: European space governance. Politicians would wish space activities to be brought further at EU's level: Council, Parliament and Commission. What is your opinion?

JW – This is a difficult debate: small Member States wish an even stronger ESA while big nations are often in favour of an increased role of the EU. Here ESA's geographic return rule definitely plays a role in the decision process. To be recalled Copernicus is a shared EU-ESA programme. Galileo is an EU programme implemented by ESA with GSA (Galileo System Agency) being in charge of the operations. All other projects are being conducted by ESA.

***JPS:* Communication – Communication is not sufficient and not at the right level to make the space domain well known by the citizens in Europe. What would you recommend to improve this situation?**

JW – You are right but I can tell you that ESA devotes large efforts to the communication: the work accomplished by our astronaut Thomas Pesquet in this domain during his ISS mission is a remarkable illustration.

It is interesting to read the results of a recent study carried out on behalf of ESA by Harris Interactive in December 2018 on "How much do European citizens know about space".

The survey questioned aged 18 or older and representative of the public in Europe's five most populous countries, Germany, UK, France, Spain and Italy.

The survey found that, almost unanimously, Europeans identified three main uses for space: better understanding the Universe, observing our own planet, for example the effects of climate change, and they recognised the ability to make life on Earth easier, for example in transportation or communications.

Fewer people believed that space activities could protect us against threats from space, though most agreed this should be a priority. This can be seen as a strong endorsement for the space Safety elements of the programme proposals at Space19+.

The survey also showed, unfortunately, that only 4 out of 10 Europeans felt well informed about space activities and their multiple non-space uses. So, I agree with you, we have to continue improving the communication on space, to do better and better in this area, but it is a matter of cost!

***JPS:* Conclusion – In a few words, why must Europe keep its present first-class ranking in space and so remain in pole position in the race of space economy?**

JW – First, **Inspiration** where **Exploration** should attract young engineers and scientists who are going to create the future.

Second, **Competitiveness** is an absolute imperative, not only for ESA but for all countries. We need stable societies, which can be achieved thanks to competitiveness.

Third, **Responsibility** spirit must be broadly installed. Space is the carrier of Human Value: **space is at service of mankind**.

EREA JOINT STATEMENT ON THE OCCASION OF THE 25 YEARS OF EREA

EREA Association of European Research Establishments in Aeronautics

18 June 2019, Le Bourget

Signature of the EREA Joint Statement on the occasion of the 25 Years of EREA at the Paris Air Show at Le Bourget

On the occasion of the 25th anniversary of the Association of European Research Establishments in Aviation (EREA), it is time to renew the commitment we, the members of EREA, make towards each other and to renew the pledge we make to our stakeholders.

We, the members of EREA, recognise that together we are more than the sum of our parts and our societal impact is greater when challenges are faced together. We therefore pledge to you, our stakeholders, to fully commit ourselves to the renewed **mission of EREA:**

To be the trusted leader in Europe in applied aviation research through expertise and innovation, by enhancing synergies amongst its members.

We pledge to always be at the forefront of innovation, proposing bold and new ways to face the challenges of our time and those of the next generations. We do so through bringing together the best and the brightest, with passion for research and innovation in aviation as our common denominator and by making available state-of-the-art research facilities that propel innovation forward. We commit to fulfil our role in the innovation ecosystem, bridging the valley of death and helping to bring both evolutionary and revolutionary ideas to market. We are objective and independent, committing ourselves to generating societal impact. We build upon 100+ years of experience to train and educate those who will succeed us.

We agree to these commitments, because we believe in the **EREA vision** of joined forces shaping a competitive and **innovative air transport system for future generations.**

About EREA

EREA, the association of European Research Establishments in Aeronautics is a non-profit organisation which gathers Europe's most outstanding research centres active in the field of aeronautics and air transport.
6.339 employees in aviation research
€ 431.000.000 spent on research in aviation

Upcoming Events

EREA Annual Event 09 December 2019
TandemAEROdays19.20 Berlin 2020

Contact information

info@erea.org / www.erea.org

clic to see EREA position on governance for avaition research in Horizon Europe

WHAT ARTIFICIAL INTELLIGENCE CAN BRING TO AIR TRAFFIC MANAGEMENT

Florian Guillermet, Executive Director, SESAR Joint Undertaking

***Florian Guillermet** was appointed as Executive Director in April 2014. He is responsible for leading the SESAR JU public private partnership, which is modernising Europe's air traffic management system. Mr Guillermet has worked in the civil aviation field for 20 years. He is an engineer and graduate of the École polytechnique and Civil Aviation Engineering School in France. He holds a master's degree in aeronautics and airport management.*

It is no surprise that artificial intelligence, or AI, is entering progressively into everyday parlance in air traffic management. The availability of data and advanced algorithms, not to mention the leap forward in computing power, means that AI now has something real and smart to offer our industry, writes Florian Guillermet, Executive Director of the SESAR Joint Undertaking.

Artificial intelligence (AI) is a branch of com- puter science that aims to create intelligent ma- chines. It has become an essential part of the technology industry. AI can be narrow, handling just one particular task, or strong, meaning a machine with the ability to apply intelligence to any problem.

Machine learning is a core part of AI. It uses data to train algorithms and give computer systems the ability to "learn" (i.e. progressively improve performance on a specific task) with data, without being explicitly programmed.

Deep learning is the most advanced type of machine learning. In recent years, the avail- ability of large amounts of data ("big data") and the leap forward in computing power have paved the way towards unprecedented levels of performance, allowing for new levels of auto- mation.

Artificial intelligence (AI) has been around for more than 60 years but has gained ground more recently, thanks to advances in computing and access to data. machine learning and deep learning – subsets of AI – are today helping to create applications that can learn autonomously and advise complex problems. Aviation is no stranger to the virtues of AI. the industry is taking a keen interest in, and turning to, AI to develop, among other things, intelligent maintenance, engineering and prognostics tools, as well as appli- cations to streamline business processes, supply chains and customer services. this is not about being cool, but rather about recognising how these technologies can improve operations and bring business benefits, while enhancing safety.

The potential of AI for Atm has not gone unnoticed by sEsAr. Automation is already a core focus of sEsAr research and development, particularly with regard to the automation of repetitive tasks by controllers. providing more support to these tasks will enable pilots and air traffic controllers to focus on safety-critical tasks. Automation is also proving invalu- able for ensuring the seamless exchange of information and im- proved collaboration between all actors, including on the airborne side.

More recently, we have built up a portfolio of projects with specific AI components often using ma- chine learning to process big data. these applications have been put to the test to better understand and address the underlying pat- terns of traffic.

Here are just a few examples of some of the complex problems where AI can lend support, ad- dressing all phases of flight, from strategic and pre-tactical planning to tactical operations themselves.

IMPROVING STRATEGIC PLANNING

Take the performance of the sys- tem. more often than not, trade- offs have to be made between key performance areas (KpA), but also between stakeholders as well as between short-term and lon-gterm objectives. this is a complex job since trade-offs are riddled with interdependencies between policies and regulations, stakeholders, technologies and market conditions.

The sEsAr IntuIt (interactive toolset for understanding trade-offs in Atm performance) project explored the potential of visual analytics and machine-learning techniques to improve our under- standing of the trade-offs between KpAs (safety, environment, capacity, efficiency) and to identify cause-effect relationships between indicators. the project trained a machine-learning model in order to assess performance for a certain piece of en-route airspace. the model was able to detect patterns that were not previously known on specific traffic flows and that, up until now, had not been taken into account when establishing key performance indicators. Another focus of the project was on identifying airlines' decision criteria using machine learning. these criteria can also be used to predict route choices in case of changes to route charges. the results of the project enable enhanced Atm performance-monitoring capabilities by helping detect

and analyse low-performing routes in the European network.

ENHANCING PRE-TACTICAL TRAJECTORY PREDICTION

While the IntuIt project pre- dicted which routes airlines would take before the flight plan was filed, the COptrA (Combining probable trajectories) project focused on predicting the trajectory closer to the time of take-off or during the flight. COptrA built probabilistic models to predict the occupancy and demands of the European airspace and airports, taking into account the uncertainty in planned flight trajectories to support improved demand-capacity balancing.

Machine learning was used to estimate the intended cruise speed of an aircraft when it is still climbing. This information about the trajectory was fed into a model previously trained with recorded trajectories. Based on the predicted trajectories, congestion indicators were calculated to support decision making.

