



**INTERNATIONAL
ASTRONAUTICAL
FEDERATION**

IAF HIGHLIGHTS

2020



Connecting @ll Space People



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Abbreviations

ADR	Active Debris Removal	ISU	International Space University
AEB	Brazilian Space Agency	ISZ	International Student Zone
AIAA	American Institute of Aeronautics and Astronautics	ITACCUS	IAF Committee for the Cultural Utilisation of Space
ASI	Italian Space Agency	JAXA	Japan Aerospace Exploration Agency
BEC	Bose-Einstein Condensate	JPL	Jet Propulsion Laboratory
CLPS	Commercial Lunar Payload Services	LEAP	Lunar Exploration Accelerator Programme
CNES	Centre National d'Études Spatiales	LTS	Long Term Sustainability
CONFERS	Consortium for Execution of Rendezvous and Servicing Operations	MARSIS	Mars Advanced Radar for Subsurface and Ionosphere Sounding
CRTS	The Royal Centre for Remote Sensin	MBRSC	Mohammed Bin Rashid Space Centre
CSA	Canadian Space Agency	MEV	Mission Extension Vehicle
DLR	German Aerospace Center	MoP	Members of Parliament
EDRS	European Data Relay System	MS	Member States
EEAS	European External Action Service	NASA	National Aeronautics and Space Administration
ELSA-d	End-of-Life Services by Astroscale-demonstration	NEO	Near-Earth Objects
EOL	End of Life	NEOSM	Near-Earth Object Surveillance Mission
ERMC	IAF Enterprise Risk Management Committee	NESDIS	National Environmental Satellite, Data, and Information Service
ESA	European Space Agency	NOAA	US National Oceanic and Atmospheric Administration
EU	European Union	NRHO	Near Rectilinear Halo Orbits
FAA Federal	Aviation Administration	OSAM	On-Orbit Servicing, Assembly, and Manufacturing
GEO	Group on Earth Observations	PDC	Planetary Defense Conference
GEOS	Global Earth Observation System of System	PNT	Positioning/Navigation/Timing
GGPEN	Angola's National Space Programme Management Office	PPP	Public-Private-Partnership
GISTDA	Geo-Informatics and Space Technology Development Agency	PRS	Public Regulated Service
GLEC	IAF Global Conference on Space for Emerging Countries	ROSCOSMOS	Roscosmos State Corporation for Space Activities
GLEX	IAF Global Space Exploration Conference	RPO	Rendezvous and Proximity Operations
GNSS	Global Navigation Satellite System	SANSA	South African National Space Agency
Govsatcom	Governmental Satellite Communications	SEOC	IAF Space Education and Outreach Committee
GRSCE-FO	Gravity Recovery and Climate Change Experiment Follow-on	SGAC	Space Generation Advisory Council
GSFC	NASA's Goddard Space Flight Center	SLS	Space Launch System
GTOC	Global Trajectory Optimization Competition	SST	Space Surveillance and Tracking
HAC	IAF Honours and Awards Committee	STC	IAF Space Transportation Committee
IAC	International Astronautical Congress	STM	Space Traffic Management
IAF	International Astronautical Federation	TC	Technical Committee
IAF	GNF IAF Global Networking Forum	ToR	Terms of Reference
IAWN	International Asteroid Warning Network	UAE	United Arab Emirates
ICAO	International Civil Aviation Organization	UAESA	UAE Space Agency
IDEA	International Platform for Diversity, Equality and Astronautics	UCLA	University of California, Los Angeles
IISL	International Institute of Space Law	UNCOPUOS	United Nations Committee on the Peaceful Uses of Outer Space
IRC	IAF Industry Relations Committee	UNOOSA	United Nations Office for Outer Space Affairs
ISEB	International Space Education Board	USA	United States of America
ISF	International Space Forum	WD-YPP	IAF Workforce Development-Young Professionals Programme Committee
ISRO	Indian Space Research Organization	WoAA	Women of Aeronautics and Astronautics
ISS	International Space Station		

Welcome Message



2020 was a year like no other. The COVID-19 pandemic severely impacted the entire world economy and our personal lives. Large physical gatherings have not been possible and social distancing has been of high importance in curbing the spread of the virus. The International Astronautical Congress supposed to take place in Dubai, United Arab Emirates, and the Global Conference on Space Exploration in St. Petersburg, Russia, were both postponed until 2021.

But even though the year proved to be full of constraints and restrictions, several interesting new initiatives and projects have been launched by the International Astronautical Federation:

- A **new IAF website** was created, providing several improvements with a new attractive design that is easier to navigate and more user-friendly.
- The **IAF Digital Library** was launched, it is the world's largest digital library on space history with more than 50 000 digital papers available. In order to facilitate career development among aerospace professionals.
- The **IAF Launchpad Mentorship Programme** was created to support the career and professional development goals of aerospace professionals around the world through one-to-one mentorship.
- The new initiative **IAF Space Economic Platform (ISEP)** will support the new space economy by integrating new space actors, entrepreneurs and non-space industry and organizations through new dedicated activities.

The **71st International Astronautical Congress** was held virtually for the first time ever in 2020, as the CyberSpace Edition. The event was offered free of charge to allow the entire global community to engage and it was indeed an outstanding success gathering more than 13,000 delegates from 135 countries. The virtual event featured live sessions, technical video presentations and a virtual exhibition.

The first ever **IAF GNF Space Conversations Series** kicked-off on 28 October 2020. These, free-of-charge live online webinars create an additional opportunity for the IAF Community to discuss the most recent developments in space, and are organized in the frame of the IAF Global Networking Forum (IAF GNF).

You will be able to read more about all of these exciting initiatives and events in this IAF Highlights 2020 Magazine. We are hoping, as the rest of the world, that science and technology will help us to address the global health crisis in 2021 and that life will soon start to get back to a new normal. The IAF has many exciting events coming up in 2021 and we are looking forward to seeing all of you, hopefully in person, in 2021. But no matter what happens, you can rest assured that the IAF will continue **Connecting @ll Space People!**

Pascale Ehrenfreund

President,
International Astronautical Federation (IAF)

IAF 2020

Events Overview



Due to the COVID-19 pandemic both the IAF Spring Meetings and the 71st International Astronautical Congress in 2020 were held virtually.

IAF General Assembly 2020

The International Astronautical Federation General Assembly has gathered virtually at the conclusion of the 71st International Astronautical Congress, IAC 2020 – the CyberSpace Edition, on Thursday 15 October 2020. Several important decisions have been taken via email voting prior to the final plenary meeting.

2020 Elections of IAF Officers

4 new Vice-Presidents have been elected by the General Assembly:



Andreas Lindenthal,
Head of Business Operations Space Systems, Head of Spacecraft Equipment and Head of Space Systems Germany, Airbus Defence and Space, Germany, has been appointed as IAF VP for IAF Global Networking Forum



Nobu Okada,
Founder and CEO, Astroscale Holdings Inc., Japan, has been appointed as IAF VP for Space Economy and Sponsorship



Anthony Tsougranis,
National Aeronautics and Space Administration (NASA), United States, has been appointed as IAF VP for Honours and Awards



Xiaojun Wang,
President, China Academy of Launch Vehicle Technology (CALT), China, has been appointed IAF VP for Societies and Museums

IAF Finance

The IAF has also approved the **final accounts 2019 and Auditor's Statement 2019** and the **revised budget and preliminary accounts 2020** and the **Proposed Budget 2021**.



New IAF Members

The IAF General Assembly also approved the applications of **19 new Member Organizations**. With this, the IAF Membership comprises **407 Member Organizations** from **71 countries**, confirming IAF's position as a truly global Federation.

The New IAF Members are:

Company	Category	Region	Country
AGI	Space Industry	North America	United States
Asgardia	Association and Professional Society	Europe	Austria
Beijing FutureSpace Space Technology Institute	Space Industry	Asia	China
Ben Gurion University of the Negev	University	Asia	Israel
Dalian University of Technology (DUT)	University	Asia	China
Fondazione E. Amaldi	Research and Development Organization	Europe	Italy
Fundacion para el Desarrollo de las Ciencias la Sociedad y el Estado (FUNDECISE)	Association and Professional Society	Latin America	Costa Rica
GK Launch Services, Joint-Stock Company	Space Industry	Europe	Russian Federation
IngeniArs S.r.l.	Space Industry	Europe	Italy
Institute for Biomedical Problems of the Russian Academy of Sciences (IBMP RAS)	University	Europe	Russian Federation
Institute of Experimental and Applied Physics, Czech Technical University in Prague	University	Europe	Czech Republic
International Peace Alliance (Space)	Association and Professional Society	Asia	China
Leviathan Space Industry LLC	Space Industry	North America	United States
Libre Space Foundation	Research and Development Organization	Europe	Greece
LIQUIFER Systems Group GmbH	Space Industry	Europe	Austria
Proximai	Space Industry	North America	United States
RFA - Rocket Factory Augsburg	Space Industry	Europe	Germany
Serbian Office for Space Sciences, Research and Development (SERBSPACE)	Association and Professional Society	Europe	Serbia
The Andy Thomas Space Foundation	Association and Professional Society	Oceania	Australia

Connecting @ll Space People



IAF Digital Library



IAF Releases World's Largest Digital Library On Space In History

The new IAF Website

After many months of hard work and dedication, we are delighted to officially announce the launch of this new version of the International Astronautical Federation's virtual interface. We wanted to make the new website faster, easier to navigate, and more user-friendly.

It's important for us to make information regarding our thought leadership, members, events, programmes and activities easily accessible for our always-growing IAF community. We endeavor to provide our members and our stakeholders with the most accurate, up-to-date information and share our knowledge and expertise in the field of space used for the benefit of humanity.

Our goal with this new website is to provide our visitors an easier way to learn about IAF's events and activities and to browse information based on their own choice. The new website gives better access to who are the actors behind the most important Federation in the space sector, all our deadlines and documents to participate into IAF awards and grant programmes, the latest news on our events, as well as improved IAF Members pages.

Amongst the new features, the site contains integrated tags buttons to easily find all the media and contents related to a topic of choice. A newly media page with a live updated tool connecting to all IAF social media accounts to foster improved communication with the global community. We will be constantly updating our content with helpful information, cutting edge thought leadership, IAF's events announcements and members

successes in the Newsletter. You will have access to all IAF's audiovisual library with photos and videos from all IAF's events around the world.

We would also like to thank our amazing IAF Secretariat and our partner Black Meridian who donated their time and energy to make this site what it is!

Best Regards,



Pascale Ehrenfreund
President,
International Astronautical Federation (IAF)



Mary Snitch
VP: Communications, Publications and Global Conferences,
International Astronautical Federation (IAF)

CONNECT | SHARE | EXPLORE | DISCOVER

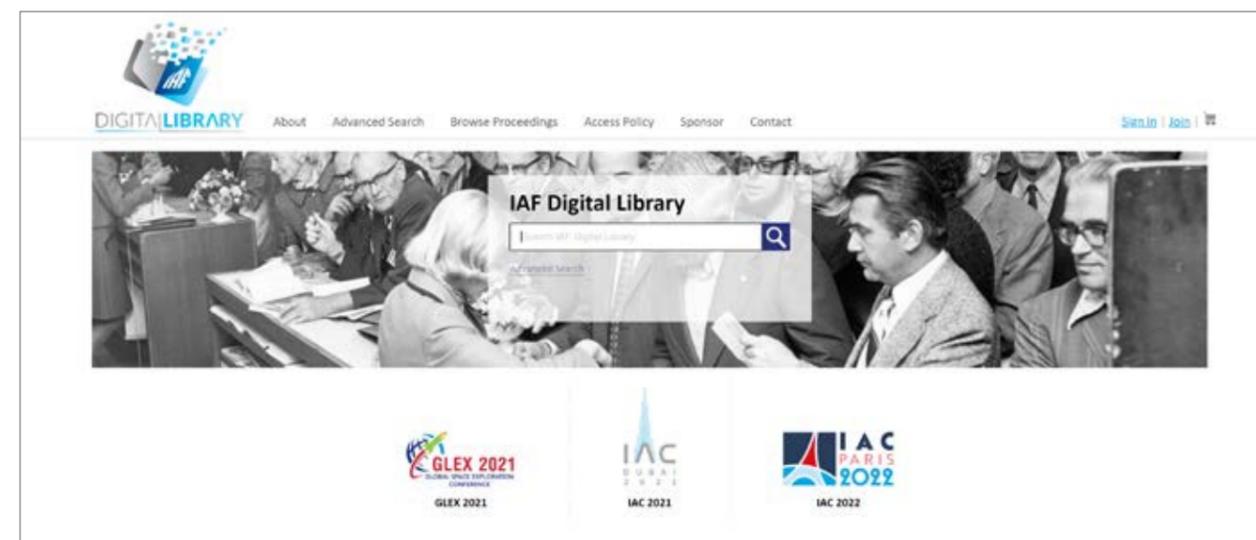
The International Astronautical Federation is proud to announce the launch of the IAF Digital Library, which represents the world's largest repository with more than 50 000 digital papers delineating the legacy of 70-year of space achievements and international cooperation for the benefit of humanity since the inaugural International Astronautical Congress (IAC) in 1950.

The IAF Digital Library is an umbrella project which was initiated in 2016 as part of the long-term vision of the IAF President's Global Innovation Agenda announced by Dr. Le Gall, and finds its concretization today as a core mission of Prof. Ehrenfreund's IAF Global Advocacy Agenda.

The project originated with the pioneering work of the space community which contributed to the annual IAC Technical Programmes with manuscripts and study projects on spacecraft and sounding rockets, and the publication of scientific papers collected during the IACs. Many of these publications were scarce: some were published in small editions with a few copies. By 1968,

IAC regular proceedings had reached four volumes in size with some 2 000 pages. Publishing and printing these volume sets became a considerable challenge. Therefore the IAF changed its publication system at the 1969 IAC in Mar del Plata, Argentina, publishing only selected papers in a special book, while all presented papers had to be available as preprints at the congress site.

While embracing the digital age, the IAF developed innovative solutions for the technical challenges associated with preserving and making all the materials accessible through DVDs and then online through virtual proceedings.



Making space knowledge discoverable and accessible for everyone has been the primary goal of the IAF Digital Library since its inception. The world's premier online library on space serves the IAF members and everyone who is passionate about space with invaluable resources covering all space disciplines, and leading-edge papers presented in major space events, including the globally-renowned annual International Astronautical Congress and the IAF Global Conferences. The IAF is fully committed and determined to accomplish its missions of knowledge sharing and spreading the benefits of space awareness, and sees the new Digital Library as a strengthening of the links between our members in industry, research and academia, and those who work in the front line in the field. We also take it as our duty to bridge the space and digital divide, and facilitate e-learning, research and publication allowing our community to succeed in the coming challenging decades.

This initiative marks a significant milestone in our journey, providing an opportunity to reflect on the missions the IAF stood for 70 years as we move forward into an exciting future. The IAF Digital Library aims to be a destination where knowledge goes beyond economic and geographic barriers to reach everyone, extending the boundaries of the past, envisioning the future and establishing itself as an infinite source of information, innovation, and inspiration for the benefit of humanity.

The IAF Digital Library is literally the gold standard for knowledge about space, and we strongly believe this treasure trove of information can be used for much more than its original purpose.



IAF Launchpad Mentorship Programme



During the IAC's Outreach day on Wednesday 14 October 2020, the IAF launched its new initiative focused on mentorship and career development, pairing early- to mid-career professionals with experienced senior professionals in the space industry.

The IAF Launchpad Mentorship Programme aims to facilitate career development and leadership capabilities of the mentee, and provide a platform for enhanced communication between the various generations represented within the IAF.

During the inaugural IAF Mentorship Programme Announcement at the **IAC 2020 - The CyberSpace Edition**, IAC participants had the opportunity to virtually meet the mentors of this programme whose diversity of talent, expertise and knowledge of the space sector represent authoritative voices that span the breadth of industry, academia and governments.

Minoo RATHNASABAPATHY, IAF Vice-President for Education and Workforce Development has created and organized this new IAF initiative together with IAF Launchpad Mentorship Programme Coordinators, Elizabeth BARRIOS and Ryan KOBRICK.



The IAF Launchpad Mentorship Programme aims to facilitate career development and leadership capabilities of the mentee, and provide a platform for enhanced communication between the various generations represented within the IAF.

IAF Space Economic Platform (ISEP)



Presently, the global space economy is worth more than 350 billion dollars of which 70% are accounted to commercial revenue. In accordance with the definition provided by the OECD,

“The Space Economy includes the full range of activities and the use of resources that create value and benefits to human beings in the course of exploring, researching, understanding, managing, and utilising space.”

Space economy is vastly expanding and becoming increasingly global, with numerous space activities and innovative technologies emerging around the world, from government space programmes to new space systems. For this reason, it is important for an organization like

the IAF, to reach a new audience and reflect on space activity in new markets in order to raise awareness of the potential uses of space services and products.

Embracing a vision for greater diversification of space activity, and greater inclusion of space products and services in day-to-day life, as part of the current IAF Space Advocacy Agenda, the IAF announced the new initiative: the “IAF Space Economic Platform – Bringing Space Down to Earth/Bringing Earth Up to Space”. Through this platform, the IAF aims to continue playing a significant role in global space activity, adapt to the “new order”, grow professionally, reach out to new audiences, voice a variety of new actors in the space sector, and reflect on the new markets space activity is entering and creating. The platform is intended to serve as an overarching framework for a variety of new and existing IAF activities which will be conducted in collaboration with the different IAF committees.

The platform is intended to serve as an overarching framework for a variety of new and existing IAF activities,

which will be conducted in collaboration with the different IAF committees. Some potential features of the platform may include:

- Shining a spotlight on promising entrepreneurs and startups at the IAC exhibitions
- Young professional’s mentorship programs
- Advancing new markets in the space economy and reaching out to non-space markets through besides events and webinars
- Advancing 3G aspects and perspectives in the global space community.

The IAF is actively supporting the space activities and raising space awareness on a global scale. Through its digital activities, the Federation will help the new space economy by integrating new space actors, entrepreneurs and non-space industry and organizations through new dedicated activities.



The IAF Space Economic Platform is also complementary to the existing IAF 3G Initiative, focusing on the 3G Diversity: Gender, Generation, Geography. These elements are significant components of the “new space” trend, and will also affect the emerging new space economy. For this reason, the IAF Space Economic Platform (ISEP) will be complimentary to the to the existing IAF 3G Initiative and will be combined under the catchphrase 3G+.

In the frame of the IAC 2020 – the CyberSpace Edition, and in collaboration with the IAF Industry Relations Committee lead by Clay Mowry and the IAF VP for Industry Relations, Bruce Chesley, the IAF organized the 3rd annual **IAC 2020 Startup Pitch Session**. Given the virtual format of this year’s Congress, each start-up was requested to present via a 5 minutes pre-recorded video, a pitch of their company’s services. Each pitch was available to watch directly within the IAF ISEP Start-up Pitch Session booth, in the Virtual Exhibition. After a careful selection by a distinguished panel of judges and experts, and with the help of a public audience vote, the winner of the IAF 2020 Start-up Pitch Session, **HostMi**, was presented during the IAC Closing Ceremony.