Meanwhile, dArt (data-driven aircraft trajectory prediction research) explored the applicability of a collection of data mining, machine learning and agent-based models and algorithms to derive a data-driven trajectory prediction capability. these algorithms are expected to provide increased levels of accuracy while considering Atm network effects in the prediction process.

BETTER UNDERSTAND- ING PASSENGER BEHAVIOUR

Big data is becoming a big deal for airports, as it is used increas- ingly to better analyse market demand, optimise security control and customise the passenger experience. the use of big data analytics is now being put to work to better understand how passenger behaviour can impact air traffic management. research in these areas has so far been constrained by the limited availability of behavioural data, typically obtained from static demographic and economic datasets, often consisting of very small samples, and usually complemented with assumptions about behaviour.

Thanks to the growth of smart devices and interconnected services, researchers now have large-scale, detailed longitudinal (dynamic) data allowing them to test hypothe- ses about passenger behaviour. partners from the Bigdata4Atm project investigated how different passenger-centric geolocated data can be analysed while respecting personal data and privacy, and combined with more traditional demographic, economic and air transport data to identify patterns in passenger behaviour, door-to-door travel times and choices of travel mode. machine-learning methods were used to support the analysis of the data sources. the project is also exploring applica- tion of this data and how it could be used to inform several of the Atm decision-making processes.

Machine learning has also been applied in sEsAr in a live trial to improve passenger flight connections at heathrow. the live trial demonstrated that such techniques can provide accurate forecasts (together with prediction intervals), which can help the airport operations centre better understand the key factors that influence passengers' connection time as well as help improve passenger services in real time. In addition, better prediction of passengers' transfer activities can also improve the accuracy and stability of the target off-block-time, which is critical for optimised air traffic flow management in Europe.

More broadly, we are seeking to enhance airport performance predictions using big data analytics as part of our work on total airport management, which connects air- side and landside processes with the flight turnaround processes. the aim is to enable optimised decision making for the benefit of passengers and goods, and improved ready times provided to the network for more predictable operations.

INCREASING THE OPERATIONAL EFFICIENCY OF AIR TRAFFIC CONTROL

Nowadays, air traffic control instructions are most of the time still given via very high frequency (vhf) voice communication to the pilots. But systems, to be safe and efficient, need up-to-date data. that means controllers mak- ing a lot of manual inputs to keep the system data correct. This is where automatic speech recognition can offer a viable alternative, converting speech into text for input into the system.

Currently, modern models of speech recognition require manual adaptation to local environments. the mAlOrCA project (machine learning of speech recognition models for Controller Assistance) designed a low-cost solution that adapts the speech recognition tools for use at other airports. the solution minimises local adapta- tion costs by automatically learn- ing local speech patterns and controllers' models from the local airspace configuration, radar and speech data recordings, which are then automatically encoded into the recognition software.

REFINING TIME AND WAKE SEPARATION

When there are strong head- winds, aircraft ground speed is reduced on final approach. this results in a reduced landing rate, causing delays and even flight cancellations. sEsAr's time-based separation aims at reducing the gap in landing rates in headwind conditions. Already deployed at heathrow with further plans for wider deployment across Europe, the solution is helping to maintain airport regularity at the same level in all wind conditions.

The solution is currently further enhanced by machine-learning al- gorithms that refine wake separa- tion minima in the departure and arrival phases. this is done by combining downlinked parameters from the aircraft with high-quality short-term atmospheric prediction of wake propagation to improve the accuracy of the predicted wake compression during the final ap- proach. this in turn improves the accuracy of the time-based separa- tion markers that advise the approach and airport controllers.

WHAT ABOUT SAFETY?

In the future, Europe's skies will be extremely busy and complex. As the number of air vehicles increases along with their levels of automation, so will the need to further automate the system, while keeping the human in the loop. In this respect, narrow AI can offer the means to develop smart solutions for managing air traffic.

For instance, sophisticated real- time decision support tools can be developed by combining machine-learning algorithms with data forecast models that capture traffic volume, airport runway direction and weather conditions. these tools can help the system with the specifics of a particular disruption or predict the likelihood of potential safety events – such as aircraft level busts, or geographical and airspace infringements. machine learning could also be used to model controller behaviour and potentially assist controllers by proposing enhanced vertical and lateral trajectory clearances for di- rect up-link to the aircraft.

However, Atm remains a safetycritical industry and the introduction of such technologies must undergo rigorous research and impact assessments to ensure they can meet with the high safety and security requirements of aviation.

ON THE HORIZON

M uch of what is described here is within sEsAr's exploratory research programme. Our job now is to mature these concepts and bring them to the next phase of industrial research. At the same time, we will also look beyond narrow AI concepts and applications, exploring among other things joint human-machine cognitive systems, in the next wave of exploratory re- search projects. these projects will also address a wider application of AI at airports as well as for network operations, such as automated slot allocation provision, traffic and tra- jectory provision, automated apron and ground control. At the same time, we will investigate how to generalise results from tests of machine-learning-based processes and procedures to ensure their application in all situations and to allow for their certification.

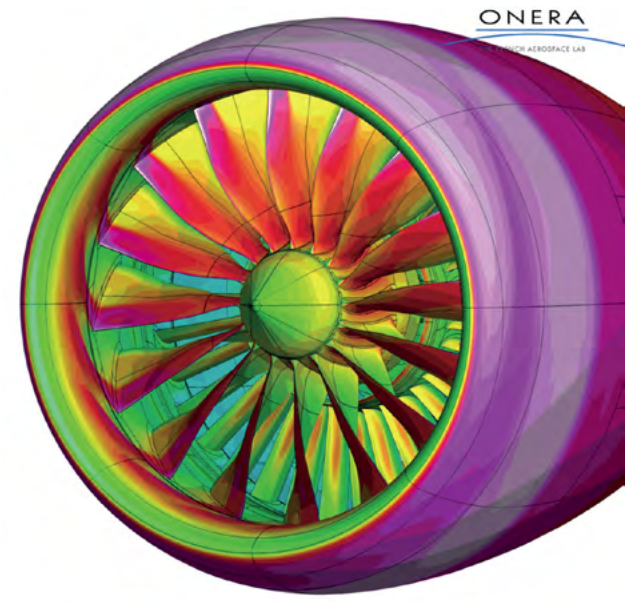
The above article has been published in ECACNEWS#69, Spring/Summer 2019 " INNOVATION IN AVIATION – Pioneering solutions for safe, secure and sustainable air transport"
https://www.acac-ceac.org/documents/
https://www.sesarju.eu

In its Letter June 2019, the EREA has published a white Paper on FUTURE SKY. This paper gives a complete description of this research programme within the framework of which EREA is promoting joining forces with the European industry and universities to design the future air transport system. Readers have access to it with the here below clic.

clic to see the programme

BIGGER ENGINES, BIGGER CHALLENGES. CLEAN SKY'S ASPIRE RESOLVES THEM

For large passenger aircraft flying medium and long-haul routes, Ultra High Bypass Ratio (UHBR) Engines will power the majority of airliners over the next three decades. But at twice the size of today's engines, their aerodynamic and aeroacoustic interaction with the rest of the aircraft presents many issues. Clean Sky's ASPIRE project has brought the best of Europe's research centres together to face those challenges.



Everyone's talking about electric, hybrid and distributed powered aircraft of the future – and their evolution is certainly gaining momentum. But for medium and large scale airliners, the prevailing power paradigm from around 2025 onwards – and probably for the next couple of decades beyond that – will be the Ultra High Bypass Ratio Engine (UHBR). In such an engine, the ratio of the air bypassing the core compared to the amount of air passing through the engine core is much higher (between 12 to 20 times) than it is in the best of today's engines (at 10 to 12 times), for in UHBR engines the bypassed air only needs to accelerate a bit in order to generate lots of thrust. New carbon-composite lightweight fan blades and reduction gearbox technologies are key enablers to achieve these ratios, and they are projected to improve fuel consumption by 15-17% compared with reference 'Entry Into Service' 2000 technology. But to accomplish this requires building engines with substantially larger diameters. "Compared to the current generation of aircraft, the size of UHBR engines increases which leads to stronger interactions between the rotating engine parts (fan blades) and the airframe. And that needs to be reliably evaluated" says Michaël Meheut, Research Scientist and Project Manager at the Aerodynamics, Aeroelasticity and Acoustics Department at ONERA, the French Aerospace Research Centre.

"The objective of ASPIRE has been to study the aerodynamics and acoustics efficiency of new propulsion systems, for instance Ultra High Bypass Ratio engines. And more precisely, the objective is to demonstrate the ability of numerical (Computational Fluid Dynamics and Computational Aero-Acoustics) and experimental methods (dedicated to wind tunnel and flight tests) to accurately assess the aerodynamic and acoustic performance of such configurations".

The project kicked off at the beginning of 2016 and was concluded last September, and in addition to ONERA brought together the leading research centres of Europe, including DLR, NLR and Russia's TsaGI (which contributed to this project through national funding from Russia, not the EU).

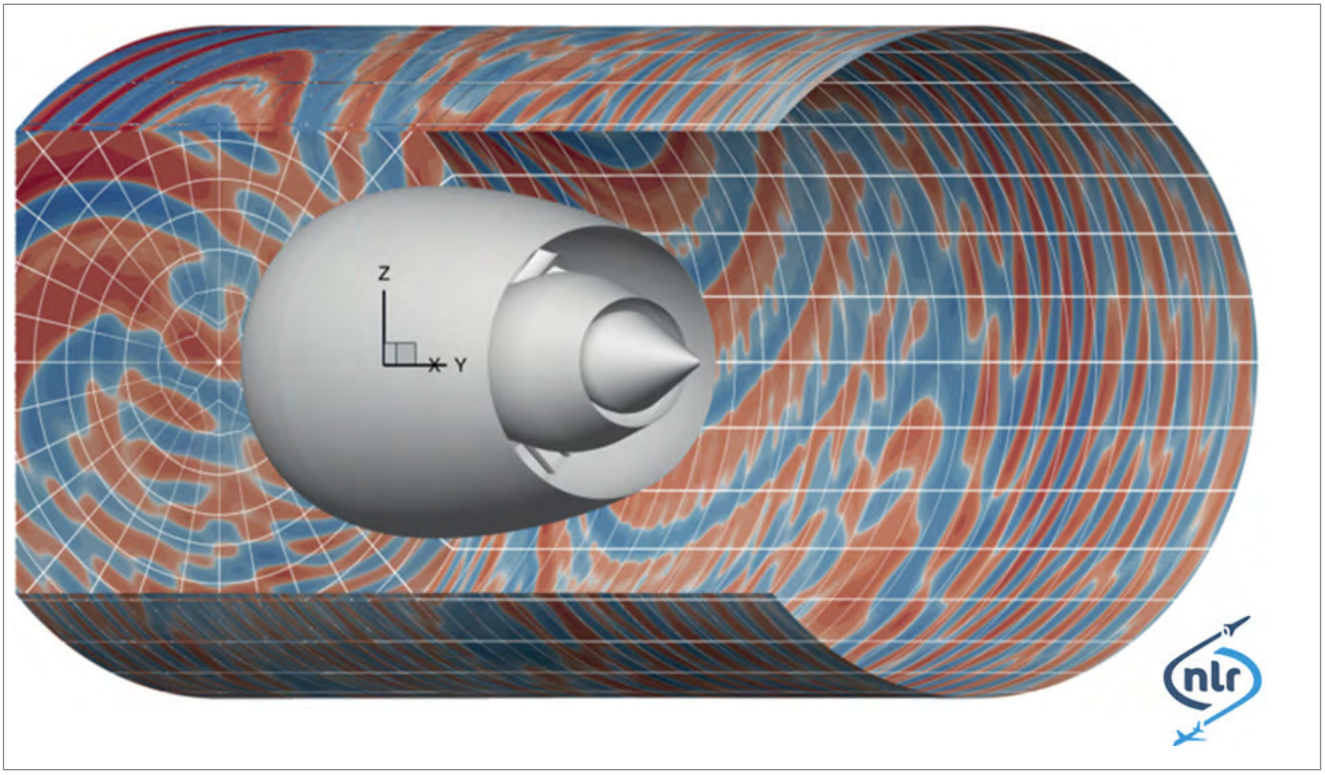
Why has it been necessary to bring such extensive and diverse research capability to the task? It's down to the sheer complexity of the challenge and the multiple facets that need to be addressed, especially the integration of UHBR engines under the wing due to their colossal size and their interactions with the aircraft's nacelles, pylons and wings. ASPIRE has demonstrated the ability of existing numerical and experimental methods to accurately assess the aerodynamic and acoustic performance of such configurations thanks to a reliable modelling of fan/airframe physical interactions. Some specific technical objectives included the design of generic fan/OGV (Outlet Guide Vane) combinations representative of a future UHBR engine; demonstration of the ability of different CFD codes to predict aerodynamic performance of aircraft equipped with UHBR engines; demonstration of the ability of aeroacoustic methods to predict aeroacoustic performance of aircraft equipped with UHBR engines; and identification and assessment of the experimental capabilities for the characterisation of UHBR installation noise sources.

"It's anticipated that most of the future generation of aircraft, with at least 150 passengers, entering into service between 2025 and 2035 will be equipped with UHBR engines" says Meheut, "therefore the capability to accurately assess the performance of such configurations is a key driver for the design of efficient concepts in the coming years". In terms of results, Clean Sky's ASPIRE has produced a reference configuration (airframe with fan blades) with several derivative shapes designed by DLR and ONERA to support the numerical activities. Based on these configurations, ONERA, DLR and NLR compared the accuracy of their numerical methods used by European industry to assess the aerodynamic and acoustic performance of such complex configurations.

"The different partners compared their approaches and test benches used to measure the near field or far-field noise produced by this new engine generation. This work is particularly relevant in order to understand the ability and capability of each method for future engine and aircraft programmes" says Meheut.
Additionally, jet noise wind tunnel tests were performed at TsAGI to assess different experimental methods dedicated to jet noise measurement, with numerical and experimental methods developed and applied in the frame of ASPIRE on a full scale UHBR design.

"The progress made in ASPIRE regarding numerical and experimental methods will help the European industry to design more efficient engine and aircraft configurations in the near future, producing less noise around the airport" says Meheut. Clean Sky's ASPIRE Project Officer Antonello Marino emphasises that the project, beyond its technical accomplishments, has also been a superb case study in demonstrating the potential of collaboration between different European research entities: "It's very important to underline the fact that this project, to achieve its challenging objectives, has demonstrated a really exceptional level of cooperation, facilitated through Clean Sky, between all these different research centres working together in European aeronautics towards a common objective. They've been sharing the ground hardware and software, and have made a comparison of the results achieved with different tools by using the same benchmark – they performed the same simulations or experimental simulations on the same benchmark in order to share results for the first time, to understand the pros and cons of the different methodologies. Really, it's an exceptional cooperation" says Marino. "There's also been a large amount of dissemination activity – they've published more than 25 papers at international conferences and in journals and books, so in terms of impact for the European Community the ASPIRE project is very productive".
As for mobility and environmental considerations in Europe, the findings of ASPIRE will contribute to the performance of current aircraft and those we'll see in the near future. "It will contribute to noise reduction, to the improvement of engine efficiency and reduced fuel burn efficiency compared to the best of today's technology" says Marino.

From Clean Sky information :
https://www.cleansky.eu/



THE FUTURE COMBAT AIR SYSTEM (FCAS) – SHAPING THE FUTURE OF AIR POWER

THE FCAS WAS PRESENTED AT THE INTERNATIONAL PARIS AIR SHOW – LE BOURGET, 17 JUNE 2019

Clic here to see the video

As Europe's most strategic defence programme, the Future Combat Air System (FCAS) is key to European sovereignty in the 21st century.
As a combat system of systems, FCAS will deliver increasing effects by leveraging the connected capabilities of pooled platforms, bringing the next level of air power to highly denied environments.

FCAS: A COMPLEX SYSTEM OF SYSTEMS

Future Air Power is composed of connected, manned and unmanned air platforms, enhanced by different sensors and effectors. They will be part of an open, scalable system architecture that enables the inclusion of future platforms and new technologies.

FCAS is a system of systems connecting interoperable manned and unmanned air platforms.

The cornerstone of FCAS is the next-generation weapon system where next-generation fighters team up with remote carriers as force multipliers. Additionally, manned and unmanned platforms also will provide their uniqueness to the collective capabilities while being fully interoperable with allied forces across domains from land to cyber. The air combat cloud will enable the leveraging of networked capabilities of all pooled platforms.
Since its inception, Airbus has lived the "working together" principle. It is the only player that combines European DNA, industry achievements and presence to make FCAS a success.
As a German and Spanish champion and a strong player in France and the UK, Airbus is uniquely positioned as a European company to drive FCAS with its partners. The company also has a strong history of guaranteeing French military sovereignty and working as a reliable partner with the French armed forces.