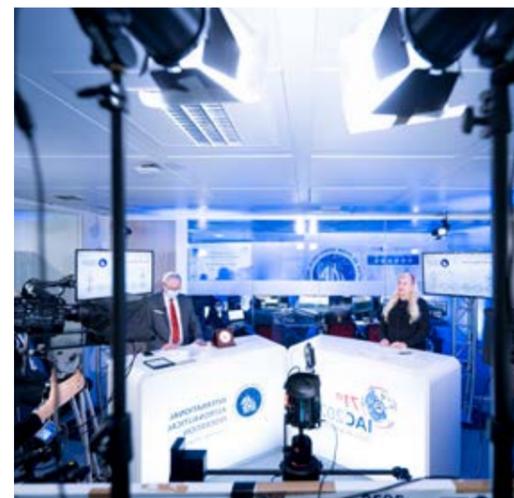


IAC 2020 – An IAF Secretariat Story

IAF Connecting @ll Space People

IAC 2020

- The CyberSpace Edition



Dear IAF Community,
2020 has been, undoubtedly, a challenging year for all of us. The spread of COVID-19 has affected lives, communities and businesses worldwide, placing a strain on our daily habits and pushing us to adjust to a new environment. This unprecedented situation called for an unprecedented Congress and, despite the physical distance, the IAF Bureau, our fantastic volunteers, our IAF Members and the IAF Secretariat have seized the unique opportunity to reach out even further and worked strenuously to create an event that could reach everyone, everywhere.

This is the story of the 71st International Astronautical Federation's Congress and how the IAC will always connect all space people.

The preparations for the IAC 2020 to take place in Dubai were proceeding according to plan when, in December 2019, the World Health Organization (WHO) declared that a mysterious pneumonia was beginning to spread in China, affecting dozens of citizens. Over the following months the situation worsened, crossing international borders, and by March 2020, the virus, called COVID-19, became a pandemic the whole world was fighting against.



Following the worldwide COVID-19 restrictions and containment measures, the IAF Spring Meetings 2020 were adapted to a virtual format, ensuring that most of the meetings and discussions that would normally take place in Paris could still take place remotely, in order not to disrupt the activities of the Federation and its community. The International Programme Committee (IPC) selected the abstracts for the IAC 2020 virtually, approximately 40 committee meetings, two IAF Bureau gatherings and more than 400 participants connecting online for the first ever fully virtual IAF Spring Meetings. Looking back, it



was fascinating to see so much dialogue and information shared and exchanged in such uncertain times.

In April 2020, due to the ongoing and growing concerns on the COVID-19 outbreak, the IAF was saddened to inform the community that the IAC in Dubai would not be taking place in 2020, but would be postponed to 2021.

However, after lengthy discussions with the IAF Bureau, strongly believing that great things can happen when the IAF community comes together, Prof. Pascale Ehrenfreund, IAF President, was delighted to announce that the IAF was to host and organize the 71st International Astronautical Congress, IAC 2020, as a Cyberspace Edition that was going to take place in the homes and offices of people around the world during the week of 12 – 14 October 2020.





Since its first edition in 1950, the IAC has been THE place for all space people to come together and discuss about the latest developments in space. As physical meetings were near-impossible, the Federation, more than ever, was determined to play its unifying role for the space community and therefore decided to offer the IAC 2020 - The CyberSpace Edition without registration fee. This allowed the IAF to reach out to new communities and stakeholders that would normally not have had the means and/or time to physically travel to an IAC.

The theme of the IAC 2020 – The CyberSpace Edition was decided to be “IAF Connecting @ll Space People”: virtually and for free, the IAF and the whole space community would embrace resilience by being connected together.

With the support of a competent technical team transforming the IAF headquarters into a high-functioning production studio and a specialized platform to broadcast our virtual events, we were able to create new types of experiences and content delivery for our participants, encompassing all the elements that make the IAC the place for all space people to come together.

Working out the ideal time frame that would allow maximum participation around the world, the IAC offered three days of 21 live sessions, including plenaries, highlight lectures, IAF Global Network Forum events, and Special Sessions. Thanks to the amazing response from our

community, we created a Technical Presentation Online Gallery which included more than 1300 video lectures, and a virtual exhibition, accessible from anywhere 24-hours a day, offering a vast selection of videos, documents and promotional materials from more than 30 prominent key actors in space.

A big thank you goes to the immense support from our Sponsors that allowed us to offer such an outstanding and rich programme free of charge, reaching even more people and breaking the record with more than 13000 delegates from 135 countries, all connected through this special IAC.

Being the first of such kind of space conferences, I am extremely proud of the IAC’s success and invite you to take a look at the figures and statistics in the next section of this IAF journal, highlighting the amazing achievements of the IAC 2020 - The CyberSpace Edition.

With all its challenges and opportunities, the preparation and execution of the IAC 2020 - the CyberSpace Edition has been an incredible journey for the Federation, for the Secretariat, and for the entire IAF and IAC community.



Dr. Christian Feichtinger,
IAF Executive Director



Opening Ceremony

At the 2019 International Astronautical Congress in Washington, DC, the world had not yet heard of the novel coronavirus. But within months, the pathogen had spread around the world. The Covid-19 pandemic has touched the lives of everyone on the planet and its devastating effects are still being felt. In times of distress and uncertainty, space exploration has served as a pillar of hope and a reminder that humans can overcome even the most daunting challenges. At the opening ceremony of the 71st International Astronautical Congress, this message of hope was stronger than ever.

For the first time in the history of the International Astronautical Congress, the entire event was held virtually and was open to anyone who wanted to attend. "The IAF was founded to build a bridge in one of the darkest moments in our recent history—the Cold War," said International Astronautical Federation president Pascale Ehrenfreund.

“2020 has been undoubtedly a challenging year for all of us and this unprecedented situation called for an unprecedented Congress.”

The opening ceremony started with a greeting from the Russian cosmonauts Ivan Vagner and Anatoly Ivanishin aboard the International Space Station. "We are convinced that holding such an important event is particularly necessary during these times," said Ivanishin. "It will create favorable conditions for promoting cooperation among space actors." They also invited to the GLEX 2021 conference to be held in St. Petersburg, Russia, 14 - 18 June 2021 in cooperation with Roscosmos.

His Excellency President of Azerbaijan, Ilham Aliyev, Mayor of Paris, Anne Hidalgo, and Chair of the IAC 2021 Local Organizing Committee, Salem al Marri, welcomed the attendees of the 71st IAC and invited to the future respective IACs to be held in Baku (2023), Paris (2022) and Dubai (2021). "Exploring and understanding space,

and the many advances this has enabled for society as a whole, is one of those quests that unite us all," said Anne Hidalgo, the mayor of Paris. "The space adventure is living proof that together we can reach goals that once seemed unattainable."

During the ceremony, Seishiro Kibe, the IAF vice president of honors and awards, also announced the IAF's fifth World Space Award on the leaders of China's Chang'e 4 mission. In 2019, the Chang'e 4 spacecraft made history when it became the first spacecraft to land on the far side of the moon. Ever since, it has delivered stunning photos and science that are helping us understand Earth's satellite in an entirely new way. "Along with the space professionals worldwide, we will keep working hard to make contributions to the space development of mankind," said Sun Zezhou, the designer in chief of the probe system for the Chang'e 4 program.

Ehrenfreund concluded the opening ceremony by announcing the creation of the International Astronautical Federation's Digital Library, which contains digital copies of more than 50,000 papers presented at the last 70 years of the Congress. "We take it as our duty to bridge the space and digital divide, facilitate e-learning, research, and publication to allow our space community to succeed in the coming, challenging decades," Ehrenfreund said. "The IAF Digital Library aims to be a destination when knowledge goes beyond economic and geographic barriers to reach everyone, as an infinite source of information, innovation, and inspiration for the benefit of humanity."



Plenaries



Plenary: Heads of Agencies

12 October 2020

The International Astronautical Congress was founded on the belief that international cooperation is critical to furthering the goals of the peaceful use of outer space and furthering space exploration. At the annual “Heads of Agencies” plenary during the International Astronautical Congress 2020, the role of interagency cooperation was a major topic of discussion. Additionally, the leaders from seven of the world’s largest space agencies discussed future exploration plans for their country’s space programs.

The session began with a presentation from NASA Administrator Jim Bridenstine, who highlighted the importance of both cooperation and competition in space exploration. “This is a space community,” said Bridenstine. “Competition is a drive, but collaboration is an enabler. We all know that we can do more when we work together and I would say it’s more important now than ever before.” He highlighted the critical importance of interagency collaboration in NASA’s Artemis mission, which seeks to send the first woman and next man to the lunar surface by 2024. Bridenstine pointed to the International Space Station as a great example of international cooperation in space that should be replicated on the moon.

Dmitry Rogozin, the director general of ROSCOSMOS, spoke about Russia’s plans to maintain a presence in low Earth orbit. The ISS is expected to be decommissioned by the end of the decade, but Rogozin said in the meantime Roscosmos plans to extend the station’s capabilities. Next year, the agency will send a multipurpose lab to the ISS that he said will “dramatically expand the capability in terms of running scientific experiments.” Rogozin was less enthusiastic about NASA’s Artemis plans, which he described as “too US-centric” in its current form.

Last year, the Japanese government committed to extending the presence of humans in low Earth orbit and around the moon and Hiroshi Yamakawa, the president of Japan Aerospace Exploration Agency, said the country is pursuing this goal in partnership with several countries. Yamakawa said JAXA would use its experience gained through

“If the whole world can actually unite together in space, we can achieve greater success.”

participation in the ISS to contribute to the Artemis program. For example, Yamakawa pointed to SLIM, the agency’s smart lunar lander that will be launched to the moon in 2022 to demonstrate JAXA’s ability to do pinpoint landing on the surface. He also noted that the agency’s focus is not limited to the moon; in 2024, JAXA will also be launching a MMX, a robotic mission to explore the moons of Mars.

Lisa Campbell has been president of the Canadian Space Agency for less than two months, but she has a big vision for the agency. She said a primary focus for CSA in the future is fostering commercial space exploration to bolster the nation’s economy. “My goal is to improve the lives of Canadians,” Campbell said. “I want space to be a true economic engine for Canada. The economic potential is tremendous.” Campbell highlighted how important space exploration is to Canada already, not just in terms of advancing human spaceflight, but also by enabling remote monitoring of the vast territory.

K. Sivan, the chairman of the Indian Space Research Organization, highlighted the importance of interagency collaboration for the country’s space goals. “International cooperation always has been the hallmark of the space program,” Sivan said. “So far, India has signed 250 cooperative documents with the 59 countries on space cooperation.” A major goal of the Indian space program is advancing human spaceflight, and Sivan said ISRO has been working closely with Russia to prepare for its first crewed space launch later this decade.

Jan Woerner, head of the European Space Agency, also underscored the agency’s international aspect, pointing to



its collaborative mission to Mercury with JAXA—BepiColombo—and cooperation with NASA on monitoring space weather. But he also spoke to the ESA’s own initiatives, such as the development of new launch systems like the Ariane 6 and Vega C, both of which are expected to launch on their maiden flights next year. Ultimately, he said, the future of the ESA will have to be determined by his successor, who will be chosen in 2022. “He or she will have to propose to the minister what to do after what we have planned so far, so we are preparing now with inspiring missions,” Woerner said.

The China National Space Agency has made remarkable strides in recent years with a number of record-breaking firsts in space, including the first landing on the far side of the moon and the first transmission of a quantum-encrypted video call through a satellite. Although China has established itself as a leader in space exploration, Kejian Zhang, the administrator of the China National Space Agency, said that the country is focused on fostering international cooperation. “The theme of this Congress is connecting all space people and I think this is in line with the philosophy of China’s space development,” Zhang said.

Plenary: Small and Medium Sized Companies – Strategies for Survival And Recovery in the Age of Covid-19

13 October 2020

The key to running a successful business is to prepare for the unknown. But no one could have prepared for the Covid-19 pandemic that has swept across the globe this year. The unprecedented outbreak has affected the livelihoods of millions of people around the world. But it has been especially hard on small and medium-sized businesses, which often have less capital to keep themselves afloat in troubled times. This is especially true for smaller businesses in the space

“You see opportunities and you want to step it up. But I think it serves as a good reminder that we should not lose sight of good business fundamentals.”



industry, many of whom depend on global supply lines and require personnel on site to build physical hardware.

During this Plenary, the CEOs from four small and medium-sized space companies discussed the challenges faced by their businesses during the pandemic and lessons learned from the experience. The panel, moderated by CNBC space reporter Michael Sheetz, included Oren Milstein, CEO of StemRad; Rafal Modrzewski, CEO of Iceye; Nobu Okada, founder and CEO of Astroscale; and Lynette Tan, CEO of Singapore Space and Technology Limited.

Although the pandemic has been raging for more than a year, Milstein says it is still too early to determine how it will ultimately impact smaller companies in the space industry. "I have been surprised for the better as far as survival of small to medium sized companies," he said. "At the same time, it's still early in the pandemic and I'm concerned regarding smaller companies that have yet to establish an investor base and companies that are strictly sales driven." Tan agreed and said she does not "see a light at the end of the tunnel" for the pandemic just yet. She said that is why it is important for smaller businesses to stay focused on the core business rather than rapid expansion because they might be dealing with this pandemic for years.

"A lot of times small and mid-sized companies go for aggressive growth," Tan said. "You see opportunities and you want to step it up. But I think it serves as a good reminder that we should not lose sight of good business fundamentals."

Okada said he believes there are three key factors for

keeping a company afloat during the pandemic: A compelling vision, a clear business plan, and a great team. He should know. During the session, he announced that Astroscale had recently closed a \$51 million funding round, which brings the total raised by the company to \$291 million. But Modrzewski pointed out that many businesses will have trouble raising any funds during a global economic downturn.

"If you raised significantly before the pandemic and you are still a small company, your risk of go-to-market strategy increases," Modrzewski said. "So raising during a pandemic will be much more challenging due to that intrinsic risk."

Each panelist also had advice for other smaller companies working in the space industry during these challenging times. Milstein said to "focus on excellence within existing contracts," Modrzewski said to "get to know your best investors," Tan suggested focusing on collaboration, and Okada said not to forget that this will end eventually. "The recovery day will come, but until then, it is really hard," Okada said. "Don't give up."



Plenary: Early 2020s - Launch of Worldwide Missions to Mars

13 October 2020

Earlier this year, Mars made its closest approach to Earth for approximately the next two years and the world's space agencies did not waste the opportunity. On July 19, the United Arab Emirates kicked off a summer of Mars missions with the launch of its Hope probe from the Tanegashima Space Center in Japan. Hope is a robotic orbiter that will be studying the Martian atmosphere and represents the UAE's first interplanetary mission. Only a few days later, China also launched its first standalone Mars mission, Tianwen-1. This ambitious project will be a combination of a Mars orbiter, lander, and rover. Finally, NASA launched its newest Mars rover, Perseverance, on a mission to collect samples of red dirt destined to be returned to Earth in the future.



The leaders of these three historic missions met to discuss the importance of Martian exploration for the final plenary of the 2020 International Astronautical Congress. The plenary began with an introduction by Thomas Zurbuchen, associate administrator for the science and mission directorate at NASA, and was moderated by the Lisa May, the chief technologist for Lockheed Martin's commercial and civil space advanced programs. The panelists included Yan Geng, director of deep space exploration at the Department of Lunar Exploration and Space Program Center at the China National Space Administration; Lori Glaze, the director of the science mission directorate's planetary science division at NASA; Omran Sharaf, the Emirates Mars mission project director

at the Mohammed Bin Rashid Space Centre; and Albert Haldemann, Mars exploration group chief engineer at the European Space Agency, which will be launching its ExoMars rover in 2022.

As Zurbuchen pointed out at the beginning of the plenary, each of the Mars missions has unique scientific and technological goals, but they also have quite a bit in common. "While our approaches to Mars challenges may differ because of our individual national scientific and engineering cultures, I believe we are united by the knowledge of the great benefits we receive in partnering internationally on Mars exploration, and also in sharing the awe and wonder of discovery," he said.



Sharaf detailed how the UAE's Mars mission was the result of close collaboration with the international scientific community to determine the best way to contribute to our knowledge of the Red Planet. "The questions we came up with are based on previous missions," he said. After these discussions, the Emirates team decided to focus on the Martian atmosphere, specifically the relationship between the upper and lower atmospheric layers, whose relationship is not well understood.

As for NASA's Perseverance rover, Glaze characterized it as a "mobile geologist and astrobiologist." The rover's main purpose is to study the geologic history of Mars and how it has changed overtime. Not only will this give scientists a better understanding of Mars' ancient history, but it will also help them determine whether the Red Planet may have hosted microbial life. The rover will also collect samples that will be picked up and returned to Earth by subsequent missions later this decade. Like Sharaf, Glaze acknowledged that Perseverance is building on the legacy of past missions. "Perseverance really builds on all of the international missions that have gone before," she said. "They have continued to provide new information, new knowledge, and new questions about Mars."

“There are thousands of people who contributed to these missions and the excitement that all those people feel in achieving Mars exploration is really the main contribution that we all achieve with these robotic missions.”



Geng highlighted the comprehensive aspects of China's Mars mission. Typically national space agencies have explored Mars in a step-by-step manner. First, with an orbiter, then a lander, and then a rover. But China is doing all three at once. It is an incredibly bold mission, and Geng said "it will provide a new solution for more efficient and low cost missions." Once the trio of robots arrives at Mars, he said the orbiter will survey potential landing sites for the lander and rover, which will spend their time on the Red Planet systematically studying its soil.

Each of these missions will arrive at Mars early next year. Further in the future they will be joined by new ExoMars spacecraft launched on a joint mission by the European

Space Agency and ROSCOSMOS. In 2016, the agencies successfully sent an orbiter to Mars and they will follow up on this mission with a lander and rover in 2022. Haldemann characterized the mission as a way to explore the earliest days of our solar system; in a way, studying Mars is like getting a look at the early Earth. "We are learning about the early days of planet planetary formation like that of the Earth," he said. "And because we have the evidence of water and organic molecules from the earlier missions, like Curiosity, we expect that studying the relationship of the organics in that geology could give us hints about the how life got started on Mars—if it did—or perhaps what the process was on Earth."

Although each of these missions is a point of national pride, all of the panelists acknowledged that they wouldn't be possible without international collaboration. "What we are really doing is building international know-how for exploring beyond Earth," said Haldemann. "There are thousands of people who contributed to these missions and the excitement that all those people feel in achieving Mars exploration is really the main contribution that we all achieve with these robotic missions."



Highlight Lectures

Highlight Lecture: IAF World Space Award – The Chang'e 4 Mission

12 October 2020

On January, 3, 2019, China made history when its Chang'e 4 lander touched down in the Von Kármán crater near the south pole on the far side of the moon. Since that day, the Chang'e 4 lander and its rover, Yutu-2, have been exploring the lunar surface and offering an unprecedented look at Earth's satellite.

The International Astronautical Federation awarded its prestigious World Space Award to three leaders of the Chang'e 4 mission during the opening ceremony at the 2020 International Astronautical Congress: Weiren Wu, the designer in chief of China's lunar exploration program, Zezhou Sun, the designer in chief of the probe system for the Chang'e 4 program, and Dengyun Yu, the deputy director of the science and technology committee at the China Aerospace Science and Technology Corporation. Yu gave a presentation on the mission and its scientific results for the World Space Award highlight lecture.

between the Earth and the far side of the moon for the first time. Several months before Chang'e 4 landed on the surface, China launched its Queqiao communication satellite to a halo orbit at the L2 point, where it would relay communications between the rover on the surface and mission control on Earth. The communication challenges involved with Chang'e 4 led to China's second technological breakthrough, the autonomous navigation and precision landing technologies that allowed the lander to touchdown on the moon without human

The Chang'e 4 mission has been more than a decade in the making and is part of China's broader vision for lunar exploration. The Chang'e program kicked off in 2007, when China successfully orbited the moon with the Chang'e 1. Only a few years later, in 2013, it landed on the near side of the moon with Chang'e 3. But Yu said exploring the far side of the moon came with several large challenges. "The Chang'e 4 mission is an innovative and complex project with great technical difficulty and big international influence," Yu said during the highlight lecture. "It has achieved a number of technological breakthroughs."