With Spain joining the project as a partner nation, FCAS is a truly European journey – strengthening the region's defence industry and its technological leadership in low observability, manned unmanned teaming, high speed connectivity,useofartificialintelligenceandhuman-machine collaboration.

New fighter FCAS
Dassault Aviation and Airbus revealed a real size model of the Next Generation Fighter (NGF) at Paris Air Show on June 17, 2019 © Airbus 2019 - photo by H. Goussé / Master Film

Airbus Defence and Space and Dassault Aviation announced their intention in 2018 to work together in developing the Future Combat Air System.
In early 2019, France and Germany awarded the first contract – a two-year Joint Concept Study (JCS) – to Airbus and Dassault Aviation. At mid-year, Dassault Aviation and Airbus delivered a joint industrial proposal to the governments of France and Germany for FCAS's first Demonstrator Phase – with full-scale models the new-generation fighter and remote carriers were revealed at the Paris Air Show in June. During the air show, Airbus also announced plans to closely cooperate with innovative technology players like start-ups, small and medium-sized enterprises and research institutes especially in the software domain to unlock new ideas, technologies and research for FCAS.

In 2018, Airbus successfully performed manned-unmanned teaming (MUT) test flight campaigns, confirming the company's expertise in controlling remote carriers from a manned aircraft. These test campaigns included demonstrations with five Airbus-built Do-DT25 target drones controlled from a mission group commander airborne in a manned command and control aircraft.

Also in 2018 – with support from French and Canadian space agencies – Airbus successfully tested its LTE AirNode technology, a key part of the company's secure networked military communications programme, **Network for the Sky (NFTS)** – which is fully aligned with the development of the required FCAS connected capabilities.

Dassault Aviation and Airbus new fighter revealing at Paris Airshow 2019 - Day 1
Reveal of first concept models for New Generation Fighter and Remote Carriers

From left to right : The German Federal Minister of Defence, Ursula von der Leyen; French Minister of the Armed Forces, Florence Parly; President of the French Republic, Emmanuel Macron; Eric Trappier, Chairman and Chief Executive Officer of Dassault Aviation; Spanish Minister of Defence, Margarita Robles Dirk Hoke , Chief Executive Officer of Airbus Defence and Space. © Airbus - Master Films - Frédéric Lancelo

Synthesis written by J.-P. S. From Airbus information:
https://www.airbus.com/defence/fcas.html

THE OPINION OF THE AIR AND SPACE ACADEMY ON THE FUTURE OF EUROPEAN LAUNCHERS

By Gérard Bréard et Eric Dautriat

THIS IS A SUMMARY OF THE OPINION OF THE AIR AND SPACE ACADEMY ON THE FUTURE OF EUROPEAN LAUNCHERS, PUBLISHED IN MAY 2019

Twenty years after the first flight of Ariane 5, which still guarantees European independent access to space today, and has long supported the position of Ariane space as world leader in the realm of commercial launches, the decision was taken in 2014 to develop a new generation of launchers: Ariane 6. Since then, however, there has been an increase in commercial, financial and technological pressures from new operators such as SpaceX, whose successful start owed much to NASA's need to regain US access to the International Space Station.

The reusable first stage of the launcher is one of the most visible aspects of this competition. Projections for Ariane 6 are at stake, particularly commercially speaking, not least due to the current collapse of the market following a drastic reduction in the current orders for geostationnary satellites, linking to the doubts surrounding the potential market for constellations.

Given this situation, the Air and Space Academy (AAE) considered it timely to examine this topic and its general context.

1. NEWSPACE COMBINED WITH POLITICAL WILL TO RENEW AND RELAUNCH THE SPACE ADVENTURE

The future of launchers can only be conceived within a comprehensive European space strategy. Currently the United States (the government but also the private sector, which is a radical innovation), China and soon India are redefining and re-developing genuinely ambitious visions for their space future, indicating their desire for power and/or to invest in technological revolutions.

Europe, though, the world's second largest economic power, which some 30 years ago was capable of promoting – and largely carrying through – a coherent, very ambitious range of programmes, seems to have run out of steam. It is lacking both impetus and momentum. And yet a grand plan for space could, more than ever, release immense economic, technological, scientific, military and strategic potential.

RECOMMENDATION 1:

Endow Europe once again with an ambitious Space Vision, transcending purely economic motivations, in which a key element is sovereign access to space and to space exploration.

2. EUROPE LACKS A SHARED APPROACH BETWEEN THE MAIN PLAYERS

The evolutions of Vega (Vega E, which still needs to be specified), the discussions around the P120 common to Ariane 6 and Vega and the announced arrival of a Lox-LCH4 engine to replace the AVUM (Vega's top-stage engine, of Ukrainian origin) all hold the risk of growing friction between the worlds of Ariane (A62) and Vega, in particular concerning European institutional launches (Figure 1).

Although Italy has become a major player in the launcher industry (or perhaps for that very reason), there is no shared long-term vision, but rather a type of separation Europe cannot afford (except possibly at the R&T stage for sound competitive reasons). Italy must be part of European leadership on access to space, alongside Germany and France, and must therefore be fully integrated into the different stakes.

RECOMMENDATION 2:

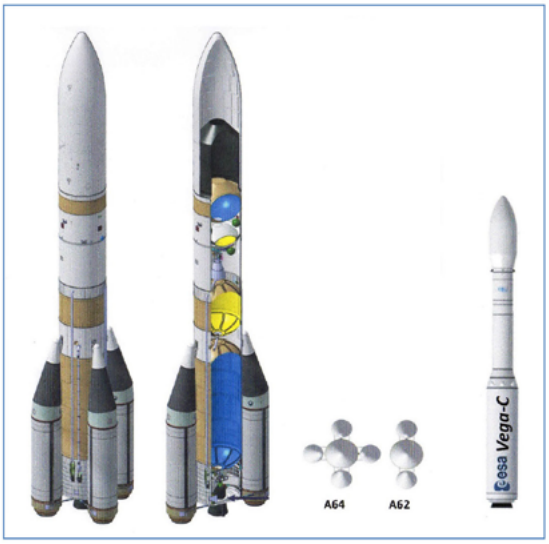
Recreate a genuine European strategic alliance in the area of launchers between France, Germany and Italy, as well as other EU members and ESA, integrating the European preference requirement.

3. SPACEX AND BLUE ORIGIN DRAMATICALLY CHANGE THE SITUATION

The formidable nature of the SpaceX challenge to Europe has been clear since the early days of Ariane 6 development: it was even an essential element in the political decision behind the Ariane 6 programme. But, four years later, it is clear that SpaceX, with the help of American institutions, has progressed both further and faster than anticipated at the time (Figure 2).

Although it has benefited from considerable indirect support from the American government through institutional orders, the success of SpaceX is also due to the fact that, after a process of continuous evolution, Falcon 9 offers a

Ariane 62 – Vega C

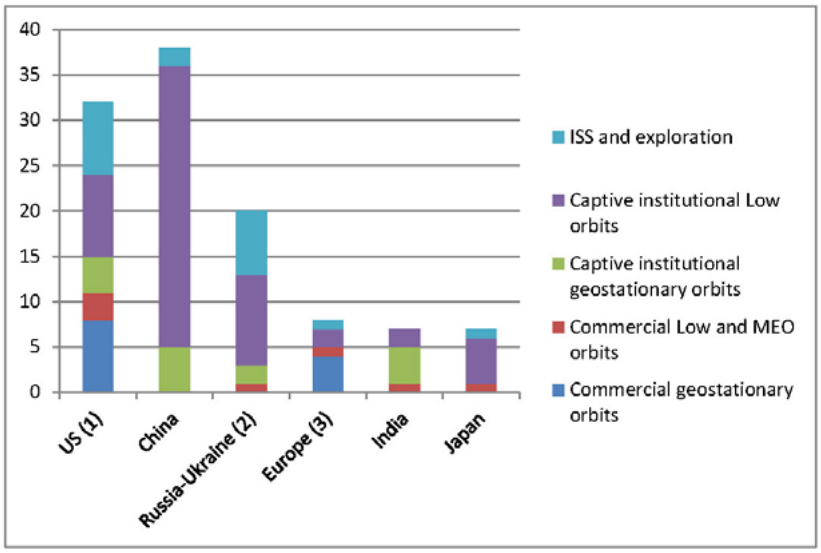


	Launcher height	Take-off weight	Payload performance sun-synchronous orbit 700 km	Geostationary transfer orbit GTO capacity	Price estimation
VEGA C	35 m	210 tonnes	2200 kg	NA	€35 M (for a rate of 3 per year)
Ariane 62	63 m	530 tonnes	7000 kg	5000 kg	€70 M (for a rate of 11 per year)

The Ariane 6 powder accelerators and the Vega C first stage use the same solid-fuel engine (P120).

The European institutional satellites (Copernicus, Metop, Meteosat, military observation, ...) of the 1.5t / 2t category are aimed at Vega C or Soyuz, or even the lower performance range of Ariane 62. Their launch rates are low.

Figure 1



Some launches involve multiple deployments (dual or cluster launches):

(1) including 21 for SpaceX (out of 32) with 8 GTO commercial telecom payloads

(2) including 15 Soyuz for 20 launches

(3) including 6 Ariane 5 (4 ECA dual launches for 8 GTO commercial telecom, 1 ECA Bepi Colombo, 1 ES for 4 Galileo) + 2 Vega.

112 launches were effected worldwide placing 452 payloads.

Geostationary orbits are mainly dedicated to commercial telecom satellites. The lower orbits (LEO, SSO, MEO) are more oriented towards institutional needs (navigation, observation, military, weather, ...).

Figure 2

remarkable cost/performance ratio. In addition, beyond its concrete successes, SpaceX helps give real meaning to the space adventure. And Blue Origin of Jeff Bezos is coming. As a result, the situation for European launchers is not only unprecedented but critical.
Only a proactive political leap as part of a global vision, as mentioned above, can restore a situation acceptable to European launchers.

RECOMMENDATION 3:

Reach a consensus at the highest political level as to the urgent need for a European strategy for access to space capable of matching scenarios of disruptive innovation introduced by SpaceX and Blue Origin in particular.

4. PROFOUND INNOVATION IN THE DESIGN AND PRODUCTION OF COMPETING LAUNCHERS

Technical and economic "reconstitution" of competing products (here, launchers) is, or should be, a basic practice absolutely essential to any new project. Detailed understanding of what is being achieved elsewhere, going far beyond natural curiosity, is indispensable at all times and in all cases. Existing publications are already very instructive. Three major axes need to be explored and analysed in depth: project management, design criteria and selected technologies and (in line with the above, although more difficult) production and operating costs estimates.

RECOMMENDATION 4:

Achieve in-depth understanding on how SpaceX reached this level of technical and economic performance, in order to draw lessons for European launchers in their own context. Proceed likewise with Blue Origin and other programmes as soon as possible. Establish a permanent entity for fact gathering.

5. EVOLUTION AND POST-ARIANE 6, NOW

IIn the first place, despite a very difficult commercial situation in an uncertain market, it is necessary to complete development of Ariane 6 - whose versatility is an asset - and to ensure a successful production ramp-up, but this only makes sense if, at the same time and as a matter of urgency, the entire medium- and long-term vision is taken into account and given sufficient funding.

For the 2023 timeline - at the beginning of its life cycle - Ariane 6 presents opportunities for incremental improvements that will enhance its competitiveness in the short term while reducing costs and improving its performance. But at the same time, technological and architectural work, especially on propulsion, must be pushed through rapidly with the aim of identifying new avenues for significant cost reductions, until it is possible **to define a new launcher to follow on from Ariane 6 by the end of the next decade**. First stage reusability is potentially a key to this competitiveness, provided that it is justified by the operational profile of the European launcher: *there is an optimal launch rate below which the ratio of fixed costs to variable costs does not justify reuse*. Moreover, there is no point in "copying" the Falcon 9 launcher of today for a post-A6 launcher that would be available in ten years' time, ten years being roughly what separates current European technology from that demonstrated by SpaceX. Europe must find ways to push forward, to go "one better" by reducing launch costs and/or differentiating itself in the service offer.

Studies currently underway are perfectly justified. However the volume and rhythm of this research is far too modest, due to the lack of any budget to commence development of a new launch vehicle around 2023. And the studies themselves are not ambitious enough. It is vital to begin architecture studies for the future launcher to guide technological developments.

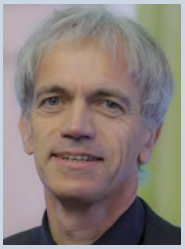
RECOMMENDATION 5:

Begin immediate, determined funding for the preparation of a successor to Ariane 6, inspired by the principle of disruptive innovation, which should deliver long-term competitiveness and flexibility.

Preparation for the ESA Council at Ministerial Level, at the end of 2019, should determine the best solutions to the challenges facing the European launcher industry, while placing them in the very broad strategic context of tomorrow's space activities as a whole. Through this Opinion and its recommendations, the Air and Space Academy has no other purpose than to make a constructive contribution to this crucial debate.

Gérard Bréard is graduated from ESTACA and ESTA.
The main milestones of his career are:
• In the years 1990 at Aerospatiale: development of the propulsion stages and of the reentry bodies of the strategic ballistic missile M4, then director of the European ARD (Atmospheric Reentry Demonstrator) programme which was concluded by the successful flight of 21 October 1998;
• From 2000 at Atrium Space Transportation: successively CTO and CQO, he contributes to the development of the strategic ballistic missile M51;
• Member of the Ariane Technical Committee, he contributes to the qualification of the launchers and to the approval of the flight readiness documents;
• From 2010 to 2018: president of Bordeaux Polytechnical Institute.

Gérard Bréard is Member of the Air and Space Academy.
French distinctions: Chevalier de la Légion d'honneur – Médaille de l'aéronautique – Palmes académiques.



Eric Dautriat is graduated from Ecole Centrale de Lyon in 1977. He spent all his career in aeronautics and space.
In particular, he was Director of Launchers at CNES (Centre National d'Etudes Spatiales), in charge of Ariane 5 developments, from 1997 to 2003, then Quality VP of Safran Group, before taking the lead of the Clean Sky Joint Undertaking in Brussels from its creation in 2009 to 2016.
He is Chevalier de la Légion d'honneur.
He was awarded the CEAS Gold Medal in 2017.
He is Vice-President of the Air and Space Academy.

TOWARDS AN AMBITIOUS ESA MINISTERIAL «SPACE19+» EUROSPACE VIEWS, 2019

ASD-EUROSPACE
The Space group in ASD

The CEAS bulletin provides its readers with the proposals elaborated by ASD-EUROSPACE in view of the ESA Council meeting at Ministerial Level which will be held on 27-28 November 2019 in Seville (Spain). This set of papers comprises four parts: Towards Space19+, Eurospace views 2019 – Keeping the European space sector at the leading edge – Strenthening the European space sector through an ambitious industrial policy – European position paper on aggregation of institutional launch services.

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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 Approved by Council - June 2019 2
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 in2020 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 returnfrom 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 refuelling, re-positioning, repurposing, 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.

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);

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

• 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

See to this link:
https://eurospace.org/wp-content/uploads/2019/06/towards-an-ambitious-esa-ministerial-council-2019-finalrev1.pdf

■KEEPING THE EUROPEAN SPACE SECTOR AT THE LEADING EDGE

Eurospace high level guidelines for Space in Horizon Europe

Space is one of the few industrial sectors where Europe remains extremely competitive against traditional (USA, Russia) and rapidly emerging (China) powers: with 4% of the global industrial workforce (43,000 jobs in Europe), the European space industry has accounted for around 20% of worldwide industrial space production over the last five years. This is the result of several decades of fruitful European cooperation and thanks to an ambitious Research & Innovation policy put in place by the European Union.

In this context, the European space industry, represented trough Eurospace, aspires to efficiently support European institutions in addressing societal challenges while generating growth, competitiveness and benefits to citizens. It is of paramount importance that the strategic specificities of the European space sector as well as its needs will be reflected by strong political action, allowing to continue reaping the benefits of the Europe Union's efforts in space at the service of European society, economy and citizens.

Therefore, as the final discussions for the next Framework Programme, Horizon Europe, are coming into an end, Eurospace wishes to highlight three guidelines of major importance if Europe wants to keep its leading edge in terms of innovation, competitiveness and readiness.