Yu emphasized several technological breakthroughs that enabled the Chang'e 4 mission during his presentation. First, the mission realized a continuous, reliable relay

“Let's work together to explore the moon, to know the moon, and to know the universe.”





Yu said these technological breakthroughs have enabled groundbreaking science. Since the Chang'e 4 mission was launched, the team has published more than 140 scientific papers. One of the most notable scientific results highlighted by Yu was the Yutu-2 lander used radar to map the subsurface structure of the moon to a depth of 40 meters, revealing a complex geology. The rover and lander are also using a suite of scientific instruments to compare the environment on the surface with data collected from the orbiter, including the radiation levels, surface particles, and low frequency radio spectrum.

assistance. A third technological breakthrough involved the deployment of two Longjiang microsats by the Queqiao communication relay. Although one satellite failed, the other became the first microsatellite to complete an Earth-moon transfer and orbit the moon. The satellite took images and studied low frequency radio emissions, which Yu said “promoted the use of micro and nanosatellites in the field of deep space exploration.” Finally, China also developed its first Radioisotope Thermoelectric Generator or RTG, a nuclear energy system that powers the lander during the two-week lunar night.

Chang'e 4 has already produced a wealth of scientific and technological knowledge, but China is just getting started. The mission to the farside is part of the country's larger lunar exploration ambitions, which includes a sample return and crewed mission in the coming years. Although the mission was led by China, it also carried payloads developed with international cooperation and this, said Yu, is a key part of its success. “Lunar exploration is the common pursuit of mankind,” Yu said. “Let's work together to explore the moon, to know the moon, and to know the universe.”

Highlight Lecture: Mev I: The World's First Commercial On Orbit Servicing Mission

13 October 2020

On February 25, a small spacecraft called MEV-1 sidled up to a massive communication satellite in a graveyard orbit more than 40,000 kilometers above Earth's surface. The communications satellite, an Intelsat 901, had been operating in geosynchronous orbit for nearly two decades and the fuel it needed to maintain its orbit was nearly depleted. Although the satellite was working fine, its operator, Intelsat, was forced to decommission the satellite so it would not pose a threat to other satellites in orbit when it ran out of fuel. So the company raised the satellite's by a few hundred kilometers and left it for dead. MEV-1 was there to bring it back to life.

MEV-1 is a first of its kind “mission extension vehicle” operated by Space Logistics, a subsidiary of Northrop Grumman. It is designed to latch on to satellites that are low on fuel and act as their new propulsion system. Most satellites in geosynchronous orbit are abandoned in a graveyard orbit because they are out of fuel, not because they have stopped working. By providing a new source of propulsion for these satellites, a mission extension vehicle can increase a satellite's lifetime by several years. And earlier this year, Northrop Grumman proved that this kind of maneuver was possible for the first time when its MEV-1 latched onto the Intelsat 901 satellite and moved

it back to a geosynchronous orbit, where it continues to provide stationkeeping services for the satellite.

Brian Weeden, executive director of the Consortium for the Execution of Rendezvous and Servicing Operations and director of program planning at the Secure World Foundation, discussed the mission with Joseph Anderson, the vice president of business development and operations at Space Logistics, during a highlight lecture at the 2020 International Astronautical Congress. Anderson described the mission extension vehicle as a game changer for satellite operators, whose satellite lifetimes are no longer limited by how much fuel they can carry to space.

“The hypothesis for our business is that a cost effective, reliable and safe method for extending the lives of these satellites would make existing operators more cost effective and break down barriers to entry to help grow the market for new and existing operators alike,” said Anderson.

Although Northrop Grumman was the first to demonstrate a mission extension vehicle in practice, Anderson acknowledged that the idea is decades old. One of the most high profile precursors to the MEV-1 mission was a series of daring missions to the Hubble Space Telescope to service the satellite and extend its lifetime. In fact, Anderson said it was the experience gained during the Hubble servicing mission by engineers at Orbital ATK, a space contractor that was acquired by Northrop Grumman, that allowed the company to be successful where other companies had failed.

The actual mission extension vehicle is based on a Northrop Grumman GEOStar bus, which is typically used for communication satellites. This was modified to meet the needs of a mission extension vehicle, which was designed to latch on to a target satellite. “Approximately 80% of all geosynchronous satellites have two common features that can be utilized to establish secure docking: the launch adapter ring and the liquid apogee engine,” said Anderson. Because of

“ I see this as a real turning point. This event marks that milestone.”

this commonality, engineers at the company were able to design a system that could design a system that clamps on to the adapter ring.

One of the main challenges with bringing the idea to life is that the regulatory institutions were not ready for it. “It simply did not fit the licensing structure that the US government had established,” said Anderson. But he said regulators and insurance companies were willing to work with the company to establish standards to let the



mission proceed. Northrop launched its second mission extension vehicle in August and is working with the US Defense Advanced Projects Agency to develop an “electric propulsion pod” that can be attached to individual satellites to provide small amounts of propulsion, instead of using an entire mission extension vehicle. It is still early days for the project, but Anderson said he thinks it could fundamentally change the satellite industry.

“I see this as a real turning point,” Anderson said. “I think satellite industry history will be discussed as a time before there was in-orbit satellite servicing in the time after satellite servicing. This event marks that milestone.”

IAF Global Networking Forum (IAF GNF)



IAF GNF - DLR Panel: Science for the Future – Earth Observation Technologies in the Age of Climate Change

12 October 2020

Each year, an estimated 10 million tourists visit glaciers around the world. These vacationers are attracted to these natural ice sculptures for their astounding beauty, but also, perhaps, out of a desire to see them before they are gone. Over the past few decades, climate change has caused glaciers to melt at an alarming

In this crisis, Paola Belingheri saw an opportunity. She is the co-founder of IceKing, an app that crowdsources images from tourists who are visiting the world's glaciers. When a user uploads a photo of the glacier to the app, this image is combined with geolocation data that can be used by scientists to validate data from Earth observation



rate. Scientists depend on data from Earth observation satellites to monitor the world's disappearing ice mass, which is important evidence to understand the planet's changing climate. But to validate the data collected by satellites orbiting hundreds of kilometers above the Earth's surface, these scientists also need to collect data on the ground.

satellites to get a better understanding of glacier health. "Our model actually aims to tackle climate change through tourism as well as providing information for water and energy management," Belingheri says.

In 2016, IceKing won the Copernicus Masters challenge at the German Aerospace Center (DLR), a competition that fosters new applications for Earth observation data collected by satellites in the European Space Agency's Copernicus program. IceKing was just one of several examples of how DLR is using Earth observation data to mitigate climate change that was on display during the "Science for the Future— Earth Observation Technologies in the Age of Climate Change" panel at the IAC 2020 CyberSpace Edition.

“ We want to make sure our imagery is being used for a good purpose”



DLR is also forging connections with established commercial Earth observation companies to better understand the effects of climate change. Planet, for example, has operated a private constellation of small Earth-imaging satellites for more than a decade. The company's aim was to image the entire Earth every day and provide these images to customers who need rapid updates. For example, Planet has partnered with DLR to provide Earth imaging data to the UN for disaster relief, where real time satellite imagery data is critical to making decisions that can save lives. The ability to monitor natural disasters with satellites will become increasingly important as climate change creates more severe weather. Planet's Earth images are also being used to manage the effects of climate change locally in Germany. For example, Germany's Brandenburg Forest Authority has used Planet satellite data since 2013 to manage and protect the country's forests.

"We want to make sure our imagery is being used for a good purpose," Pooja Pandey, a customer success engineer

at Planet, said during the panel. "I am proud that Planet uniquely supports the UN's sustainable development goals, which is the most ambitious project to make sure that the world is sustainable for our kids."

In addition to working with commercial partners, DLR is also developing new Earth observation capabilities in house. In 2021 or 2022, the German Aerospace Agency and French Space Agency will jointly launch their new MERLIN satellite, which will produce global maps of methane emissions. Methane is the second largest contributor to anthropogenic climate change after carbon dioxide. But even though there is 200 times less methane than CO2 in the atmosphere, it is far more potent as a greenhouse gas. MERLIN will use laser-based radar systems—also known as Lidar—to measure concentrations of methane in the atmosphere and search out emission hotspots. "It will nicely complement existing passive sensors, especially in key regions such as the arctic or the tropics," Mathieu Quatrevalet, a scientist on the MERLIN mission, said during the panel.

Understanding and mitigating the effects of climate change is a global effort that will require a tight collaboration between industry and government. DLR is setting an example for how these collaborations combined with data collected by space assets can be used to benefit life on Earth. "Global change forecasts on the basis of scientific facts can be delivered by observation data," Hansjörg Dittus, an executive board member at the German Aerospace Center, said during the panel. "They are not limited by any artificial borders and not biased by political decisions and discussions."

IAF GNF - ISS Commercialization and Future Industry Innovation in Low Earth Orbit

13 October 2020

This year marks the 20th anniversary of the continuous human occupation of the International Space Station, a remarkable milestone that can be easy to take for granted. For two decades, the ISS has served as humanity's home away from home, and a critical proving ground for new technologies that are pushing the

boundaries of what's possible on Earth and in space. But the ISS was not meant to last forever. The iconic space station is expected to be decommissioned in the near future—possibly by the end of the decade. However the end of the ISS also marks the beginning of a new chapter in the commercialization of low Earth orbit.



From its inception, the International Space Station was meant to be an enabler of space commerce. By footing the tremendous bill and pooling the talent of thousands of engineers, the world's space agencies were able to build a massive orbiting laboratory that would provide the foundation for the future of extraterrestrial industry. The idea was to get companies hooked on space. The ISS would

and consisted of Michael Suffredini, the president and CEO of Axiom Space; Masatoshi Nagasaki, the cofounder and CEO of SpaceBD; and Andreas Hammer, the senior vice president of space exploration at Airbus Defense and Space. Each executive is making unique contributions to fostering off-world industry and all agreed the future of cosmic commerce looks bright.



show them the endless possibilities of microgravity and foster further investment in the commercialization of low Earth orbit. Two decades later, this vision is starting to pay dividends in a big way.

During a global networking forum panel at the International Astronautical Congress 2020, three executives from leading space companies offered their thoughts on the commercialization of the ISS and the future of industry in orbit. The panel was moderated by Lena De Winne, the head of administration at Asgardia,



Before starting Axiom Space, Suffredini was the program manager for the ISS, and he said the company's goal is to continue the legacy of the space station. "Our mission is to improve life on Earth and foster the possibilities beyond it by building and operating the world's first commercial space station," he said. Axiom will begin by attaching its own commercial modules to the ISS before transitioning to a freeflying space station later in the decade. Like the ISS, Suffredini plans for Axiom's commercial station to be accessible to be a multinational platform for research and space tourism.

By transitioning the responsibility for operating space stations in low Earth orbit to commercial companies, NASA and other space agencies hope that it will allow them to focus on human missions on the moon and Mars. In addition to being a platform to test the new technologies that will be necessary to sustain humans on other worlds, Hammer says he also sees commercial stations as evolving into a crucial link in the supply chain connecting orbital industries with outposts on the moon. "It does not make any sense to fly everything directly from Earth to the moon," Hammer said. "If you think a little ahead, low Earth orbit could also be a kind of station in the logistical chain. I do not believe the moon is possible without LEO."

But until commercial space stations like Axiom's become a reality, there is plenty of work to be done commercializing LEO today. At Airbus, Hammer and his team have developed Bartolomeo, a payload platform attached to the European module of the space station. Hammer described Bartolomeo as a "little hotel" that allows commercial customers to test their products in space without having to deal with all the logistics and management themselves. Once the company is finished testing, Hammer said Airbus is able to deliver the payload



back to the customer on Earth so they can see how it was affected by the space environment. "That was never done before," said Hammer.

At Space BD, Nagasaki is using the ISS as a springboard for launching small commercial satellites into orbit. An increasing number of companies want to launch micro and nanosatellites into orbit, but many do not have the experience needed to navigate the complex logistics of getting a payload into space. Space BD takes care of all that; all the customer has to do is build their satellite. The company was also tapped by the Japanese Aerospace Exploration Agency to develop rideshare services for commercial companies when the agency launches its own satellites.

Despite their different business models, all three speakers agreed that the commercialization of low Earth orbit is going to be critical to enabling deep space exploration. "Without a commercialization of LEO, it is hard to happen the commercialization of this deep space," said Nagasaki. Suffredini concurred. "If we are going to go to Mars, there's technologies you need to test, and systems you need to demonstrate," he said. "You cannot have a sustainable exploration program without a low Earth orbit platform."

IAF GNF - The Artemis Mission

13 October 2020

In December 1972, the crew of Apollo 17 left the moon's surface and no one has been back since. It was not supposed to be that way. Plans to return to the lunar surface have come and gone over the past five decades, but despite the obvious enthusiasm to do human exploration beyond low Earth orbit at the world's space agencies,

space sector that range from industry titans to startups. At the International Astronautical Congress 2020, Mika Ochiai, associate senior administrator at the Japanese Aerospace Exploration Agency, moderated a discussion between Kathy Lueders, associate administrator for the human exploration operations mission directorate at



none of these plans have come to fruition. That's about to change.

In 2024, the first woman and next man will put a fresh boot print in the lunar regolith for the first time in half a century as part of the Artemis program, an effort to establish a permanent human presence on and around the moon. Artemis is a NASA-led program, but it is fundamentally international in scope. It is also highly dependent on the efforts of dozens of companies in the

NASA, Walter Cugno, the vice president of exploration and science domain at Thales Alenia Space Italia, and Brent Sherwood, vice president of development programs at Blue Origin, on the role of government and industry in the return to the moon.

“ At NASA we firmly believe that exploration is a team sport”





“At NASA we firmly believe that exploration is a team sport,” Lueders said. “We are leveraging our capabilities along with our international partner capabilities and the ingenuity of our academic fellows and industry across the globe. It is going to take all of us to get through this.”

Artemis, of course, will not begin with a direct descent to the lunar surface. Instead, it will proceed in small steps, beginning with an uncrewed mission around the moon in 2021 and the establishment of a small space station in lunar orbit called Gateway. Once these building blocks are in place, the world can prepare for its next descent to the lunar surface. At each of these junctures, NASA’s industry partners will play a critical role in ensuring that the hardware is ready to support the next chapter of living and working in space.

Blue Origin, for example, is leading a consortium of companies called the National Team to develop a human landing system that will carry Artemis crew to the lunar surface. “The crew will be delivered to cislunar space by Orion launched on the SLS and then transfer into this vehicle,” said Sherwood. Each of the contractors in the National Team is using their expertise to develop critical elements of the landing system. Lockheed Martin, for instance, is working on the ascent element that will carry the crew back to orbit from the surface of the moon and Draper is working on the system’s guidance and navigation.

Europe is a major partner in the Artemis program and Thales Alenia, which has deep experience building

crew habitation elements for the International Space Station, will be leveraging its expertise to develop the international habitation module on Gateway. Cugno said the company is also looking further in the future and will be involved with developing the surface infrastructure that will be necessary for astronauts to live and work on the moon. “Our visitation is a step-by-step progress on getting to the moon and to provide the infrastructure for the exploitation of the moon and preparing for a new economy,” said Cugno. “It is preparing for the next step, which is sending humans to Mars.”

Indeed, one of the main motivations of the Artemis program is to use the moon as a proving ground for the technologies that will be needed to support humans on the Red Planet. For example, a key part of living and working on Mars will be the ability to use on-site materials. There’s also plenty of scientific work to be done to prepare for humanity’s next great leap like studying the radiation environments beyond low Earth orbit and how it affects humans. “There are lots of different aspects that we are going to need to learn to make to make sure that the systems we are building to go even farther into space will be able to do it safely,” said Lueders.

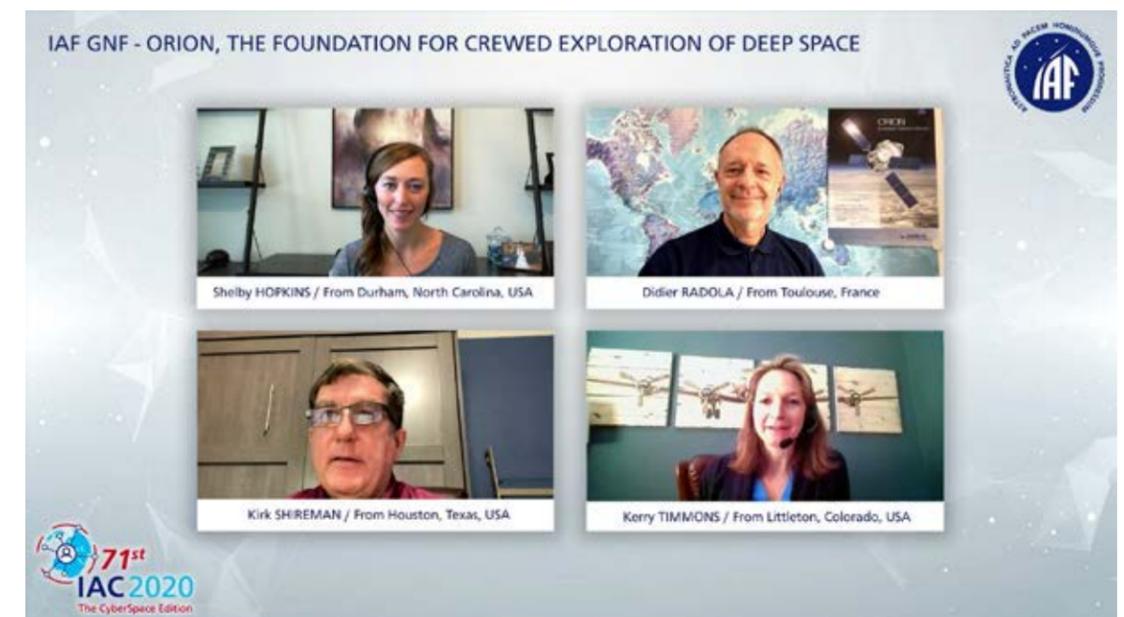
Each panelist acknowledged the incredible difficulty that’s involved with sending humans to the moon and Mars. “Landing on the moon with people, operating there, and getting them back home safely is very hard,” said Sherwood. “We are used to seeing very sophisticated simulations and renderings that make it all look easy, but this is not an easy thing.” It is only through strong international, industry, and public support that this kind of ambitious mission is possible. And as Lueders pointed out, the challenge is one of the main reasons to do space exploration. “The reason people say let’s go to the moon was not necessarily just to go to the moon, it was about how we can expand the knowledge base and then be able to use that to solve our big problems here on Earth,” she said. “What is amazing about Artemis is it is going to take the smarts of academia, the smarts of our industry, and the smarts of our nations to move us forward.”

IAF GNF - ORION, The Foundation for Crewed Exploration of Deep Space

13 October 2020

The first flight of NASA’s next-generation crew capsule, Orion, has been a long time coming. The system can trace its lineage back to 2006, when NASA began developing a crew exploration vehicle for its ill-fated Constellation program. Although Constellation was canceled before it could fulfill its goal of returning astronauts to the moon, the development of a crew capsule laid the foundation for NASA’s current push to the lunar

2020 CyberSpace Edition, several Orion engineers and program managers came together to discuss the challenges of building the world’s first and only human-rated deep space exploration capsule. The panel included Kerry Timmons, a senior manager for systems integration at Lockheed Martin, Kirk Shireman, the vice president for lunar exploration campaigns at Lockheed Martin, Didier Radola, the European Service



surface called Artemis. By 2024, the US space agency aims to put fresh boot prints on the lunar regolith, but before that happens astronauts will have already gazed upon the lunar surface from orbit out of the window of the Orion capsule.

The first flight of Orion is scheduled for late 2021. The Artemis-1 mission will be an uncrewed loop around the moon, but it will be a critical safety test to prove the new capsule is safe for a crewed mission. Artemis-2, the first crewed mission in Orion, will involve a lunar flyby and is expected to happen no later than 2023. If all goes well with these demos, the stage will be set for the first humans to descend to the lunar surface in more than 50 years. During a Global Networking Forum panel at the IAC

Module ORION program manager at Airbus Defence, and Shelby Hopkins, a systems engineer working on the environmental control and life support systems integration at Lockheed Martin.

As Timmons pointed out at the beginning of the panel, after years of work Orion is “pretty much done” and ready to be handed over to NASA. She said Lockheed Martin recently installed the solar array wings and has a few more integration tasks left, such as installing the forward bay cover. Once the capsule is in NASA’s hands, the agency will integrate the vehicle’s launch abort system and integrate the capsule with its launch vehicle, the SLS. Unlike NASA’s last crewed vehicle, the Space Shuttle, Orion will have a sophisticated launch abort system that can boost the crew

to safety in the event that something goes wrong on the launch pad or during flight. “This is a key aspect of the safety systems in Orion,” said Timmons.

Although NASA and its American contractors are leading the development of Orion, it’s not solely a US vehicle. A critical component of the capsule is the European Service Module, which will provide electricity, water, and oxygen to the crew inside the Orion. “The complexity of this module is amazing,” said Radola. He said progress on the ESM was progressing rapidly despite the pandemic and that Airbus was preparing to integrate the propellant tanks for the service module in the near future. “Our plan is to deliver to NASA by mid-next year,” he said.

The hardware developed for Orion will be used for more than just sending astronauts around the moon. As Shireman pointed out, much of its hardware and software will also be used for the human landing systems that will carry astronauts from lunar orbit down to the surface. That will allow the company to get valuable test data of

the different components of the landing system during Orion’s test flights, which will be critical for ensuring the safe landing and return of astronauts from the moon. “Since we are using the hardware and software from Orion, one of the benefits is testing that hardware and software not only on the ground before flight, but during flight,” Shireman said. Artemis 1 will test a lot of the hardware in the human lunar lander and Artemis 2 will test its environmental control and avionics systems as well.

And as Hopkins pointed out, testing these systems on Orion is not just preparing humanity for its return to the moon. It will also be critical for creating a sustainable presence on the moon and eventually Mars. “Our flight-proven hardware can help us more quickly build up a habitat to live and work on the moon, and this can include rovers and different sized habitats,” Hopkins said. “And Artemis is not just about doing amazing science on the moon. It is also about preparing us for our next destination, which is Mars.”



IAF GNF - IAF /ASE Astronauts Panel

14 October 2020

It seems like every child wants to be an astronaut when they grow up. And how could they not? Space calls to us from a young age with the promise of adventure and discovery, not to mention the thrill of doing zero G acrobatics. But until recently, spaceflight was a relatively exclusive domain; everyone might want to be an astronaut, but there simply was not enough room on the rockets to take them. That is changing rapidly. With the birth of a bonafide commercial space tourism industry driven by launch companies like SpaceX, Blue Origin, and Virgin

Galactic, hundreds of people are now in line to get their astronaut wings as non-professionals. Like the rest of the space sector, astronautics is rapidly changing and the future of human spaceflight is sure to look much different from the past.

At the 2020 International Astronautical Congress, several astronauts came together to discuss the present and future of their profession for a Global Networking Forum panel. Moderated by Reinhold Ewald, a former astronaut



for the European Space Agency, the panel included Richard Arnold, an active NASA astronaut; Cady Coleman, a retired NASA astronaut; Pedro Duque, a former ESA astronaut; and Michael Lopez-Alegria, a former NASA astronaut. The astronauts discussed their experiences in space and how their profession is evolving to meet the needs of future space exploration missions.

As the only active astronaut on the panel, Arnold gave his perspective on the many ways that astronautics has changed just in the past few years. One of the biggest changes, he said, is that astronauts now focus largely on space station training since the space shuttle is no longer in operation. But with a variety of new crewed launch vehicles under development, including SpaceX’s Dragon, Boeing’s Starliner, and NASA’s Orion capsule, astronauts are soon going to have to learn how to fly a variety of different spacecraft, rather than just one. “It will be interesting to see what the training team does with the next class of astronauts that will come on,” Arnold said.

The astronauts also discussed the exciting prospects of crewed missions to the moon and Mars. NASA and its partners plan to land the first woman and next man on the lunar surface by 2024 as part of the Artemis program, which will use the moon as a proving ground for technologies that will carry humans to the Red Planet. “I live out in Massachusetts with a very dark sky and when I look up at the moon it makes me feel differently today,” said Coleman. “Just to think that in not very long, the first woman is going to be there. Nothing will ever be the same.”

The first astronauts to arrive on the moon will certainly be professionals. But in low Earth orbit, an increasing number of astronauts will be tourists catching a ride on commercial launch vehicles. For now, these commercial flights to space are still too expensive for most people to afford, but Lopez-Alegria compared it to the early days of passenger planes. “In the 1920s and 30s, commercial aviation was something that was only reachable by the very wealthy,” he said. “Now people get on a plane without thinking much about it. One day we will see that kind of access to space.”



“Just to think that in not very long, the first woman is going to be there. Nothing will ever be the same.”

IAF GNF - Europe on and Around the Moon and Mars

14 October 2020



The United States and Europe have always been close partners when it comes to space exploration and the Artemis program will continue this legacy. As humanity prepares to return to the moon in 2024, NASA and the European Space Agency are working hand in hand to ensure a successful mission. During this Global Networking Forum, a panel of young European engineers discussed their contributions to the Artemis program and spoke with ESA director general Jan Woerner and NASA administrator Jim Bridenstine about the future of crewed deep space exploration. The diverse panel included representatives from several leading space companies in Europe, including Abbie Hutty, senior spacecraft structures engineer at Airbus Defence and Space; Giada Meogrossi, the program manager in the platform equipment and subsystem business area at Leonardo; Nelly Offord, the head of exploration business development at Surrey Satellite Technology; David Parker, director of human and robotic exploration at ESA; Liz Seward, senior strategist for space systems at Airbus Defence and Space; and Eleonora Zeminiani, an aerospace engineer at Thales Alenia Space Italia.

Before humans set foot on the lunar surface in 2024, they will do a lap around the moon in NASA's Orion crew capsule, the world's only spacecraft rated for deep space exploration. Although the development of the capsule itself was led by the US, the systems that will be critical for keeping astronauts comfortable and safe during the journey was built in Europe. Known as the European Service Module, this component of Orion is responsible for providing electricity, oxygen, and water to the crew on their journey as well as the spacecraft's propulsion. "That

is just the beginning," said Bridenstine. "We are also also going to collaborate on building a Gateway in orbit around the moon and that, too, will be powered by the European Space Agency."

Once astronauts are on the moon, they will be using a variety of technologies developed in Europe. For example, Seward described the European Large Logistics Lander that will ferry cargo to the lunar surface and Europe's first 3D metal printer that will be used to create tools for astronauts on and around the moon. "The first lunar bases will rely heavily on robotics and robotic support, and we have developed these autonomous technologies," Seward said.

Europe is also making a big contribution to the Lunar Gateway, a small space station that will be put in orbit around the moon to serve as a jumping off point for excursions to the surface. ESA is partnering with the Japanese Aerospace Exploration Agency and NASA to develop the international habitation module, or IHAB, for the station. "It is designed to be at the same time extremely safe and comfortable for astronauts for long stays, but also able to survive and operate autonomously when not tended by the crew," said Zeminiani. She also said that Thales Alenia is studying infrastructure that can be used to support crew on the lunar surface, leveraging its deep expertise from building crew modules for the International Space Station.

Offord called in from the Surrey Satellite Technology office in the United Kingdom, which will be responsible for providing communication services for the first lunar

communications relay satellite. Astronauts and robots on the surface of the moon will use this satellite to send data back to Earth. "This service is indispensable as an autonomy enable for rovers and surface missions that may lose line of sight with their surface relay," said Offord.

The Artemis program aims to use the moon as a stepping stone for humanity's next great leap to Mars. And Europe is already paving the way for a mission to the Red Planet through its robotic exploration program. Many of the companies represented on the panel are contributing to ExoMars, an ongoing mission jointly run by the ESA and Roscosmos. In 2016, Europe placed an orbiter around Mars, and will follow on this mission in 2022 with a lander and a rover. Meogrossi said that the experience gained from building robotic components for the ExoMars mission will also benefit lunar exploration. For example, Leonardo built the robotic drill for the ExoMars mission and was tapped by the ESA earlier this year to develop a similar system for PROSPECT, a robotic mission to look for ice and other chemicals beneath the moon's surface. "it is really a challenging program even if we had a great experience in robotics with the ExoMars," said Meogrossi.

Although each European company is providing different technologies to enable a return to the moon and the world's first human mission to Mars, they are united in their emphasis on collaboration. "For us, exploration is much more than just sending some people or robots into space," said Woerner. "Space exploration is an aspect where cooperation can totally make a difference."

“For us, exploration is much more than just sending some people or robots into space”



IAC 2020 Special Sessions



SPECIAL SESSION: State and Response of the Global Space Sector During Covid-19

12 October 2020

The Covid-19 pandemic is unlike anything the world has seen in recent memory. The pathogen has affected everyone, but the consequences of the pandemic have been unevenly distributed. During a special session at the IAC 2020 CyberSpace Edition, a panel of experts with a global perspective offered their assessment of how the virus has impacted the space sector. In some ways, the space sector was uniquely prepared to handle a pandemic due to its fundamental internationalism and safety standards. But the panel also noted that there was room for improvement in how the sector has responded to the virus.

One of the main drivers of the space sector's resilience during the pandemic was its heavy reliance on digitalization. "We have managed to transfer to the online environment," said Simonetta Di Pippo, the director of the United Nations Office for Outer Space Affairs. "Through the adaptation of our programmatic activities and the strength of our partnerships network, we are delivering continued engagement with the international space community." She pointed to the launch of Guatemala's first satellite through a collaboration with UNOOSA and JAXA, as well as the successful production of a virtual UN webinar series on the space economy, as examples of how space exploration managed to continue during the pandemic.

Juan De Dalmau, the president of International Space University, observed how the pandemic has also stoked interest in space exploration among young people. "They are more and more aware of the important role they can play in the future to make a change on this planet," De Dalmau

said. "That vision of inclusiveness and international collaboration that is common to both space exploration and space development is something that is attracting more young people." De Dalmau also noted that the space sector's familiarity with emergency preparedness and risk analysis made it uniquely suited to handle the pandemic crisis and share these techniques with others.

But there have been serious downsides for the space sector, too. Bruce Chesley, the former senior director of strategy for space and missile systems at Boeing, says the pandemic has presented a major challenge for the space industry. "The challenge has been how do we reimagine how we fulfill existing commitments with completely different ground rules for how we have to operate," Chesley said. For example, companies have had to develop new workflows on the fly to continue building hardware while also keeping workers safe through social distancing and contact tracing practices. The success of these programs is critical for limiting supply chain disruptions, which can easily compound if several employees at a company get infected and work grinds to a halt. "It really comes down



to collaboration and teamwork among industry, supply chain, and governments in order to bring these important capabilities into the world," Chesley said.

Pascale Ehrenfreund, president of the International Astronautical Federation and research professor at Space Policy Institute at George Washington University, also pointed out that the pandemic has been especially difficult for smaller companies in the industry. "They are really struggling," said Ehrenfreund. Still, she also highlighted the fact that technologies pioneered and developed for space applications, such as artificial intelligence and telemedicine, were critical in enabling the global

response to the pandemic. "When addressing global health crises, such as the one we are currently facing space can support both national and global policies tremendously," Ehrenfreund said.

This sentiment was also expressed by Di Pippo, who spoke of the need to find opportunity in the crisis. "Building a knowledge based society is a must," Di Pippo said. "We know the problems, we have the tools, we have the solutions, and we need to make well-informed, coordinated international action to take global challenges. So despite the many negative impacts of COVID-19, we must embrace it as an opportunity."



SPECIAL SESSION: Unleashing the Potential of Artificial Intelligence & Machine Learning into Space

14 October 2020

The rapidly falling cost of space access due to the commercialization of launch service providers has opened up entirely new opportunities for space exploration and commerce that would have been unthinkable only a few years ago. At the same time, there has been a parallel development in the field of artificial intelligence marked by new sophisticated machine learning methods and the rapidly falling cost of computing enabled by the cloud. Space exploration has always depended on autonomous machines that are capable of performing their duties without human intervention, but the convergence of cheap space technologies and new AI solutions is opening up entirely new possibilities beyond Earth.

During a special session at the 2020 International Astronautical Congress, a panel of AI experts met to discuss the present and future of artificial intelligence in space. The session was moderated by Hilde Stenuit, the scientist team lead at ICE Cubes Space Applications Services and the panel included Andrei Sapera, marketing and business analyst at ICE Cubes; Nicolas Clémencin, a payload system engineer at ICE Cubes; Naeem Altaf, the chief technology officer of space technology at

IBM; William Carbone, a member of IBM Academy of Technology; and Matthias Biniok, lead AI architect at IBM's space technology division.

Biniok outlined what he sees as the four main use cases of AI in space. The first is AI for anomaly detection. Artificial intelligence algorithms are great at looking for anomalies in large quantities of data and can help satellite and spacecraft operators identify unwanted behaviors in their spacecraft systems early on to avoid failures later. AI also has a lot of potential as a way to support operators. It can be really time consuming to dig into manuals when a system needs to be troubleshooted and AI can help by recommending the best next action or in some cases autonomously performing that action itself. AI is already proving to be immensely helpful for Earth observation. It can be difficult for a human to identify small changes in an image over time, but it's a breeze for deep learning systems.

There is also a lot of room for AI to be used as an astronaut assistant in space. Astronauts are incredibly busy and have turned multitasking into an art, but AI can help take some of the burden off their shoulders. This was proven

astronauts cope with boredom and loneliness on long duration missions. "This is a glimpse into the future of AI astronaut support," said Biniok.

At ICECubes, AI is also being integrated with the company's existing products to help with payload management. As Clémencin pointed out, ICECubes is not an AI specialist; rather, its business is providing companies access to space. The company operates a facility on the International Space Station that can host "experiment cubes" for organizations that need to do research in the microgravity environment. He says ICECubes is developing an experiment cube that will work as a small server that can run AI algorithms for companies that want to test intelligent robotics or medical devices on the station. "More and more

be used to autonomously share data and verify the ownership of space assets without human intervention. Another promising technology is edge computing. Today, collected in space is typically routed to Earth for processing. This is highly inefficient, especially for things like Earth observation where the majority of pictures are obscured by clouds and not useful for intelligence gathering. But by implementing AI on the satellites themselves, they would be able to filter out the useless data and only send the important information back to the ground.

This is just the beginning of AI in space. Sapera concluded the session by speculating about a far future where AI envoys explore the solar system for knowledge and profit. Whether that looks like swarms of intelligent



“ More and more AI applications are now running in the medical field to analyze health data from patients in hospitals”

in 2018 with CIMON, a floating AI assistant developed by IBM, Airbus, and the German Aerospace Center that is meant to help astronauts with their day-to-day tasks. CIMON can do things like film an astronaut while they perform a task or provide instructions for installing new station components. In the future, these types of intelligent robotic assistants may even be able to help



AI applications are now running in the medical field to analyze health data from patients in hospitals," Clémencin said. "And we think it would be a good idea to bring it to space."

The panelists agreed that it was still early days for the next wave of AI in space, but it's increasingly clear that computers in space will be increasingly intelligent. Altaf discussed several emerging technologies that he sees as being critical to fostering extraterrestrial commerce and advanced space exploration technologies. One example is the blockchain, a distributed ledger system that can

spacecraft uncovering the secrets of the outer planets or an AI astronomer studying the cosmos with a radio telescope on the moon remains to be seen. But one thing is for certain pushing the boundaries of space exploration will require us to push the boundaries of our technology. "From a technological point of view, harsh and challenging environments have always required innovation," Sapera said. "AI powered space exploration might offer new perspectives and new understanding of life and its origins, and answers to questions we have not even asked yet."

NASA Events

NASA SESSION: **Nasa Exploring As One**

12 October 2020

On October 31, 2000, a Soyuz rocket departed from the Baikonur Cosmodrome carrying NASA astronaut Bill Shepherd and cosmonauts Sergei Krikalev and Yuri Gidzenko to the International Space Station. It marked the beginning of an uninterrupted human presence in space that has not been broken in 20 years. When the trio arrived, the ISS was only a small station that consisted of a pair of Russian and American modules; today, it is the size of a football field. But what has not changed is the station's role as the world's premiere orbital laboratory, where the technologies that will shape the future of humanity on and off the Earth are put to the test.

As part of a special NASA session at the IAC 2020 CyberSpace Edition, Thomas Zurbuchen, the associate administrator for the science mission directorate at NASA, and Kathy Lueders, the associate administrator for the human exploration and operations mission director at NASA, discussed how the agency's robotic and human space exploration programs benefit and support one another. The ISS is a leading example of this collaboration and has been a critical resource as the agency prepares to go back to the moon and on to Mars.

"The International Space Station has been a key area where for us getting ready to that next stage to get ready for the Moon and Mars," said Lueders. "We have been using it as a testbed for our new equipment. We have got to try it out in low Earth orbit before we make that next step to the lunar surface."

As part of its Artemis program, NASA has committed to sending humans to the lunar surface by 2024 and

“The International Space Station has been a key area where for us getting ready to that next stage to get ready for the Moon and Mars”

establishing a permanent human presence on and around the moon. But living and working beyond low Earth orbit comes with a host of new challenges. NASA's primary goal is keeping its astronauts safe, which requires new technology and new scientific missions to better understand the environment astronauts will face on the moon. One of the biggest concerns, said Zurbuchen, is the intense radiation environment. Astronauts on the ISS are shielded from the brunt of solar radiation by the Earth's magnetic field, but the moon's magnetic field is virtually non-existent.

"The radiation environment in low Earth orbit is fundamentally different from the radiation environment on the lunar surface," said Zurbuchen. To better understand this environment, and how to protect astronauts from potentially hazardous space weather, NASA is developing a suite of space weather instruments called HERMES that will be installed on the agency's Gateway station orbiting the moon. The data from these instruments will be critical for predicting space weather events and keeping astronauts safe on and around the moon. "It is really about safeguarding the journey through space weather," Zurbuchen said. "There is so much that remains to be known."

NASA sees its Lunar Gateway station as a critical element in expanding humanity's presence in space, but it's just a stepping stone toward an even more ambitious goal. "The Moon is not the destination," said Zurbuchen. "It is a throughway to Mars." But sending humans to Mars is dramatically more difficult. Unlike the moon, which can be reached in a matter of days, it takes several months to get to Mars. That means that the first astronauts to land on Mars will need the ability to be self-sufficient to save on the cost of sending supplies or in case something goes wrong. NASA plans to use the moon as a test bed for many of the technologies that will let the first Martians live off the land. "If we can figure out how to use the resources at the location, we are going to," Lueders said. "Not having to take everything to the location as part of the journey is huge."



What are you all hoping to discover on Mars that will provide guidance for human exploration of the planet?

How will the commercialization of space resources play a part in NASA's goal to expand humanity throughout the solar system?

Will Artemis establish Moon Bio-research facilities to improve our planetary protection protocols for samples from Mars?

But just because NASA sees the moon and Mars as the future of human space exploration, Lueders and Zurbuchen said the agency also plans to stay in low Earth orbit. There are plans to decommission the ISS by the end of the decade and Lueders said she sees NASA as a customer of commercially operated space stations in the future. "We want to stay in low Earth orbit, it is a great proving ground for our exploration technologies," Lueders said. "What we are trying to do is enable commercialization so that companies can leverage the investment that we have made by developing capabilities themselves so that we can do our next hard job."