1) A GAME-CHANGING BUDGET FOR SPACE HORIZON EUROPE

First, the European space sector needs to rely on an ambitious R&I budget at the level of the aspirations of the European Union for space. Indeed, a significant budget for research and innovation shall aim at a four-fold objective: maintaining the technological readiness of the EU-owned strategic infrastructures (EGNOS, Galileo, Copernicus), preparing the development of the new components of the EU space programme (SST, Govsatcom), establishing an efficient and sustainable common technology base for European space systems as well as ensuring the necessary technological leadership to be able to compete on open markets.

With 4 Billion budget for Space in Horizon Europe the EU would be a game changer.

2) SUPPORT THE EMERGENCE AND ADOPTION OF A DETAILED SRIA FOR SPACE TECHNOLOGIES, A CORNERSTONE OF HORIZON EUROPE'S UPCOMING SPACE WORKPROGRAMMES

Second, it is more than important to support the emergence and the final adoption of a Strategic Research and Innovation Agenda (SRIA) for competitiveness and technology. Eurospace is from the beginning fully engaged and committed, alongside other stakeholders (i.e. the European institutions, Member states, space agencies, research and technology organisations, labs and academia), to the elaboration of a detailed SRIA for space technologies. All the consented efforts must ultimately deliver its expected outcome to form the stepping stone to build the Horizon Europe Workprogrammes for space.

3) GIVE THE POSSIBILITY TO THE EUROPEAN SPACE SECTOR TO BENEFIT FROM A CO-PROGRAMMED PARTNERSHIP, THE WORKING ARM OF THE SRIA

Finally, Eurospace positively welcomes the possibility to manage and implement the SRIA in the context of a Co-Programmed Partnership, with the private sector as a strong partner, and for which the governance and the conditions still need to be defined and discussed with all the potential interested stakeholders – our industrial community is in this respect looking forward to working hand in hand with the EU institutions in the next few weeks and months.

■STRENGTHENING THE EUROPEAN SPACE SECTOR THROUGH AN AMBITIOUS INDUSTRIAL POLICY

HIGH-LEVEL GUIDELINES FROM THE EUROPEAN SPACE INDUSTRY

BACKGROUND AND EUROPEAN UNIQUENESS IN SPACE

The space sector is one of the few industrial sectors where **Europe remains extremely competitive** with respect to the traditional (USA, Russia) and rapidly emerging powers (China): with 4% of the global industrial workforce (45,000 jobs in Europe), the European space industry has produced and launched about 20% of the space infrastructures in the last five years. This achievement is the **result of several decades of European cooperation** - through the European Space Agency and thanks to the more recent role played by the European Union.

The situation of Europe in space reflects nonetheless a certain number of specificities that sets us apart from the other large space powers: the **institutional demand for space infrastructure and services remains limited on our continent**, whereas it constitutes, in all the other space powers, a very important protected (captive) market, which is fuelling domestic industrial competitiveness. **European institutional investment is thus six to seven times smaller than in the United States**; The Russian space budget has meanwhile increased by an average of 10% per year over a decade, while the Chinese budget efforts in this sector are considerable, with significant achievements.

As a consequence of this unique situation and unlike its international competitors, the European space industry highly relies on the commercial business and export sales – that are now experiencing a severe downturn

and face uncertainties in the medium term: between 2014 and 2018, 72% (estimation) of the spacecraft mass produced by the European space industry was devoted to commercial activities, against 28% to local institutional markets (which represented about 65% of the estimated sales in value). The same ratio for spacecraft mass in the US industry was an estimate of 43 % (against 57% to the domestic market). This situation of extreme exposure of our industry to the competition on open markets makes the institutional support to promote the competitiveness of the sector, through dedicated measures of industrial policy, even more crucial, in line with article 189 of the Lisbon Treaty.

1 Supporting the expansion of industry's positions worldwide

Considering that the European space industry strongly relies on the commercial business and export sales, a stronger support from the EU institutions to actively promote European space industry offers on the open markets should be a priority – in complement and good coordination with national efforts - with the objective to **facilitate access to new markets**– by the active promotion of European capabilities.

2 Investing in research & innovation: a must to preserve long-term competitiveness

Furthermore, today's investment in innovation will be the driver of tomorrow's competitiveness for the European space sector: maintaining Europe 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 Horizon Europe, via relevant budgets, adequate tools and appropriate priority areas, shall ensure that Europe consolidates its leading position.

3 Ensuring a key role for space-based technologies in support to the EU's rising ambitions in security & defence

Even more in the field of "military space" than on other space markets, **captive government markets create externalities on space infrastructure market that distort the terms of the competition, at the detriment of the European space industry** – since there are f.i limited space military programmes in Europe or no ambition for Europe-manned systems sustaining industrial activities on a long-run.

In such a context where Europe is lagging behind, **new EU policy actions could have a key role to play to foster the competitiveness and innovativeness of the EU's space technological and industrial base** – and contribute to bridge the existing gap with the other space powers.

For this purpose, the **implementation of the new regulation creating the European Defence Fund** can therefore offer a new opportunity to boost institutional investment in strategic and military applications of space – the central pillar of American, Russian and Chinese space policies.

In complement with this new instrument and pursuant to the TFEU provisions, a priority for the next European Commission should be to decline operationally, in due cooperation with the Member States, the ambitions expressed in the pillar of the Space strategy calling to "reinforce Europe's autonomy in accessing and using space in a secure and safe environment". This would require to address the missing capabilities Europe needs to be equipped with to ensure its awareness, autonomy and freedom of action (i.e **security of EU-owned infrastructures in space and security from space**).

4 The European space sector needs a regulatory framework driven by strategic considerations and worldwide practices

Since space markets are still characterized by a predominance of public demand and a captive dimension, the development of a **procurement strategy that takes into account the specificities of the space sector** should be a priority, aiming at:

- Preserve and enhance the European capabilities to design, develop, launch, operate and operate space systems (**European autonomy imperative**)
- Strengthen the competitiveness, efficiency and reliability of the European space supply chain
- Reduce the technological dependence of the European space sector and ensure security of supply for critical technologies (**European sovereignty imperative**)

Based on the current policies in all the other space powers and in order to **ensure predictability for manufacturers through long-term commitments, stable regulatory framework and sustainable budgets**, a reflection on the modalities of a «European preference» should thus be initiated, in order to meet the European institutional needs for space technologies and services.

In the meantime, it is essential that any attempts to open European institutional markets to non-European actors be strictly conditioned not only to mirror reciprocity practices, **but also to ensure that reciprocity is conditioned to a level playing field with non-European competitors**.

In the same vein, the **adaptation of the EU trade policy** to defend the European strategic autonomy and promote a «level playing field» is also a major challenge for the European manufacturing space industry.

5 Making EU public policies reap the full benefit of space-based technologies and services

Lastly, **unlocking the cross-sectoral added-value of space based technologies and services** at the benefit of other Union's policies should be actively promoted, with the three-fold objective to maximize the impact of investments pursued in space infrastructures, foster

therefore industrial activities and optimize efficiency of public decision-making: **all this contributing ultimately to provide wider and more tangible socio economic benefits to the European citizens**. In this context, new schemes should be jointly reflected to implement a demand-side policy, where the European Commission would evolve from an exclusive role of "space technology prescriber" towards a stance of sectorial consumer or user of space-based data.

■EUROSPACE POSITION PAPER ON AGGREGATION OF EUROPEAN INSTITUTIONAL LAUNCH SERVICES

PREAMBLE

Space is a strategic and multifaceted tool in daily-life for European governments, businesses and citizens: indeed, space-based applications support major crisis management, economic growth, innovation, employment and information access, resulting in a significant benefit for people, growth, employment and innovation.
In order to keep the European autonomous access to space, it is thus essential for Europe to maintain its global leadership throughout the entire value chain of the space sector.

With 82 successful Ariane 5 flights in a row and 11 flawless Vega flights out of 11 attempts from the Guiana Space Center, the current ESA-developed European fleet of Launchers is characterized by an unprecedented, worldwide recognized reliability. Arianespace, the European Launch Service Provider, has got more than 40 years of experience and competence in this sector and can count on a highly competitive industrial base with skilled workforce and recognized high level of expertise and excellence.
Nonetheless, the current worldwide scenario is being severely challenged by an aggressive competition and asymmetries in access to the market: in particular, the size of captive markets and pricing policies are different from one space power to the other, resulting in an unbearable competitive disadvantage for the European launcher industry. The aggregation of all European institutional launch services is needed in order to counter such distortions and move towards a level-playing field to the benefit of Europe developed launchers.

THE CURRENT SCENARIO - ANALYSIS OF ASYMMETRIES

Arianespace's business model relies on a significant success in the commercial and foreign institutional launch market.
On the contrary, Arianespace's competitors benefit of a strongly protected institutional domestic market: American, Russian, Chinese, Japanese and Indian Launch Service Providers rely on an exclusive access to their respective civil and military governmental market through long-term procurement contracts. For the sake of comparison, the US captive institutional market, civil and military, represents more than $5 Billion per year for domestic launch related procurement activities, while the European institutional market, which too often has been open to competitive bids, represents only around €500 Million per year.
Chart 1, Annex 1, shows how in the period 2012 to 2016 the institutional demand of launch services in space powers has been met by captive market solutions, with the sole exception of Europe. Charts 2 and 3, Annex 1, illustrate respectively the distribution in 2017 of global launch services per space power, and between captive and non-captive market segments.
This asymmetry in volumes of captive launches is further stressed by the pricing policy: generally, institutional launches are offered at significantly higher prices than the commercial ones, the latter being able to benefit by extra revenues generated by "generous" institutional contracts.

For example, Space X can practice an extremely diversified pricing policy for the same class of launch service, e.g.:
- Commercial and foreign institutional offers: 45 to 75M$ with prevailing trend and offers around 55/60M$,
- Institutional offers for US market: 82 to 112M$, with prevailing offers now above 100M$.

Chart 4, Annex 1, provides an overview of the price levels trends in the non-captive GTO market segment between Arianespace and Space X: the distortion is evident, with Space X selling in its institutional captive market at prices dramatically higher if compared to those applied to the export market. In addition to such major advantages, governments of Arianespace's competitors are also covering costs associated with maintaining launch infrastructures. Always regarding Space X, the US Air Force, NASA and state governments shoulder the bulk of these expenses, whereas Arianespace contributes to the direct funding of Europe's spaceport, through more than 200 M€ external procurements per year (fixed costs), the majority of which is being then dedicated to exploitation, maintenance and adaptation of the strategic launch facilities.

HOW TO IMPROVE THE CURRENT SCENARIO

In 2014, the European industry has taken an unprecedented step to improve its competitiveness through the development of Ariane 6 and Vega C, both co-financed by industry, and for which industry bears the risks linked to exploitation, with the commitment on the public side to ensure five institutional launches per year for Ariane 6 and two for Vega C in order to sustain the corresponding part of the business case. In that respect, the aggregation of the European institutional launch service needs is the first measure to be taken by European institutions

in view of being served by Europe developed launchers. Indeed, by securing guaranteed yearly average volumes of institutional launches at agreed market prices is considered to be a basic, affordable and sustainable countermeasure against the abovementioned asymmetries, enabling industry to plan all the activities at an increased rate, thus moving forward the establishment of a level-playing field.

In particular secured, high-rate and bulk-procured launch services will provide long-term benefits to industry, allowing to increase its competitiveness and therefore its long-term sustainability.

An additional measure could be the institutional co-funding of selected activities related to the exploitation of launch facilities, such as contributing to maintaining the ground infrastructures, as well as mission and launch service needs.

ANNEX 1: **CHART 1, CHART 2, CHART 3, CHART 4**

CHART 1 - 2012-16 Institutional demand of launch services

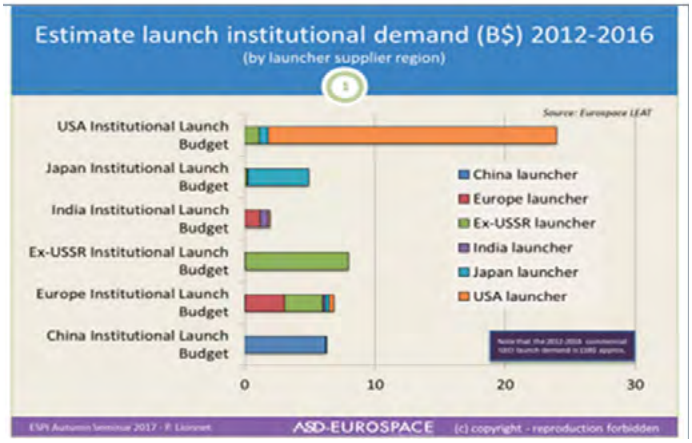
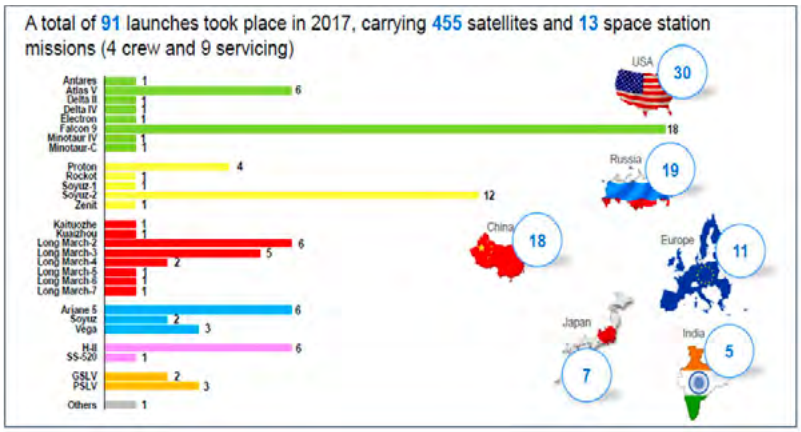


CHART 2 - Global launch services share per space power (2017)



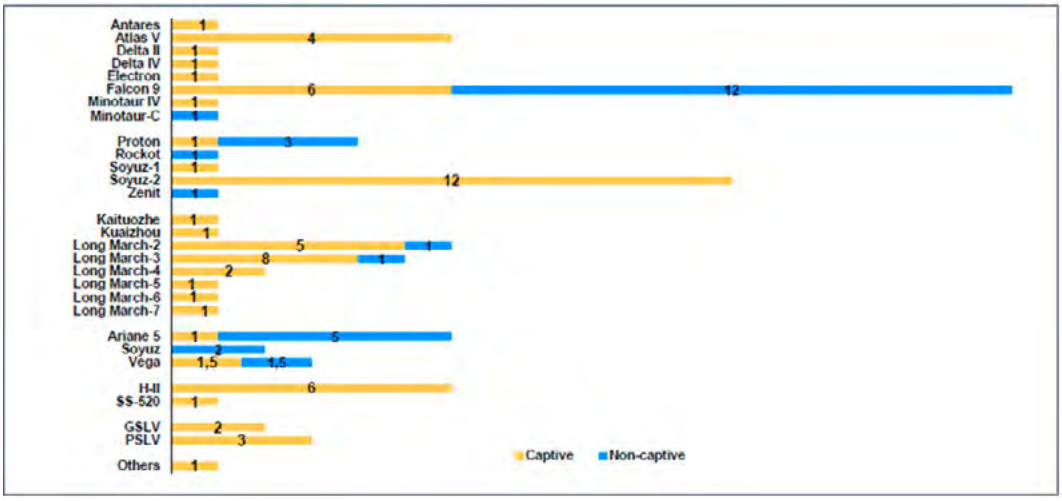
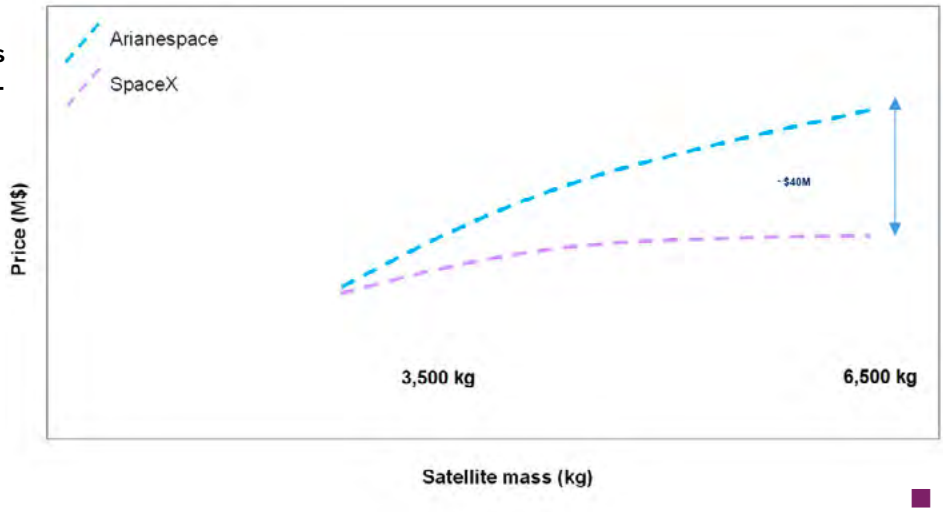