“The radiation environment in low Earth orbit is fundamentally different from the radiation environment on the lunar surface”



NASA SESSION: International Participation in the Artemis Program

13 October 2020

Outer space is changing. What was once the provenance of two world superpowers is now home to spacecraft operated by dozens of countries and private companies around the world. At the same time, national space agencies are hatching plans to create outposts on the moon, mine asteroids, and send humans to Mars. These activities are the next logical step in expanding humanity's presence in the cosmos, but they also invite opportunities for conflict and misunderstandings. The key to ensuring that space remains peaceful and accessible to all are the international rules and standards of conduct for operating in low Earth orbit and beyond.

The foundational document of space law, the Outer Space Treaty, was originally signed in 1967 by the United States, the United Kingdom, and the Soviet Union. Since then, more than 100 nations have signed on as parties to the treaty, but some feel it is inadequate to address the rapidly changing regulatory needs of space exploration. During a historic meeting at the 2020 International Astronautical Congress, leaders from eight world space agencies signed the Artemis Accords, which were written to reinforce the obligations of the Outer Space Treaty.

"The principles described in the Artemis Accords will

create a bright and prosperous future that we all want for ourselves and the generations to come," said NASA Administrator Jim Bridenstine. Among the principles outlined in the Artemis Accords are a commitment to transparency, rendering emergency assistance to astronauts in distress, respecting heritage sites, and the public release of scientific data. "These are the values we want to take with us to the stars," Bridenstine said.

The impetus for the Artemis Accords are their namesake mission: the Artemis program. Led by NASA, the Artemis program aims to return humans to the lunar surface by 2024 and create a permanent human presence on and around the moon. The hope is to use lunar activities to lay the foundation for a crewed mission to Mars next decade. During the session, Bridenstine said that the Artemis Accords are "establishing consequences for Outer Space Treaty compliance." If a space actor doesn't abide by the principles in the accords, they will be prohibited from participating in the Artemis program.

Among the many issues addressed by the Artemis Accords are the use of space resources. Companies and nations are looking for ways to use space resources, whether it's mining asteroids for precious metals or



harvesting water on the moon to turn into rocket fuel, and this will be critical to sustaining humans on other worlds. But without regulations in place that clearly define how these resources can be used, many space organizations think it's too risky to pursue. This is a major barrier to extraterrestrial commerce that the Artemis Accords hope to alleviate.

"It affirms the simple contention that we can in fact extract and utilize space resources," Bridenstine said. "Countries and companies should be able to enjoy the fruits of their labor, and all such activities can and will be done in full compliance with the Outer Space Treaty."

Bridenstine was joined by representatives from seven other nations who are the first signatories to the Artemis Accords: Australia, Canada, Italy, Japan, Luxembourg, the United Arab Emirates, and the United Kingdom. Representatives from each country affirmed their commitment to the values of the Artemis Accords before a signing ceremony. "The accords provide a framework for the continuation of multinational cooperation in space," said Sarah bint Yousef Al Amiri, Minister of state for advanced

technology and chairwoman of the UAE space agency. "We are passionate proponents of the ideal of international collaboration. We are one human race and we are In this together."

“ For us, exploration is much more than just sending some people or robots into space”



CGTN/TV Event

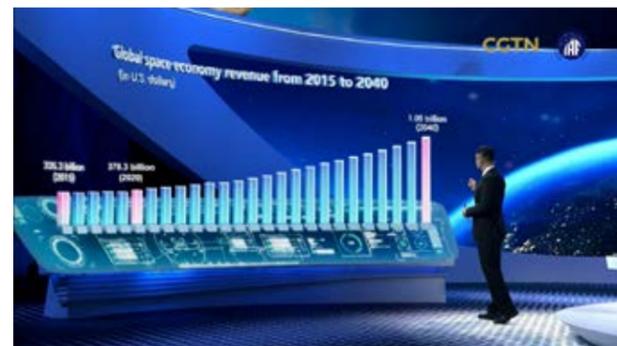
CGTN/TV/IAF SESSION: **New Era in Commercial Space**

14 October 2020

The CGTN panel on the “New Era in Commercial Space” was a wholly unique experience at the 2020 International Astronautical Congress. The session was a throwback to the classic space television program, *Cosmos*, which guided viewers on a journey through the solar system on a spaceship of the imagination. Like *Cosmos*, the CGTN panel took place on a fictional spacecraft hurtling through space, but the developments discussed by the panelists were grounded in reality. The panel consisted of leading voices in the space industry from companies operating around the globe. Included on the panel was Liu Le, the general manager and deputy director of the commercial aerospace division at China Volant Industry Company; Kevin Shu, the general manager of global marketing and services at LandSpace; Pascale Ehrenfreund, president of the International Astronautical Federation; Dimitri

Loskutov, director general of Glavkosmos; Clayton Mowry, the vice president of global sales marketing and customer experience at Blue Origin; S. Somanath, the director of the Indian Space Research Organization’s Vikram Sarabhi Space Center; and Victoria Alonsoperez, the founder and CEO of ChipSafer.

Each panelist brought their unique perspective on the ways that commercialization is changing space, but they all agreed that low Earth orbit would never be the same. A key driver of the transition to the commercialization of LEO is the many ways that space technology can benefit life back on Earth. “We try to make space technology people-centric and touch the everyday life of the individual,” said Somanath. Mowry agreed. “The benefit of space is for life here on Earth,” he said. “It is really helped us understand this planet.”



Consider ChipSafer, a company Alonsoperez founded. The company uses satellite data to track and monitor livestock using sensors worn by the animal. “This is a great example of how a space application can have a positive impact on the world,” said Alonsoperez. She also pointed out several other use cases for space technology on Earth, ranging from monitoring deforestation to improving agriculture. “The United Nations has set 17 goals to be achieved by 2030 and right now we really need to be able to step up to be able to achieve them,” she said, referring to the United Nations Sustainable Development Goals adopted in 2015. “Space technology is a key enabler for that.”

Of course, the commercialization of space exploration is also benefiting space exploration itself. This is particularly true when it comes to enabling space access through low cost launch services. There are several new commercial rockets under development around the world that aim to dramatically lower the cost of getting a payload to orbit. LandSpace, for example, is developing a rocket that can

boost more than 300 kilograms into LEO. “Right now we are facing quite high market demand in the space industry for satellite launches,” said Shu. “There is nowhere near enough low cost launchers to get them access to space.”

The panelists also highlighted other ways that space is being commercialized. Ehrenfreund pointed to the promise of asteroid mining in the future, which will be critical for allowing astronauts to “live off the land” on the moon and Mars. “Mining is a difficult endeavor, but we would not have imagined 10 years ago what we are doing today in space,” she said. Blue Origin also has big plans for the final frontier and dreams of seeing millions of people living and working in space. Indeed, the new era of commercialization in space has fundamentally altered the way we think about the possibilities beyond Earth. “The space age has changed our mentality,” said Loskutov. “When you understand that there are no horizons, no boundaries, for exploration, that is something amazing.”

IAF Awards 2020

Every year, the IAF confers a number of awards to individuals and groups who have distinguished themselves in space cooperation and space activities on a global level. Even though this year was characterized by unusual circumstances where physical meetings did not take place, it was very important for the IAF to continue recognizing and celebrating the

achievements and successes of our colleagues and peers.

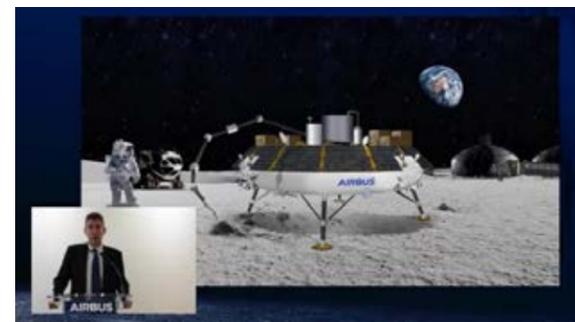
With a compilation of various greetings and personal video messages, keynotes and presentations, the 2020 IAF Awardees participated virtually at the IAC 2020 - The CyberSpace Edition, making the award ceremonies and the entire congress a diverse and celebratory event.



This year, the IAF World Space Award was presented to the Chang'e 4 Mission Leaders during the IAC Opening Ceremony with the Chinese Society of Astronautics connecting live from the headquarters in Beijing, China.



Kicking-off another exciting edition of the IAC's Industry Day, the IAF Excellence in Industry Award Ceremony featured a special Keynote and Announcement by the 2020 Award Winner: Airbus Defence and Space.



In the frame of the IAC's Diversity and Outreach day, the IAF Excellence in "3G" Diversity Award was presented to the 2020 Award Winner European Space Agency (ESA). The award was accepted by ESA's Chief Diversity Officer, Ersilia Vaudo, who gave a special Keynote on ESA's Diversity Initiative.



With many contributions from the 2020 IAF Award Recipients, the IAC 2020 Closing Ceremony featured the celebration of this year's Allan D Emil Award, IAF Hall of Fame, Frank J. Malina Astronautics Medal, IAF Young Space Leaders, IAF Distinguished Service Award and IAF ISEP Startup Pitch Session.



IAF GNF Space Conversations Series



In light of the global context and in order to ensure an ever-growing connection with the space community, the IAF, in line with its motto “*Connecting @ll Space People*”, decided to launch in September 2020 a new initiative called the “**IAF GNF Space Conversations Series**”. These free-of-charge registration live online webinars create an additional opportunity for the IAF Community to discuss the most recent developments in space, and are organized in the frame of the IAF Global Networking Forum (IAF GNF). The latter has been, since its creation in 2012, one of the most efficient platforms for the Federation to meet, share and connect, giving speakers and participants the opportunity to showcase their research, results and latest developments, while providing the audience with the opportunity to learn and keep abreast of the latest space-related events.

Throughout these live conversations, the IAF aims at strengthening even further the ties with its Members and flags topics that are relevant for the overall space community. These conversations provide a chance for the global space community to come together, connect, be inspired and informed by leaders and experts in multiple fields of space. Thanks to this new initiative, and following its theme “*A space-faring world cooperating for the benefit of humanity*”, the Federation will continue to advance knowledge about space, and foster the development of space assets by advancing global cooperation.

The launch of this new initiative has been very positively welcomed by the IAF Community, and following the very successful IAC 2020 – the CyberSpace Edition, the first ever IAF GNF Space Conversations Series kicked-off on 28 October 2020. Organized by the Japan Aerospace Exploration Agency (JAXA) on the topic of “**Global Exploration Roadmap - Supplement August 2020, Lunar Surface Exploration Scenario Update**”, this lecture, given by Mr. Naoki Sato, Director of the Space

Exploration System Technology Unit of JAXA Space Exploration Center, and Chair of the International Space Exploration Coordination Group (ISECG), presented the Supplement issue of the Global Exploration Roadmap (GER) and discussed how the space agencies should implement the scenario and the architecture described.

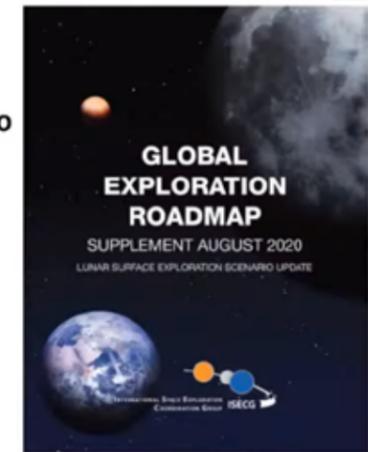
This presentation focused on the GER Supplement issued in August 2020, that describes the latest mission scenario and architecture for human and robotic lunar surface missions and preparatory activities for Mars, and integrates renewed and emerging national plans and commercial capabilities among ISECG participating countries. Mr. Sato presented the 12 common sets of objectives for human lunar surface exploration with rationale and performance measure target, and presented the architecture and campaign sequence, to realize the objectives, that have been studied and coordinated into one scenario. Finally, Mr. Sato put forward the conclusion of the ISECG to have three phases approach, which are:

- Phase 1: Boots on the Moon
- Phase 2: Expanding and Building
- Phase 3: Sustained Lunar Opportunities

The second, very successful, IAF GNF Space Conversations Series, took place on 25 November 2020 on the topic of “**Bridging the Space Divide for Developing Countries and Emerging Communities**”. This panel discussion, organized by the IAF Administrative Committee on Developing Countries and Emerging Communities (ACDCEC), brought together experts from around the globe, to exchange on how to best advance in the objectives identified by the ACDCEC Committee in order to best serve Emerging Space Nations. These objectives, include: optimize the cost benefit in terms of affordability and accrued value, improve communications and create awareness of the IAF offerings, advocate for a better understanding of the full space related benefits; and

Outline

- Expected to be used as the common reference of the international space exploration roadmap and for the dialogue with stakeholders and international or commercial partners to promote collaboration.
- Contents are:
 - ◆ EXECUTIVE SUMMARY
 - ◆ CHAPTER ONE
Growing Global Momentum
 - ◆ CHAPTER TWO
Major Updates in Lunar Exploration Plans
 - ◆ CHAPTER THREE
Lunar Surface Exploration Objectives
 - ◆ CHAPTER FOUR
Updated Lunar Surface Exploration Scenario
 - ◆ CHAPTER FIVE
Increasing Industry Capabilities



https://www.globalspaceexploration.org/wp-content/uploads/2020/08/GER_2020_supplement.pdf



finally, increase the representation of experts in IAF events and activities.

During this interesting roundtable, the speakers discussed and exchanged views on how to enable programmes within the Federation that can bring an added value and benefits to the Emerging Space Nations, and ensure the long-term success and sustainability of their space activities and initiatives.

A third edition of the IAF GNF Space Conversations Series was held on 9 December 2020 on the theme of “**Spaceland’s first 3D-Printed Mars Habitat as Game-Changer in Planetary Exploration Programs**” and organized by SpaceLand Africa. This session shed a new light on both the container and the content of the SpaceLand Center which will be the 1:1 pilot project

show-casing such unique breakthroughs to demonstrate the state-of-the-art of the technologies addressing out-of-this-world targets while at the same time hosting immersive interactive facilities to enable anybody to experience low-gravity on the ground, at any age, and serving valuable humanitarian projects world-wide.

The IAF GNF Space Conversations Series will continue to bring together the IAF Community, and beyond, will continue to serve the purpose of providing networking opportunities for students and young professionals, academics, decision & policy makers, the general public and all who can contribute to the sharing of knowledge in the global space community.

All IAF GNF Space Conversations Series are available for re-watch on the [IAF YouTube Channel](#).

“ These conversations provide a chance for the global space community to come together, connect, be inspired and informed by leaders and experts in multiple fields of space.”

IAF Committees

IAF Technical Committees

IAF Committee for the Cultural Utilisation of Space (ITACCUS)

The Committee for the Cultural Utilisation of Space (ITACCUS) seeks to promote and facilitate the innovative utilisation of space (data, systems, applications) by organizations in the cultural sectors of society internationally, including all areas of the arts and humanities, including the fine arts, entertainment, popular culture and tourism. In a cultural context, it may include cultural production, cultural preservation, cultural representation, cultural education and cultural development. ITACCUS' activities comprise:

- Advocacy – promoting, developing and raising the profile and quality of 'cultural utilisation of space' within the space community and within the cultural community internationally, and with the general public
- Collaboration – organizing meetings and workshops internationally
- Communication & Dialogue
- Knowledge Hub
- Promoting Quality Cultural Products

ITACCUS consists of liaisons from: Space organizations (agencies, industries, NGOs, educational and research Institutions); Cultural organizations (presenting organisations, museums and galleries, non-profit cultural organizations, for-profit cultural organizations, educational and research Institutions), and from other IAF Committees. Individuals serving on ITACCUS serve as liaisons to their organizations, not as representatives.

Committee Meetings

The IAF ITACCUS Technical Committee for the Cultural Utilisation of Space (2018-2021) held virtual committee meetings on Tuesday 24 March (during IAF Spring virtual meetings) and on Thursday, 8 October 2020, ahead of the 71st IAC Cyber Space Edition.

The agenda included key topics:

- IAF ITACCUS Committee (members, experts, friends, observers, + IAF secretariat rep.)
- Introduction, Roundtable, ITACCUS scope/objectives and TOR, IAF committees,
- Membership, Experts and friends, (update based on proposals received before committee, and at meeting) and Update list on IAF website
- IAF Highlights 2019 (including ITACCUS IAF GNF and other events), IAF Reports
- ITACCUS Website (non IAF) - Website structure and contents, Brand identity.
- Sessions for IAC Cyberspace and for IAC 2021 Dubai, IAC 2020 paper selection, Interactive presentations and competition, Preparation of the committee activities
- Review and planning of annual activities and committee objectives
- Events at IAC 2020 & IAC 2021, ITACCUS proposals for GNF at IAC2021
- ITACCUS endorsement for projects, update repository
- Reports from projects endorsed at IAC 2019 & : IAU astro and art, ILEWG ArtMoonMars, MoonGallery, Kosmica, others
- New projects proposed for ITACCUS 2020 endorsement and implementation
- 2020-2021 ITACCUS draft Strategy document
- News /announcements from ITACCUS members & partners

Committee Participation in IAC CyberSpace & IAC 2021 Dubai

The ITACCUS is contributing to and organizes and sessions at IAC E5 Space & Society Symposium, and collaborates in other IAC symposia.



Some of the participants on stage after a GNF panel event co-organised by ITACCUS at IAC Bremen Symposium in 2018. You can see a wide diversity addressing the IAF 3G goals: Gender, Geography, Generations.

ITACCUS has sponsored sessions at other general events with COSPAR, EGU European Geoscience Union, Europlanet Science Congress (session on Planetary Exploration Through Arts).

ITACCUS membership status

Prof Bernard Foing (ESA/ESTEC & ILEWG EuroMoonMars & ArtMoonMars, Amsterdam-Leiden U.) is the current ITACCUS committee chair, with Aoife van Linden Tol, Nelly Ben Hayoun, Sarah Jane Pell supporting as vice-chairs. We made efforts in increasing the number of experts and friends with a good number of participants at the committee meetings during the virtual IAF Spring Meeting and before the 71st IAC Cyberspace.

New developments in ITACCUS area

- ITACCUS had endorsed the MoonGallery initiatives (MoonGallery.eu) to be launched to the Moon in 3 years , with precursor deployment in extreme environments in a Swiss glacier during Igluna campaign, near HISeas Moonbase in Hawaii during EMMIHS camapiagn. MoonGallery xhibition events took place in Prague Design week in October 2019, Amsterdam Amstelpark in June 202, in Aveiro Water festival Portugal on 14-19 July, and in Leiden Old Observatory on 12 sept- 20 Dec 2020 (with an hybrid format using tools for telepresence and teleoperations due to the pandemics)
- ITACCUS has endorsed 'KOSMICA', a regular series of social galactic gatherings bringing together those interested in sharing cultural ideas about space.

- ITACCUS has co-sponsored talks, conferences and events at various universities
- ITACCUS members have participated to events and webinars organized by Women in Aerospace, and SGAC
- ITACCUS is planning on preparing space cultural activities and events for GLEX St Petersburg in June 2021, & IAC Dubai in October 2021.
- We gave tribute to Space Art Pioneer Prof Lowry Burgess (1940-2020)
- New projects endorsed by ITACCUS in 2020 include: Space Games Federation, cultural exhibit within SpaceLand City, Red Moon movie production, SEEDS collective with artwork for ISS, Leonardo Space Space Art Science Workshops, women workshop and pink cards , ETHNO-ISS Ethnography of an Extraterrestrial Society: the International Space Station.