CHART 3 - Captive and commercial launches (2017)

CHART 4 - Overview of the price levels trends in the non-captive GTO market segment between Arianespace and SpaceX:



AMONG UPCOMING AEROSPACE EVENTS

2019

OCTOBER

08-09 October – FTF – **Aerospace Technology Congress 2019 – Sustainable Aerospace Innovation in a Globalised World – Stockholm (Sweden)** – Stockholm Waterfront Congress Centre – www.FT2019.SE

15-17 October – IATA – **Global airport and Passenger Symposium 2019 – Warsaw (Poland)** – https://www.iata.org/events/

15-17 October – Aviationweek – **MRO-EUROPE – Maintenance and Repair Overhaul Conference and Exhibition – London (UK)** – https://mroeurope.aviationweek.com

15-20 October – Seoul – **Seoul Adex 2019 – Seoul International Aerospace and Defense Exhibition 2019** – Seoul (South Korea) – Seoul Airport – Seongnam Air Base – www.milavia.net/airshows

17 October – EDA/NATO– **2nd AAR Conference in Europe – Air-to-Air Refuelling Conference in Europe –** Brussels (Belgium) – https://aarconference.org

21-23 October – ESA– **EPIC Workshop – Electric Propulsion Innovation and Competitiveness –** Noordwijk (NL) – ESA/ESTEC – https://atpi.eventsair.com/

21-25 October – IAC – **70th International Astronautical Congress** – Space: The Power of the Past, the Promise of the Future Washington, D.C.(USA) – Convention Center – www.iac2019.org/

29-30 October – RAeS/EASA – **EATS 2019 – European Airline Training Symposium –** Berlin (Germany) – Estrel Hotel – www.aerosociety.com/events/ - www.eats2019

NOVEMBER

04-06 November – China Aviation Development Foundation – **IASS2019 – 72nd annual International Air safety Summit –** Taipei (Taiwan) – Mandarin Oriental Hotel – https://www.flightsafety.org/events

04-08 November – COSPAR – **4th COSPAR Symposium – Small Satellites for Sustainable Science and Development** – Herzliya (Israel) – Hotel Daniel – http://www.cospar2019.org/

06-09 November – ESA – **7th Intenational Conference on Astrodynamics Tools and Techniques (ICATT)** – Oberpfaffenhofen (Germany) – DLR Centre – https://www.esaconferencebureau.com

07 November – RAeS – **Greener by Design Conference –** London (UK) – RAeS/HQ – www.aerosociety.com/events/

12-13 November – RAeS – **The Commercial UAV Show 2019 –** London (UK) – The Excel, London – www.aerosociety.com/events/

12-13 November – RAeS – **Rotorcraft Simulation – Trends and Future Applications –** London (UK) – RAeS/HQ – www.aerosociety.com/events/

12-14 November – ICAO – **Drone Enable – ICAO's 3rd Unmanned Aircraft Systems Industry Symposium (DE/3) –** Montréal (Canada) – ICAO/HQ – https://events.icao.int

14-15 November – RAeS – **Global Megatrends in Aviation Forum – Visions for the Future of the Industry –** London (UK) – RAeS/HQ – www.aerosociety.com/events/

17-21 November – Dubai DWC – **Dubai Airshow 2019 – Connecting the Aerospace Industry** – Dubai – UAE) – Dubai World Central – Al Maktoum, Jebel Ali – www.dubaiairshow.aero

19-20 November – IATA – **Wings of Change Europe** – Berlin (Germany) – Grand Hyatt Berlin Hotel – https://www.iata.org/events/

25-27 November – ACI – **ACI Airport Exchange – Abu Dhabi (UAE) –** ADNEC, Abu Dhabi – www.airport-exchange.com

DECEMBER

02-04 December – SESAR-ACI-Europe – **Take the digital sky challenge – To reinvent aviation –** Athens (Greece) – Athens International Airport – https://www.sesarju.eu/events

02-06 December – SESAR – **9th SESAR Innovation Days 2019 – Athens (Greece) –** National Centre of Scientific Research (NCSR) – https://www.sesarju.eu/events

09 December – EREA – **EREA Annual Event –** Brussels (Belgium) – https://www.erea.org/

09-10 December – AAE/AM – **Towards unmanned ships and aircraft** – Paris (France) – Ecole militaire Amphithéâtre Foch – www.academieairespace.com

AMONG UPCOMING AEROSPACE EVENTS

2020

JANUARY

06-10 January – AIAA – **AIAA SciTech Forum – AIAA Science and Technology Forum and Exposition –** Orlando, FL (USA) – https://www.aiaa.org/events/

14-16 January – AIAA – **2nd IAA Conference on Space Situational Awareness –** Washington, Dc (USA) – www.icssa2020.com

FEBRUARY

25-28 February – CCEAS-3AF-AIAA – **AEC2020 – AREOSPACE EUROPE CONFERENCE -** Thematic: Greener Aerospace innovative Technologies and operations for a human Friendly Environment – Bordeaux (France). Congress Center www.aerospace-europe2020.eu

MARCH

07-14 March – IEEE/AIAA – **2020 IEEE Aerospace Conference –** Big Sky, Montana (USA) – https://www.aiaa.org/events

10-12 March – CANSO – **World ATM Congress 2020** – Madrid (Spain) – IFEMA, Feria de Madrid – https://www.worldatmcongress.org/

24-26 March – AIAA – **23rd AIAA International Space Planes and Hypersonic Systems and Technologies Conference** – Montréal (Québec, Canada) – https://www.aiaa.org/events/

APRIL

01-04 April – Friedrichshafen – **AeroFriedrichshafen - The Leading Show for General Aviation –** Friedrichshafen – Friedrichshafen Airport – www.aero-expo.com

20-24 April – HiSST – **2nd International Conference on High-Speed Vehicle Science & Technology -** Bruges (Belgium) – Oud Sint-Jan – www.aerosociety.com/events/

MAY

12-17 May – European Commission/BDLI – DLR – Federal Ministry Economy **– AERODAYS2020 - 8th European Aeronautics Days – As part of ILA Berlin -** Berlin Aviation Summit and ILA Future Lab Forum - www.aerodays2020.eu

13-17 May – ILA – **ILA Berlin 2020 – Innovation and Leadership in Aerospace** – Berlin (Germany) – BER Airport – ExpoCentre Airport – https://www.ila-berlin-de/en

25-27 May – Elektropribor – **27th Saint Petersburg International Conference on Integrated Navigation Systems –** Saint Petersburg (Russia) – www.elektropribor.spb.ru/en/conferences/142

26-28 May – EBAA – **EBACE2020 – 2020 European Business Aviation Convention –** Geneva (Switzerland) – Geneva's Palexpo – Geneva International Airport – https://ebace.aero/2020/

27-29 May – EUROMECH – **17th European Mechanics of Materials Conference –** Madrid (Spain) – https://euromech.org/

JUNE

21-26 June – ESA **– 11th ESA Conference on GNC –** Sopot (Poland) – https://atpi.eventsair.com/

23-26 June – ICNPAA **– ICNPAA 2020 – Mathematical Problems in Engineering, Aerospace and Sciences –** Prague (Czech Republic) – www.icnpaa.com

JULY

05-10 July – EUROMECH – **10th European Nonlinear Oscillations Conference –** Lyon (France) – https://euromech.org/

19-24 July – ECCOMAS – **ECCOMAS Congress 2020 – Jointly organized with the 14th World Congress on Computational Mechanicse** – Paris (France) – www.eccomas.org/lin-de/en

20-25 July – Farnborough – **Farnborough International Airshow 2020** – Farnborough (UK - Show Centre, ETPS Rd – Farnborough GU14 6FD – https://www.farnboroughairshow.com/

AUGUST

11-15 August – AAS/AIAA – **2019 AAS/AIAA Astrodynamics Specialist Conference –** Portland, ME (USA) – www.space-flight.org

20-25 August – COSPAR – **43rd COSPAR Scientific Assembly –** Sydney (Australia) – International Convention Centre – https://www.cospar2020.org

24-26 August – AIAA – **AIAA Propulsion and Energy Forum –** New Orleans , LA (USA) – https://www.aiaa.org/events/

SEPTEMBER

14-18 September – ICAS – **ICAS2020 –** Shangaï (China) – https://www.icas2020.com

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