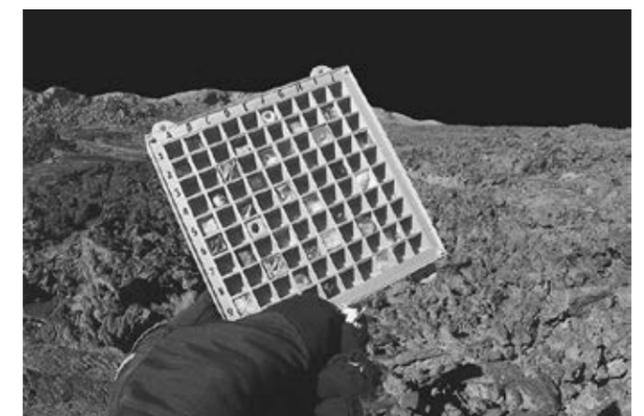


Image of the first Art Moon Gallery deployed during the Expedition EMMIHS EuroMoonMars-International MoonBase Alliance-HI SEAS Hawaii.

IAF Earth Observations Committee

The Earth Observations Committee (EOC) has had quite a year, starting after the Washington IAC, the committee held its normal virtual meeting in December and working with its GEOS subcommittee planned and proposed many events for Dubai. The committee also faced the good challenge of one of its sessions being overwhelmed with interest and abstracts - then Covid-19 emerged changing the Spring meetings to virtual.

The Virtual Spring meeting took place and the committee developed a very robust set of technical sessions and stood by to await the decision on whether IAC2020 would be held in Dubai. Following the announcement to postpone on April 10th, and the announcement of the IAC2020 cyber edition on April 27th, the committee and its GEOS subcommittee worked fast to respond to several requests to combine or otherwise transform the proposed events. Of particular note was coordination with the Disaster Charter Secretariat to defer the B.1.6 session focused on the 20th anniversary of the charter to 2021.

The committee and subcommittee met through a teleconference in June and came to agreement on how to address these various changes and best utilize the IAC2020 Cyber edition. The committee held its IAC virtual conference meeting on October 7th to confirm readiness for the IAC2020 cyber edition, and map out preparations for IAC 2021 in Dubai. One of the opportunities the committee has had is addressing how best to renew the partnership with the Young Professionals, convey the highlights of COVID response impacts on the earth's environment, and support an initiative for emerging countries, first discussed last year at the GEO plenary in Australia.

The committee had a good showing at the IAC2020 cyber edition. Of the many papers selected, 34 high quality video papers were available for the conference participants.

The EOC now has 35 members improving its distribution between Agencies, Industry and Non-Governmental Organizations and improving 3G Diversity. The EOC is actively looking for new members to further enhance its generation, gender, and geographic distribution – particularly to improve the ratio of non-European members.

Earth Observations in general is rapidly advancing with the advent of several new Copernicus missions approved for further definition, the increase in commercial options for data, small sat LEO architectures, and the impact of Artificial Intelligence / Machine Learning and big data analytics on algorithms and analysis, and cloud computing on ingest / processing / distribution architectures. The EO technical sessions have featured many papers addressing these trends and key advances that result from them. There are also rapidly increasing challenges with climate change, societal development goals, biodiversity threats, water management, severe weather, other environmental challenges, and the expansion of human developments and infrastructure. These have also been extensively addressed in the EO technical sessions and event proposals.

One piece of good news this year is that our former Chairman, Gunter Schreier, received an IAF Distinguished Service Award. The Award is for his outstanding services to the Federation as Chairmen of the Earth Observation Committee.



Gunter Schreier, Deputy Director of the DLR Remote Sensing Data Center (DFD).

A virtual EOC meeting is now being planned for December 2020 to agree on the events to propose for the IAC in Dubai.

IAF Enterprise Risk Management Committee (ERMC)

This was a very peculiar year for all committees and for the ERM committee in particular: The main focus was to analyse the role played of a robust Risk Management system during the COVID pandemic and draw some lessons learned. Was such a risk analysed? How were the Risk Managers solicited during the pandemic and what was their participation in drafting the business continuity plan?

The activities of the ERM committee this year have been reduced to virtual meetings, but it seems that this did not hinder the good spirit of its members:

The first meeting took place during the Spring IAF meetings (cyber edition) in March 2020 and every member was able to report on their business continuity plans within their organizations.

The second meeting was during the IAC 2020 cyber-edition with a key note speech from Candace Johnson, serial space entrepreneur & investor, member of "E-BAN" European trade association for Business Angels Network.

The main message from Candace during these hard times of COVID Pandemic are that clearly there are some risks and pitfalls linked to such a situation, nevertheless, the Pandemic offers many opportunities which need to be grasped. Illustrating her speech with some concrete examples of her career, Candace stressed that we need to take risks, and the world is ready today, in domains

such as interconnectivity, AI, 5G, etc. in order not to lose opportunities.

Indeed, opportunities can rise from catastrophic events like a pandemic and the increase in use of telemedicine and tele-education have proven vital during the last 6 months. A reflection took place this year on how to capitalise on the COVID 19 aftermath. Next year, hopefully the ERM committee will be able to meet in person: Mr Adnan Al Rais from the Mohammed Bin Rashid Space Center gave us an overview on how the conference is being prepared in Dubai ensuring the venue can adapt to the new health and safety measures required in times of pandemic.

To capitalize on the times we are experiencing the idea rose to ask for abstracts relative to the COVID pandemic risks impacting the space business, as well as on the resulting opportunities.

A proposal was made to look at two directions: the first one focusing on past experiences, and looking at how the COVID-19 pandemic impacted the way organizations addressed their risk management approaches, the identification, management, and communicating of risks before the pandemic. What were previous strengths and weaknesses? A second area of interest is to look at the future and to see how to improve ERM processes, including integration with other processes, to make organizations/companies better prepared for a future systemic risk event and search for appropriate responses to expected catastrophic events, such as a pandemic.

What is Risk ?

- Not Taking Risk !
- Not taking opportunities!
- Focusing on the Negative!
- Making certain that you do everything to take the Risk OUT of your venture !
- Focusing on the Positive !!!

IAF Human Spaceflight Committee

Overview of the past year

IAC Technical sessions

The Human Spaceflight committee organizes the Human Spaceflight Symposium (B3) with in total ten sessions. These sessions include the overview session (B3.1) and multiple sessions focusing on different aspects of human spaceflight.

- A Keynote lecture was delivered this year by Kathryn Lueders from NASA HQ on Innovative Partnerships in Human Space Exploration.
- Two GNF sessions of the Cyberspace Edition of this year's IAC where with support and involvement from the Human Spaceflight Committee:
 - » ISS Commercialization and Future Industry Innovation in Low Earth Orbit Day: Tuesday 13 October • Time: 14:00 – 14:40 CEST
 - » IAF/ASE Astronauts Panel Day: Wednesday 14 October • Time: 15:40-16:20 CEST

The committee

Three new members were accepted to the committee. All are Young Professionals. The new members of the last few years have shown enthusiasm in supporting the committee in various roles.

Kevin Foley, Igor Sorokin stay on as Chair and co-chair until the spring meeting in 2021.

New developments in the field of the committee

Apart from the new developments in the field of Human Space flight we had a major celebration this year: 20 years of permanent human presence in space on the ISS. This represented a major milestone for all the involved parties.

The major developments in the field of Human Spaceflight are:

- Commercial human Spaceflight
 - » SpaceX flew the first crewed mission to the ISS with the Dragon 2

- » Axiom is preparing the first private flight to the ISS with actor Tom Cruise with veteran astronaut Michael Alegria Lopez, HSC member, as commander
- » The first commercial airlock, the Bishop Airlock, built by Nanoracks, Inc, will launch to the ISS in November 2020.

- NASA's new crew-rated super-heavy-lift launch vehicle, the Space Launch System, will undergo its first hot fire test in November. This rocket will carry the Orion capsule on an uncrewed circumlunar test flight.
- NASA has presented the Artemis Accords in which they invite other countries to join the Artemis programme to explore the Moon
- The Artemis Accords were signed by the United States, Australia, Canada, Japan, Luxembourg, Italy, the United Kingdom, and the United Arab Emirates on October 13, 2020.
- NASA has selected three commercial teams for the development of the Human Lunar Lander for the Artemis Missions.
- On October 15th the Russian Soyuz MS-17 delivered the ISS Expedition 63/64 crew to the Station in a record time of 3 hours and 3 minutes. Rendezvous of Soyuz MS-17 spacecraft with the ISS is carried out automatically using a super-fast two-orbit rendezvous profile.



The ISS celebrated its 20th anniversary of permanent Human Presence in space (© NASA).



9 Countries signed the Artemis accords on October 13th during the IAC.



NASA has announced three commercial teams to develop the human lunar lander for the Artemis missions. (© NASA).



Astronauts Robert Behnken and Douglas Hurley fly the first SpaceX Dragon mission to the ISS (© NASA).



Cosmonauts Sergei Ryzhikov, Sergey Kud-Sverchkov (Roscosmos), and astronaut Kathleen Rubins (NASA), the crewmembers of the ISS Expedition 63/64, fly the fastest Soyuz MS-17 mission to the ISS (© Roscosmos).

IAF Committee on Integrated Applications

The goal of the symposium is to enable the development of end-to-end solutions by connecting the user communities that are driving toward end-to-end solutions with those that are developing enabling technologies for integrated applications.

The Integrated Applications Technical Committee met on 7th October 2020, to discuss the progress of the Integrated Applications Symposium. The meeting was chaired by R. Mugellesi and provided the opportunity to discuss current status of the Symposium and next steps.

In light of the COVID-19 situation, similarly to what

happened for the 2020 Spring Meetings, the IAF was obliged to make the IAC 2020 event, including the Committees meetings, as virtual events and as a result the 2020 edition has become the CyberSpace edition.

As this year edition is going to be virtual, speakers of the selected papers have been invited to upload a video with their presentation.

Main points discussed during the meeting are reported below.

- The B5 Symposium includes three sessions, B5.1, B5.2

and B5.3. What clearly emerged is that, especially for session B5.1 and B 5.2, the videos which were uploaded were unfortunately less than half of the invited papers. This was not the case for session B5.3. This year was quite exceptional in terms of quality and quantity of submitted abstracts. This was also the reason to not identify and invite a key note speaker, as the committee, at the time of the Spring Meetings, had chosen to invite more authors, to the detriment of a key note speaker.

- The committee members discussed the reasons behind the high number of withdrawals, one reason being the uncertainty of the current circumstances, but also the difficulties in travelling -especially for not EU authors- given the fact that only 3 months ago was announced that IAC 2020 was intended to be virtual. Moreover, the new format of the event, the new mechanism where real presentations were replaced by pre-recorded videos, could also have been a reason.
- It was clarified that the videos would be available during the entire duration of the conference from 12 until 14 October, only for registered people, therefore each member of the committee can follow the presentations independently at the time that is more convenient. The form to fill-in the evaluation of the papers is available on line in the technical platform.
- Given the large amount of proposed contributions to the symposium for IAC2020, about the double of what could be accommodated in the two sessions, a strategy could be devised in accordance with IAF management on how to deal with it. Several options were discussed, where one option would be to create an extra session for next IACs.
- The Symposium is called Integrated Applications. A change of the name could be considered as Integrated Applications could not be of immediate understanding to players residing, for instances, in the US or in Asia as other Space Agencies and International Organizations use different names such as downstream services, space applications etc.
- As possible development, a topic could be selected for the next IAC as central theme of the sessions/symposium, such as “Smart Cities” or “Energy”, to contribute to the discussion at a global level.

Session B5.1: Tools & Technology in Support of Integrated Applications

The session focused on specific systems, tools and technology in support of integrated applications and addressed the various issues associated with the design

of space and ground systems, the kind of data they collect, how they collect data, and how the data are integrated and distributed to address key user needs. The following is the list of papers for which the video has been uploaded:

- Deep learning Development Platform for Aerospace Applications, Dr Y. Mao, X i'an Microelectronics Technology Institute, CASC, China
- Applying Geographic Information Systems for Monitoring of Bloom Dynamics from Spce, Dr. Mostafa Elfouly, Chair of Geoinformatics, Technische Universität München, Germany
- Edge Computing and it applications in satellite, Mr. Arkit Latkar, Ramaiah Institute of Technology, India
- Multipurpose Integrated Quadcopter, Mr Pradnesh Mhatre, University of Pune, India
- Challenges of NLP for Space Industry, Dr. Akram Tayyebi, Allameh Tabatabai University, Iran

Session B5.2: Integrated Applications End-to-End Solutions

The session is a forum for end-to-end solutions, including case studies, proof-of-concept missions, and current projects that provide, or could provide, innovative user-driven solutions. Applications that combine ground- and space-based data sources with models to address specific user requirements were presented. These examples covered a variety of domains, like disaster/crisis monitoring and management, energy, food security, space situational awareness, transportation, health, etc. The following is the list of papers for which the video has been uploaded:

- Predicting What We Breathe: Machine Learning, Smart Cities, and Space Data, prof. Jeanne Holm, UCLA and NASA/JPL, USA
- ESA Space Solutions: Socio-Economic Impact Analysis of NEWSPACE, Mr. Elia Montanari, ESA, UK
- The ESA Business Applications Ambassador Platform for Italy: a closer look to the national space activities and the way forward of the Italian and European business applications ecosystem, Mrs Eleonora Lombardi, Fondazione E. Amaldi, Italy
- GPS Supported Assessment Integrated with GIS Service Area Network Analysis of Healthcare Institutions of Basona Werana Wereda in Comparison with Debre Berhan Town, Ethiopia, Mr. Wondwossen Mindahun, Ethiopian Space Science and Technology Institute (ESSTI), Ethiopia
- A Business Case Analysis for Satellite Backhaul in 5G/6G Mobile Networks, Mr. Alexander Kharlan,

Skolkovo Institute of Science and Technology, Russian Federation

Session B5.3: Commercial Applications

This session is focus on aspects of commercial satellite applications, including innovative business models, case analyses, product discussions, and uses. The following is the list of papers for which the video has been uploaded:

- Highly Efficient Satellite Imagery Denoising Technique using Deep Convolutional Neural Network,

Dr. Alavikunhu Panthakkan, University of Dubai

- Space Technology and Smart Cities, Ms. Yuwei MA, ISU, France
- Connect by CNES : Give more space to your ideas!, Mrs. Christelle Astorg-Iepine, CNES, France
- Development of User Interface System for MBRSC, Mr. Mohammad Haneef, University of Dubai, United Arab Emirates
- Development of Analysis Portal for MBRSC, Ms. Navneet Kaur , University of Dubai, United Arab Emirates
- Visualization of MBRSC Satellite data using Kepler , Mr. Firas Abou Naaj , University of Dubai, United Arab Emirates.

IAF Knowledge Management Technical Committee (KMTC)

Key themes addressed by the committee are strategies and tools for the sharing of existing knowledge to develop and sustain new projects, the impact of the internal social network in driving innovation and creating new knowledge, and processes and technologies that organizations are using to energize their ability to learn, innovate, and share knowledge.

Examples of case studies of particular interest include successful projects and innovations in the application of knowledge management, grounded research in knowledge and risk management, methods that allow data, information or knowledge exchange within or amongst organizations in support of actual programmes, and capturing engineering knowledge and information in computer models.

The Knowledge Management Technical Committee met on 7th October 2020. The meeting was chaired by R. Mugellesi and provided the opportunity to discuss current status of the Symposium and next steps.

In light of the COVID-19 situation, similarly to what happened for the 2020 Spring Meetings, the IAF was obliged to make the IAC 2020 event, including the Committees meetings, as virtual events and as a result the 2020 edition has become the CyberSpace edition.

As this year edition is going to be virtual, speakers of the selected papers have been invited to upload a video with their presentation.

Nine papers were presented during this session. By simplicity, we can divide these communications between two groups: one group oriented mostly by applications issues, and another oriented mostly by learning issues.

In the first group (applications issues)

A first presentation addresses the application of data science to the city, citizens:

Promoting Global Space Knowledge and Expertise in Developing Countries [Another title has to be found]

The Data Science federation, was created to tackle different challenges: tackle tough City problems with new ideas, diverse thoughts and new technology; expose City staff to new approach and technologies; recruit young people to City government by showing them the impact they can have in their neighborhood. Another is to respond to the students need for real – world, resume-building problems and data that have a big impact.

Two presentations approach although from two different viewpoints, how knowledge management could optimize satellite design: one by proposing to create a community of practice on cubsats, the other by implementing a design according to the Industry 4.0 paradigm.

Developing a Community of Practice to Promote Knowledge Sharing Across the Global CubeSat Industry

Cop The relatively low costs and short timelines associated with CubeSat development have promoted the accessibility of space and resulted in over 1000 CubeSats being launched to date. However, the success of CubeSat projects still depends on the availability of local expertise and an organization's ability to exchange knowledge. Inexperienced or geographically isolated groups are often left without the technical support required to complete their projects, and thus struggle to establish strong internal competencies.

Streamlined requirements management and matchmaking between space payloads and satellite bus enabled by Industry4.0 transformation and data intelligence

New Space comes along with complex topics such as digitization and Industry4.0 which play a crucial role regarding emerging expectations of new clients. Requirements such as time-to-market and total cost of ownership are becoming more stringent, while at the same time demand for product and service quality is increasing. Furthermore, increased complexity of product lifecycle management makes a sustainable transformation of the space industry necessary. Based on the project SLOTD4.0 funded by the German Federal Ministry for Economic Affairs and Energy and administrated by the German Aerospace Center Space Administration, this paper addresses how platform economics with accurate knowledge management methods combined will be used to contribute to a more customer oriented and sustainable transformation towards meeting such expectations in the near future.

Another presentation addresses, from another point of view, the issue of rationalizing the production of knowledge within the framework of a knowledge center implementing a Machine learning approach:

Automated knowledge centre with machine learning approach

Space Industry is highly technology driven and usually faces critical need while investing in knowledge management solutions. Information are often available in unstructured manner, such as in cluttered inboxes, unorganized repositories and the brains of coworkers. This consumes significant amount of time in gathering and retrieval of useful information. An automated knowledge center with machine learning approach was conceived to address and mitigate this problem.

A fifth presentation deals with the question of tracking Resident Space Objects (RSO) and manage information about them using Blockchain technology:

A Blockchain-Based System For Tracking And Collision Avoidance Of Resident Space Objects

The knowledge related to objects orbiting Earth has become a critical component of any space-based operation. Space Situational Awareness refers to the capability of detecting and tracking objects in orbit and predicting their position to avoid collisions. Particularly, the term Resident Space Object refers to Earth-orbiting natural or artificial objects. The current solutions for RSO tracking, acquisition and data collection are based on a centralized architecture, which are a bottleneck and a single point of failure due to the scalability issues in any distributed environment composed of a large number of nodes.

In the second group (learning issues)

Two presentations focus more on the organizational dimension of knowledge management. In one case, it is a question of taking into account the organizational culture of the company, in the other, of giving the feedback all its importance. In both cases, the aim is to make the company a learning organization.

A third presentation focuses on the implementation of communication and human interactions in KM processes in two specific contexts that are especially relevant to young professionals: academia and startups. A fourth presentation can still be linked to the previous ones insofar as it proposes a standardized learning procedure design in a virtual reality environment.

The role of organizational culture in knowledge management

Today knowledge management is accepted as an integral element for organizations seeking to secure and keep a competitive advantage. In literature, it is pointed out that, to become a useful tool to the knowledge workers, KM also needs to take into account organizational culture, keeping in mind the values that define the culture such as: belief frameworks, shared attitudes, and the written and unwritten rules that support the understanding -processing-, and utilization of knowledge. KM processes may organize and lead the knowledge flows, but it is the culture that determines whether these flows will be bolstered or constrained by social-and business oriented cultural barriers.

Novel approach for lessons learned @ esa

The European Space Agency is a knowledge-based, knowledge-driven and learning organization. Since more than 50 years ESA produces data, information

and knowledge in the execution its activities, projects and missions. In the frame of ESA Knowledge Management activities, lessons learned, knowledge from projects is a top priority for the Agency. The communication how the lessons learned approach at corporate level has been designed: introducing clear instructions, developing a comprehensive and simple platform for collecting, analysis and sharing lessons and, most important, testing this approach with real teams and projects.

Knowledge Management in Academic and Industrial Environments Related to the Aerospace Field

With costs declining, technology improving, and public-sector interest increasing, members of the aerospace industry must surely have every reason to feel optimistic about the future of their field. Challenges in engineering are being conquered

with unimpeded speed, and humanity's reservoir of knowledge about space and the universe is expanding with every breakthrough. Knowledge management, or KM, is a means for ensuring that knowledge and information are created, shared, transferred, used, stored, and managed within an organization.

Simulation of off-world communities by design of standardized learning procedures to assess safety measures and risk prevention

The ability of humans to survive and run productive activities in a harsh environment depends highly on how information is created, held, stored and shared. Skills, forms of tacit knowledge and organizational behavior are at the basis of any human-based activity. Nowadays, such skills in a connected world are being supported and enhanced by Information and Communication Technologies.

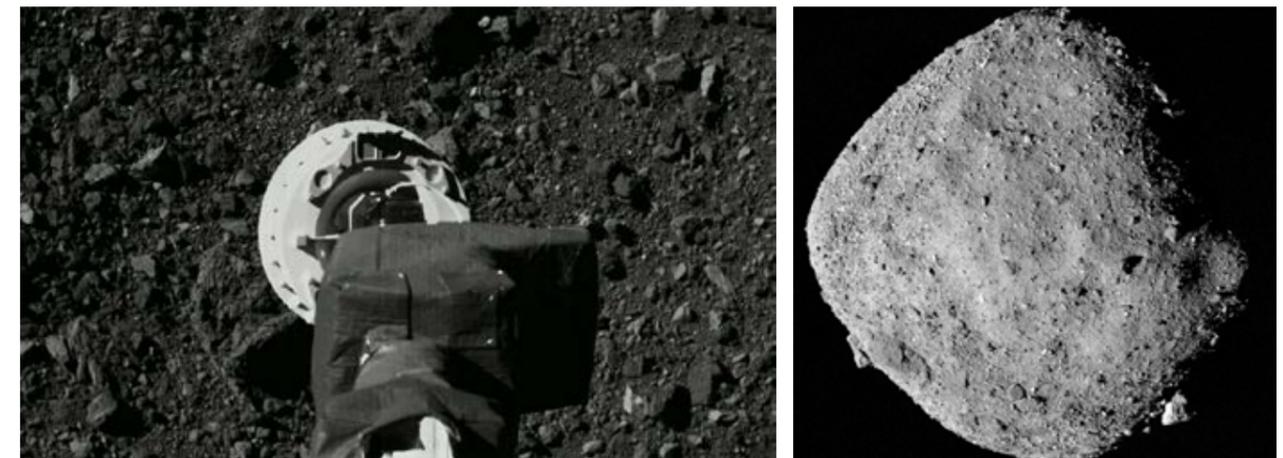
IAF Committee on Near Earth Objects (NEOs)

The Technical Committee (TC) on Near Earth Objects (NEOs) continued to work on its goal to raise awareness among the global space community about the ongoing work within the NEO and Planetary Defense communities and to get more people, especially students and young professionals interested and attracted to the topic.

During the last year five new members joined the committee: Mariella Graziano (GMV), Dr. Alissa Haddaji (Harvard University), Dan Mazanek (NASA), Josph

Mousel (Luxembourg Space Agency), and Alejandro Roman (Paraguay Space Agency). The aim is to strive for a balanced membership in terms of the 3G (gender, generation, geographical distribution) and representation of individuals with various backgrounds and specialties from agencies, industry, academy and organizations that can contribute their expertise to the knowledge base of the TC in various NEO related areas.

Activities this year were limited mostly to virtual events. The committee held its two annual meetings during the



Osiris Rex sampling asteroid Bennu.

IAF Spring Meetings and the Vice Chair Nancy C. Wolfson established contact with the AIAA as part of her outreach work, resulting in some of our members participating in the AIAA virtual events 2020 to bring NEO related topics to new audiences. In 2019 she proposed a “Women in NEO” mentoring effort initiative which is being discussed within the committee, but was explored in detail in her recently published paper “The Importance of Modern Mentorship for Women in the Space Industry From Traditional to Digital Platforms” by the AIAA. She also updated the committee on the progress of establishing a dedicated Technical Session on NEOs which she had proposed in 2019. For the time being, until slots for new session become available, the NEO committee is interested in collaborating with already existing sessions that have an overlap in topic.

It was another eventful year for the NEO community.

ESA’s Ministerial Meeting at the end of 2019 approved the funding for the HERA mission. HERA is the European contribution to an international double-spacecraft mission (along with NASA’s DART) to demonstrate our ability to deflect asteroids would mean significant progress in building our confidence towards utilizing asteroid deflection techniques.

Many of our members participated in the virtual Asteroid Day, celebrated each year on 30 June to inspire, engage and educate the public about asteroids opportunities and risks.

JAXA’s Hayabusa 2 spacecraft collected samples from asteroid Ryugu and has left orbit and is currently on its way back to Earth for a sample delivery on 6 December. NASA’s Osiris Rex recently collected samples from asteroid Bennu and will bring them back to Earth in 2023.



Members of the TC on NEOs during a virtual meeting.

IAF Space Astronomy Technical Committee (SATC)

Committee Meetings

The SPACE ASTRONOMY TECHNICAL COMMITTEE (SATC, 2018-2021) held a virtual committee meeting on Tuesday, 6 October 2020, ahead of the 71st IAC, - The CyberSpace Edition.

The agenda included key topics:

- Preparation of the committee activities for the 71st IAC
- Review and planning of annual activities and committee objectives
- Reporting and fostering of cooperation between the SATC and COSPAR and IAU
- Current events in space astronomy, particularly in the areas of small satellites and the impact of megaconstellations on the dark sky and astronomic observations

Committee Participation in the 71st IAC

The SATC organizes and hosts Symposium A7, the **Symposium on Future Space Astronomy and Solar-System Science Missions**.

The symposium invites leaders from the science, space industry, and space-agencies community to share information, insights, and planning for future space missions in exoplanets, astronomy, space physics and fundamental physics. The Symposium comprises both invited talks and contributed papers in these four areas of scientific endeavor. For each, the Symposium solicits discussion of phenomena coming within our reach over the next decades:

- Enabling measurement and system technologies, including significant progress made by research laboratories within industry and agencies,
- Mission concepts to implement such investigations,
- Corporate and space agency strategies for prioritizing and investing to make them real.

We trace this thread, from strategy to emergent technologies, throughout the week at each IAC, typically in three oral sessions plus interactive presentations, co-chaired and reported by committee members.

SATC membership status

Pietro Ubertini (INAF, Italy) is the current SATC committee chair, with Eric Wille (ESA/ESTEC, The Netherlands) supporting as vice-chair. Efforts in increasing the number of active members have been successful, with a large number of participants at the committee meetings during the virtual IAF Spring Meeting (11 participants) and the 71st IAC (10 participants).

New developments in the SATC’s Area

During the SATC meeting, held in the occasion of the 71st IAC, the problem related to the contamination of the dark sky due to the planned LEO commercial small satellite megaconstellations has been addressed from three view points:

1. Planned need for 1,000s (up to >10,000) commercial communication satellites operated in LEO
2. Need to preserve the so called “dark sky” both for scientific needs, and
3. For the human kind right to observe in the future a “dark sky”.

In particular SATC has discussed the first two points

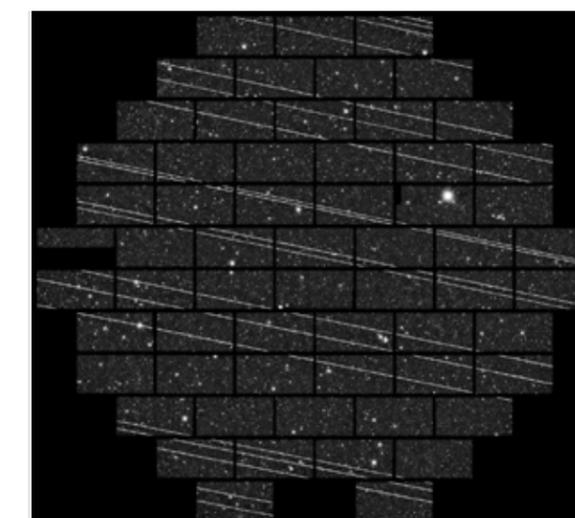


Image from the Cerro Tololo Inter-American Observatory. Overimposed on the astronomical image can be clearly seen streaks left by Starlink satellites. (Credits: © NSF’s National Optical-Infrared Astronomy Research Laboratory/CTIO/AURA/DELVE).

falling under the mandate of the committee. During the United Nations Office for Outer Space Affairs (UNOOSA) World Space Week 2020, the problem of the possible sky darkness contamination from LEO satellites has been deeply investigated. After several months of meetings and discussions at international level dedicated to this issue, the astronomical community, basically represented by the International Astronomical Union (IAU), have reached the new awareness of the anticipated problems related to the injection of an unprecedented number of small satellites in LEO orbits (300-2000km). The following picture shows an example of an astronomical field taken recently from the Cerro Tololo Inter-American Observatory.

The launch of these constellations of several satellites could create severe problems to the astrophysical observation from ground-based observatories (incidentally, one of the

topics of the SATC meeting is the synergy between ground and space programs).

The “Appeal by Astronomers” statement taken during the UNOOSA World Space Week 2020 can be found at: <https://astronomersappeal.wordpress.com/2020/10/08/our-statement-to-unoosa/>

The Space Astronomy Technical Committee (SATC) will further analyze the issue mentioned above with a particular attention to mitigate the conflicting interest of the space communication satellites need and paramount importance to preserve at some level the sky darkness.

IAF Space Communications and Navigations Committee (SCAN)

The Space Communications and Navigation Committee examines most recent developments in technology, applications and systems related to fixed and mobile communication services, near-Earth and interplanetary communications, satellite broadcasting, position determination, navigation and timing as well as interactive multimedia provisioning.

As a consequence of the evolution in this field, the SCAN Committee has adapted its symposium structure which was stable for several years to adapt to the changes and newly emerging topics in the space communications and navigation community. The new symposium structure was introduced with the call for papers for the IAC 2020 and the amount of submitted abstracts and accepted papers for this year conference has proven to be adequate.

These topics are dealt with in seven regular sessions, Global Technical Session and one Interactive Presentations session, however, the current global pandemic has meant that all sessions have been transformed into an online format.

Despite the negative impact that the health crisis has had on a variety of industries, there has been little to no impact on the communications industry. In fact, in some areas of the broader telecommunications industry there

has even been an uptick in business as companies change their operations to more virtual modes. This shift in the way business is being conducted has shone a light on the importance of reliable, global telecommunications infrastructure, including the use of satellite services, in order to reach the farthest reaches of the planet.

To that point, and after much fanfare over the last few years, the stakeholders that have placed their bets on constellations of satellites in low-Earth orbit are starting to see elements of their visions coming true. While OneWeb has fallen by the wayside recently after having declared bankruptcy in March, SpaceX and Telesat have been charging ahead with their plans. At the time of writing, SpaceX claims the lead with over 396 of their Starlink satellites orbiting in 18 different planes. SpaceX is even beginning to de-orbit the first versions of their satellites that were used for shake-out operations. By comparison, Telesat has taken a more modest approach to demonstrate their constellation by flying a single satellite that was launched over 2 years ago. They have, instead, focused on lining up the procurement contracts with a three-way competition being held between Airbus Defence and Space, Thales Alenia Space, and Maxar Technologies.

Skeptics of the constellation business point to the last attempt to generate business with such a concept

back in the 1990's from which the world got Iridium – a company that has died and been re-born again at least once – and say that there is still no path to closing the business case. However, today's proponents are banking on cheaper access to space along with COTS-oriented design principles to prove out new business models. Only time will tell who will come out to be the winner this time around and the race is long!

Switching gears to navigation, Europe's Galileo constellation has been making a splash this year as the system enters into full operation. The European Global Navigation Satellite Systems Agency website has been

awash with news about the latest performance of the system and services coming online. In August of this year, ESA announced that it was transitioning from their focus on the first generation of satellites to procuring the second generation, complete with new capabilities to meet the needs of the global market. The key new feature of this next generation of navigation satellite will be its ability to be fully reconfigurable in orbit. Despite all this effort, questions are beginning to circulate around the role the UK will play in the future of the system following the outcome of Brexit. While Galileo may take a hit in the short term, there is little doubt that it will be providing service for many years to come.

IAF Space Education and Outreach Committee (SEOC)

Overview of Year 2020

The Space Education and Outreach Committee (SEOC) promotes the development and delivery of quality learning and outreach opportunities for students, educators, and members of the IAF so that space, science, and technology become better known and are more accessible to the global community.

The SEOC worked throughout 2020 to plan for excellent support to the 71st International Astronautical Congress (IAC) Cyber Space Edition and have begun preparations for the 72nd IAC, which will be held in Dubai, UAE in 2021.

Virtual IAF Spring Meetings

The SEOC participated virtually during the March 2020 IAF Spring Meetings. The committee received a large number of abstracts for its sessions and members selected the best abstracts, which represented diverse authors and topics. These selections would ensure the E1 Space Education and Outreach Symposium and E2 48th Student Conference offered a wide variety of presentations from primary school projects to nation-wide outreach campaigns.

IAC 2020 CyberSpace Edition

The SEOC supported many activities of the IAC, including the regular Next Generation Plenary, the Young Space Leaders (YSL) Recognition Program, and

the Emerging Space Leaders (ESL) Program. The SEOC continued its commitment to more active support of the communications of the IAF, by submitting SEOC related information to the IAF Newsletters, which are distributed within the IAF community.

The Next Generation Summit was held on October 10 and focused on engaging the next generation of space professionals through an online event, which was organized by the Space Generation Advisory Council (SGAC), International Space Education Board (ISEB), and the IAF Committees/SEOC and Workforce Development / Young Professionals Program (WD-YPP). The event was livestreamed and promoted several engaging activities, such as panels, interactive presentations and quizzes, as well as sessions on career trajectories of young professionals. The Zoom and You Tube platforms were used to ensure global participation. Blue Origin sponsored this very successful event.

The Frank J. Malina Astronautics Medal is presented annually to an educator, who has demonstrated excellence in using his/her available resources to promote the study of astronautics and related space sciences. This year, the Malina Medal was awarded to Dr. Peter Martinez, Executive Director of the Secure World Foundation.

General Changes to the Committee

Due to the Covid-19 Pandemic, the SEOC held its two IAF Spring Meetings virtually (see photo). Several nominations were received for membership. They were reviewed and

voted on, then submitted to the IAF for consideration/ approval.

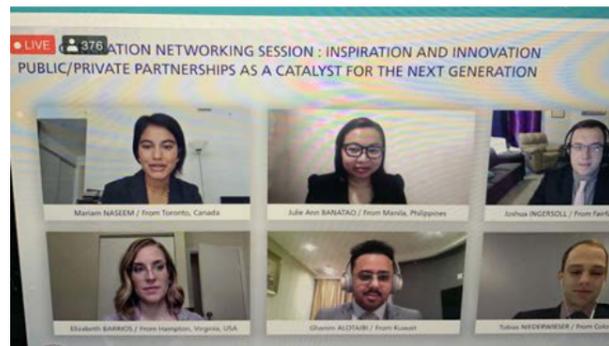


New Developments in the Field of the Committee

The SEOC is making a conscious effort to be more collaborative, by increasing its engagement with stakeholders and sister committees. Thus, we are seeing successful results, which are mutually beneficial. Specifically, members of the SEOC participated in the planning and execution of a very successful NextGen Summit.

The SEOC also supported the planning and execution of a very successful NextGen Networking session, with excellent virtual participation.

Ms. Nancy Wolfson, who was a recently approved SEOC member submitted a technical paper to the 71st IAC, which was selected. It was entitled, “New Worlds – Non-Traditional Space Education and Outreach.



Dr. Camille Alleyne, SEOC Vice Chair for Outreach was recently selected to serve as one of the mentors for the IAF Launchpad Mentorship Program, which was announced on the last day of the 2020 IAC.

In summary, in spite of the challenges associated with the Covid-19 Pandemic, the IAF was able to hold a very successful IAC, of which the SEOC made significant contributions.

IAF Committee on Space Security

Thanks to the efforts of the Committee members and the support of the IAF Secretariat, the Committee welcomed the creation of a dedicated Symposium on Space Security (E9) at the IAC which was introduced at the IAC-2020 CyberSpace Edition in October 2020, a first since the 1st IAC in 1950. This new symposium, which may undergo a name change for IAC-2021 in Dubai (proposed: Security, Stability and Sustainability of Space Activities) to reflect more accurately the span of topics it intends to cover, is currently made up of two joint sessions: E9.1/A6.8 (Policy, legal, institutional and economic aspects of space debris detection, mitigation and removal) and E9.2/D5.4 (Cyber-security threats to space missions and countermeasures to allow them). For the IAC CyberSpace Edition, 48 abstracts were submitted to be considered for this Symposium.

Since one of the objectives of this Committee is to bring under a common umbrella IAC sessions dealing significantly with security issues in a broad sense, it will continue efforts in 2021 to seek additional joint session(s) for IAC-2022 and beyond.

The Committee pursued in 2020 the work started in 2016 regarding a range of security issues addressing economic, business, technical, political, legal through a series of graded risks (1 to 5) using the matrix below. To that end, speakers were invited to contribute via presentations at the March and October Committee meetings.

On March 23 we had the following presentations:

- **SSA, STM and Sustainability Challenges in the New Space Era**, Dan Oltrogge, Director, Center for

Space Standards and Innovation, Analytical Graphics Incorporated (AGI)

- **Acting together for a Safe, Secure and Sustainable Outer Space**, Dr Carine Claeys, Special Envoy for Space, Space Task Force, European External Action Service (EEAS)
- **Space Traffic Management and Salient Challenges in Space Security**, Prof Moriba Jah, Aerospace Engineering and Engineering Mechanics Department, The University of Texas at Austin,

receiving views from a leading company involved in space domain awareness, those of the European Commission about the 3SOS (Secure, Safe and Sustainable Outer Space) initiative, and an academic viewpoint regarding enhanced transparency in space security handling.

On October 8, we had the following presentations:

- **Security and stability in space through transparency**, by Dr. Brien Flewelling, Chief SSA Architect ExoAnalytic Solutions, standing for invited Dr Douglas Hendrix, CEO and co-founder of ExoAnalytic Solutions
- **Building a sustainable STM: the way forward to ICSO, International Civil Space Organization**, by Mr Didier Alary, consultant, SIRIUS Chair researcher,

receiving views from another leading American company involved in tracking space objects and space domain awareness, and an academic viewpoint on the possibility and relevance of setting up an international organization to regulate space traffic.

In 2021, the Committee will continue to work along the same line using the issues/risks matrix approach. By end 2021 the outcome of such method will be discussed and evaluated.

Priority Urgency	Problem to Address	Type of Risk					
		Economic	Business	Technical	Political	Legal	
1	Mega-constellations Cubesats/smallsats, debris issues, cubesats-100kg class in LEO	1	3	5	1	2	12
2	Vulnerabilities of space systems			4	1	1	6
2	Supply chain risks	2	1		1		4
1	Sharing surveillance data		1	1	5	1	8
1	Implications of non-registered space objects and the threats they posed to other space-objects		1	1	4	3	9
2	The need for space weather common standards			4	1		5
1	Spectrum allocation and management including the international/domestic regulatory interface		1	4	1	4	10
2	Maritime Domain Awareness (MDA)				1		1
		3	7	19	15	11	

As Chair of this Committee, I remain concerned by the following: the number of attendees to our meetings varies between 25 to 30, and has been in the same bracket for the last 5 years, with a peak participation beyond 30 at the Washington DC meeting in October 2019. While the Committee lists about 60 members, experts, and friends, less than 50 % show up, whatever the committee meetings are, real or distant. Some

members have never showed up for the last 5 years, despite number of reminders. When the Committee will be renewed in October 2021, we will need to go through a rigorous cleaning of the member's list, dropping those who never showed up over several meetings, and make clear what being member of an IAF Technical Committee means in terms of engagement and attendance.

IAF Space Transportation Committee (STC)

The Space Transportation Committee (STC) addresses Launch Vehicles in service or in development, Launch Services missions + operations and facilities, Upper Stages + Space Transfer + Entry & Landing Systems, Future Space Transportation Systems technologies, Future Space Transportation Systems verification and in-flight experimentation, Small Launchers concepts and operations and Space Transportation Solutions for deep space missions. As a special topic within the IAC 2020 *The CyberSpace Edition* the STC addressed the Emerging Global Space Ventures describing developments in countries that have government or commercial space programs which are new or emerging within the global picture, including space transportation systems or spaceports either under development or recently deployed.

Overview on the past Year

Spring Meeting Paris

The IAF spring meeting was the occasion for the STC members to select the papers for the IAC 2020 and to start the preparation of the IAC 2021 by defining the D2 symposium sessions.

For the first time the spring meeting was not held as a physical meeting but as a virtual meeting following the severe travel restrictions all over the World due to the Covid-19 pandemic. Even so this set-up was very new for all members of the STC between Japan and the United States of America, the situation was perfectly mastered by the STC members using the means provided by the IAF.

All sessions have received a significant number of abstracts so that after a difficult selection process all sessions were completely full with a lot of interesting papers for an oral

presentation during the IAC 2020 in Dubai.

IAC 2020 *The CyberSpace Edition*

Due to The STC finalized the organization of virtual IAC 2020 *The CyberSpace Edition* in frame of the committee meeting held on Tuesday, October 6 2020 as a videoconference. Due to the special environment this year, the number of withdrawn papers and no-shows was significantly higher compared to past years. Nevertheless a lot of interesting and inspiring presentations were uploaded in a video format.

IAC 2021 Dubai

The final D2 symposium program for the IAC 2021 was agreed during the virtual STC symposium meeting prior to the IAC 2020. As described above the description of the session D2.9 was adopted towards the Arabian region as an emerging space region considering also reusability and other innovation. The STC is looking forward to an interesting and fruitful IAF spring meeting in Paris considering the lessons-learned from the IAC 2020. Hopefully the meeting will take place as a physical meeting as in the past as the exchanges between the STC committee members and also with other committee members are much easier and more fruitful in the standard set-up.

General Changes to the Committee

In frame of the IAF spring meeting 1 new member was elected within the STC, Mr. Markus Staudt from MT-Aerospace Germany.

In frame of the IAC 2020 2 new members were elected within the STC: Mrs. Michele Cristina Silva Melo and

Mr. Danilo Sakay from Agência Espacial Brasileira (AEB), Brasil. Therefore, for the first time since several years, the STC has members from South America.

The STC consist today of 61 members, 1 expert and 3 friends.

New Developments in the Field of the Committee

As seen out of the paper submission for the IAC2019 and confirmed once again in the preparation of the IAC2020, 2 main area of interest currently exist within the Space Transportation community: Deep space exploration based on heavy launchers and the need for affordable and flexible transportation solutions for small payloads. For both interest areas the question of re-usability is one of the main points to be answered in future. Such it is one important task for the STC to extend the list of members by members from companies like SpaceX, Blue Origin and

RocketLab as leaders in the field of re-usability. Another important evolution task for the STC is the integration of members from emerging space nations in Arabia. The hope is to achieve in frame of the next IAC in Dubai. Also we lack on Students and Young Professionals in our committee. Otherwise several small European companies working on small launch vehicles have already confirmed their interest to join the STC in Spring 2021: Orbex Space from Scotland, HyImpulse from Germany and Skyrora from England.

In order to support the trend of deep space exploration a special discussion was organised in frame of the IAC 2020 committee meeting with the focus on Chinese plans w.r.t. human space exploration. Dr. Yuguang Yang has given a very interesting description on the ongoing activities in terms of launch vehicles, crew capsules, space station and lunar landing. This presentation has engaged a discussion of other international initiatives in terms of lunar exploration.

IAF Subcommittee on the Global Earth Observation System of Systems (GEOSS)

Overview of the Year

GEOSS supported IAF participation in the 2019 Plenary of the intergovernmental Group on Earth Observations (GEO) as part of GEO Week held from November 4 to 9 in Canberra, Australia. IAF is a Participating Organization in GEO's worldwide effort to build a Global Earth Observation System of Systems (GEOSS). The IAF delegation included Exec Director Christian Feichtinger, VP for Education and Workforce Development Minoo Rathnasabapathy, and two members from the IAF GEOSS Subcommittee, Danielle Wood and Krystal Azelton. Building on the 2015 Mexico City Declaration, GEO Week focused on accelerating the delivery of GEO's Strategic Plan and brought the GEO community together to scale-up the impact of Earth observations. To that end, attending Ministers endorsed the [Canberra Declaration](#) and the GEO Work Program. During the event, Dr. Feichtinger and the GEOSS members set up meetings with potential collaborators including the NASA Applied Sciences Program (see below). GEOSS member Azelton and Feichtinger offered a statement for the proceedings from the IAF prepared by the

Subcommittee, while Wood hosted a technical side event entitled "Earth Observations and Modeling: Dialogue for Added Value and Knowledge" featuring a discussion on the practical challenges of combining measurements and models to understand the Earth system and inform decision making." The IAF delegation recognized future opportunities to share the message of the need for global cooperation on Earth observation applications via the IAF platform for connections across government, the private sector and civil society.

Also at the Canberra GEO Plenary & Ministerial meeting, Christian Feichtinger, Lawrence Friedl, Director of Applied Sciences Program at NASA, and GEOSS members discussed the potential partnering between NASA / GEO / IAF on helping emerging countries to profit from the available experience and knowledge in the use of Earth Observing (EO) data for specific projects. A plan was established to target IAF events to provide a "match-making" opportunity between people from emerging countries and the three organizations to present concrete project ideas and needs, and matching them with experts from the EO community (industry and agencies). A small

group met to follow up on the idea at the fall AGU meeting in San Francisco this past December to discuss the idea and determined that there was much interest in the concept. A plan was established for a first "matchmaking" event at the Dubai IAC now delayed until 2021 due to COVID. It was decided that a broad coalition would become a "core" planning and implementation group. This core group would consist of members of the GEOSS (and EO committee), Emerging Countries Committee, and CLODIN.

Following an approval of the IAF Bureau, the Federation organized a new chapter of its Global Series Conferences: **the Global Space Conference on Climate Change – GLOC 2021**. GLOC will contribute to the global efforts to better understand and battle climate change through the use of space-based services and applications. GLOC 2021 was planned to take place in Oslo, Norway, on 8 - 10 June 2021 and was hosted by the Norwegian Space Agency (NOSA). GEOSS member Barb Ryan was appointed co-chair of the International Programme Committee (IPC). Due to COVID, the conference has been delayed to 2022.

For the IAC2020 conference, GEOSS members organized two events dedicated to highlighting the world International Disaster Charter (IDC). The IDC provides satellite data to those affected by natural or man-made disasters through registered organizations for use in monitoring and response activities. A paper session was devoted to discussing the successes of having invoked the charter and a highlight lecture was arranged with the three founding agencies to discuss the origins of the Charter. Due to the change to the virtual format, these two events were deferred to Dubai for IAC2021.

GEOSS members also coordinated with the Communication Committee to develop a concept for a plenary event at



GEOSS Member Danielle Wood, IAF Exec Director Christian Feichtinger, and VP for Education and Workforce Development Minoo Rathnasabapathy at the GEO Week conference.

the Dubai meeting addressing the contention and the ramifications of the new spectrum allocation. This event was also put on hold until next year.

The GEOSS subcommittee was a co-sponsor of the IAC 2020 Next Generation Plenary. The support included helping select the theme for 2020 (Public Private Partnerships), developing the Plenary proposal, editing the announcement for candidate panelists, reviewing videos submitted by candidate panelists and helping select the final slate. When it was announced that IAC2020 would move to a virtual format, the GEOSS subcommittee also provided recommendations to the leads who were negotiating with the Secretariat on how to adapt. The session was held on Tuesday, October 13th as a Next Generation networking event.

IAF Global Workforce Development Subcommittee

Overview of Year 2020

The Global Workforce Subcommittee is organized jointly by Space Education & Outreach (SEOC) and the Workforce Development & Young Professionals Programme Committees (WD/YPP) of the International Astronautical Federation (IAF).

The Global Workforce Development Sub-Committee is responsible for promoting the development of the worldwide space community in order to foster a highly skilled and motivated workforce, with a special focus on attracting and retaining high caliber and talented young people to face the global challenges of tomorrow.

The Global Workforce Subcommittee is running the dedicated Technical session as part of Space Education and Outreach (SEOC) Symposium. Every two years, this Technical Session is organized in collaboration with the IAF International Project/Programme Management Committee.

Virtual IAF Spring Meetings

The Global Workforce Development Subcommittee participated in the virtual March 2020 IAF Spring Meetings. It is already the tradition that the session "Enabling the Future- Developing Space Workforce" E.1.5 attracts the highest number of abstracts submitted to the SEOC Symposium sessions.

During IAF Spring Meeting Global Workforce Subcommittee supported IAF Vice-President Minoo Rathnasabapathy, Education and Workforce Development, in the development of the IAF Mentorship Program initiative. The Subcommittee held three virtual meetings after IAF Spring meeting (April-June 2020) to discuss the basic ideas of the proposed IAF Mentorship Program.

IAC 2020 CyberSpace Edition

At the 2020 IAC Cyber Space Edition, the Technical session "Enabling the Future- Developing Space Workforce" was very successful with nine video presentations. We have two papers devoted to gender equality discussing various initiatives including the strategy "Space4Women" of the UN OOSA level to support females to choose STEM based education and later pursue careers in the aerospace engineering domain. Based on papers and presentations submitted this year to the Workforce Development Session it is remarkable to see the significant growth of space workforce in non-space fairing nations such as Mauritius, Latin American countries that include Bolivia, Colombia, Peru and Venezuela and number of countries from the African Continent.

Two members of the Subcommittee Elizabeth Barrious and Rian Kobrick supported IAF Vice-President Minoo Rathnasabapathy, Education and Workforce Development, to finalize the IAF Mentorship Program that was successfully launched at the Congress this year. Eight high profile IAF leaders will be identified and selected and mentees will be selected through competitive application process.

It is interesting that mentorship programs are recent trend in aerospace domain. This year two of the Workforce

Development E1.5 session presentations were discussing mentorship programs where school teachers, high school students and students were pairing with industry experts and gaining hands on experience.

General Changes to the Committee

Because of COVID-19 pandemic Global Workforce Development Subcommittee held its two Meetings in Spring and during 2020 Congress Cyber Space edition by video-teleconference. The new members are nominated by the Space Education and Outreach Committee (SEOC) and by the Workforce Development / Young Professional Programme Committee (WD/YPP) and approved by their respective Chairs. Few new members joined the Subcommittee.

New Developments in the Field of the Committee

Pandemic COVID-19 brought interesting challenges to the development of Space Workforce worldwide. Majority of human communications and interactions, educational and training programs are moved into Cyber Space edition. The Subcommittee discussing the organization of an event "Cyber Space Edition of Space Education and Training: Challenges and Lessons Learned".



Congratulations to everyone with very successful IAC 2020 Cyber Space Edition!!!!

IAF Administrative Committees

IAF Honours and Awards Committee (HAC)

Started two years ago upon the request of then IAF President, Dr. J. Y. Le Gall, the in-depth review of the IAF Awards Terms of Reference (ToR) by the HAC has been completed. The IAF now has a complete, consistent and coherent set of ToRs for all of its awards. In addition, the HAC ToRs have also been reviewed and updated.

Ever flexible and ready to accommodate any new event or evolution of the space environment, the HAC has introduced three significant novelties:

First, realizing the ever-increasing team efforts that are nowadays necessary for the success of space research, exploration and systems, the HAC has introduced the possibility for teams to be nominated and awarded for the IAF World Space Award (WSA). Therefore, two separate categories of nominees, individuals and teams can be nominated for the IAF WSA.

Second, the IAF has initiated the creation of the “IAF Excellence in International Cooperation Award” as one of the most prestigious awards of the Federation. This new award will be presented and awarded for the first time during its inaugural Award Ceremony at IAC 2021 in Dubai.

Third, with the aim to play a proactive role in encouraging nominations, especially for the World Space Award, the HAC has created the HAC Search Committee. As a subcommittee of the HAC, the Search Committee is chaired



by Dr Karl Doetsch and will have a broad international representation to support the search and nominations of eligible candidates in different countries.

In appreciation of the great work and commitment of all the HAC members, a big thank you also goes to Dr Seishiro Kibe for his very significant help and support to the committee in these substantial moves as the IAF VP for Honours and Awards.

Dr. Kibe’s VP term has now come to an end and a warm welcome goes to the new IAF VP for Honours and Awards, Anthony Tsougranis from NASA.



IAF Committee on Developing Countries and Emerging Communities (ACDCEC)

At the Bureau Meeting in Washington DC, USA, in October 2019, a decision was taken to transform the existing IAF Working Group for Developing Countries and Emerging Communities into an Administrative Committee for Developing Countries and Emerging Communities (ACDCEC), which demonstrates a greater emphasis being placed on developing countries and emerging communities. It is also expected that synergies will be created by collating the discussions of the various IAF Regional Blocs and channelling these through the ACDCEC directly into the IAF Bureau, which will also ensure that the Bureau has sight of these important developments. The objectives of the Administrative Committee includes the following:

- a) Involve stronger participation of developing countries and emerging nations in IAF activities,
- b) Provide knowledge and expertise support to these countries and communities,
- c) Produce tangible benefits for these countries and communities, and
- d) Cooperate with IAF partners to promote activities relating to these countries and communities.

The ACDCEC comprises of 25 members that are dedicated to advancing the participation and development of developing countries and emerging communities. The Committee has met to discuss and draft an Action Plan that will inform the work of the ACDCEC and in its approach a problem statement has been articulated, which reads as follows:

The IAF has been successful in attracting organisations and experts from the leading space nations, both from the developed and developing world, to its manifold planned events and activities. However, there are many new entrants (developing countries and emerging communities) that have hitherto not been active within the IAF suite of events and activities. The challenge, therefore, remains on how to actively engage and attract these developing countries and emerging communities in a manner that (i) directly supports them in addressing specific challenges that they may be facing, (ii) highlights the associated socio-economic benefits of space applications, and (iii) promotes the benefits of actively participating in IAF events and activities.

The ACDCEC then set about to understand the root causes contributing to the problem statement, and the outcome of this exercise is shown in the schematic in Figure 1.



Figure 1: The root causes relating to the Problem Statement

Four focus groups were then convened to discuss and propose solutions to each of these root causes. The solutions (focus areas) shown schematically in Figure 2 now form part of an approved Action Plan, which will be used by the ACDCEC over the coming years to advance its work.



Figure 2: Focus areas informing the work of the ACDCEC

The Action Plan is framed in a way that ensures it responds to its primary objectives and success will be measured through (i) the increased participation of representatives from developing countries and emerging communities in

IAF activities and initiatives, (ii) the number of targeted events that promotes the benefits of space to developing countries and emerging communities, and (iii) the number of targeted events that helps build capacity in developing countries and emerging communities.

A special GNF, “Bridging the Space Divide for Developing Countries and Emerging Communities”, was developed and hosted during the margins of the 2020 IAC Cyberspace

Edition and was a targeted intervention for showcasing the work of the ACDCEC to the countries and communities it intends to serve, and to draw them into participating in the targeted suite of IAF activities and initiatives to be planned. The work that has been started under this portfolio is vitally important for future developments and initiatives relating to developing countries and emerging communities.

IAF GRULAC Subcommittee

Year’s overview: Since October 2019, the following activities have been undertaken in this committee:

1. Latin American Lunar Program and its development.

In 2018, during IAC2018 in Bremen, the IAF GRULAC launched the Latin American Lunar Program as an extension of the LATCOSMOS program launched in 2017, back in Bremen, 2018, the intention was to engage the countries of the region in lunar exploration programs in order to test and demonstrate their own indigenous technologies.

Leaping forward one year, on IAC2019 in Washington DC, the IAF GRULAC chairman held a press conference to announce the participation of 2 Latin American countries as contractors for a lunar rover property of SpaceBit UK, Ecuador (EXA) and Mexico (Dereum) were selected to develop the technology for a rover that will be launched in 2021 Q3 Astrobotic’s mission to Lacus Mortis on the Moon.

2. GRULAC people joins the effort for the future of interplanetary propulsion

In 2019, the American Institute for Aeronautics and Astronautics (AIAA) co-organized the IAC2019 along with the IAF. One of its technical committees, the Nuclear and Future Flight Propulsion, approached the GRULAC due to their mutual relations with the IAA. The NFFP is a committee studying concepts of current and future propulsion at the frontier of modern science.

On October 24, in a plenary meeting in Washington DC



during IAC2019, the AIAA’s NFFP asks IAF GRULAC’s chairman to join this prestigious TC, who, on December 17 during the TC bi-monthly meeting proposes the creation of a task force with the sole purpose of producing the designs of an engine capable of reaching a top speed of 2% of the speed of light, in the next 10 years.

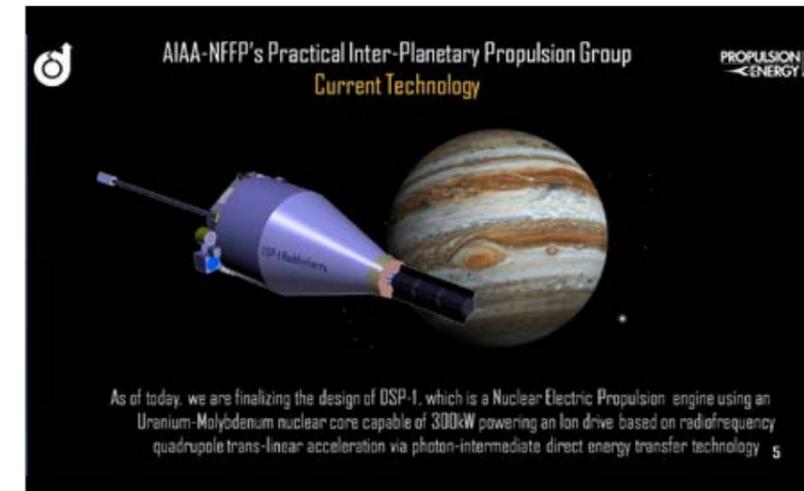
The idea is that this development will allow mankind to reach the worlds of the solar system in a practical time frame, not having to wait years but just weeks to travel to those worlds, thus opening up the practical colonization of the solar system to humanity.

On January 15/2020, the task force is created as the **Practical Interplanetary Propulsion Group** and IAF GRULAC’s chairman is chosen as its first chairman. By August 2020, the task force presented and theoretically validated the results of its first design, the DSP-1 (Deep

Space Probe-1) capable of achieving 509 km/s, enough to reach Jupiter orbit in **6 weeks**.

3. Latin American Lunar Program and its development.

The first all-Latin-Americans crewed mission, ESAA-01, has selected its definitive crew roster and is fully funded by the EXA, although training activities under the ASA/T program and the general schedule have been hit by the pandemic, the program continues with the academic part of the training activities on schedule, 4 countries will fly in this first mission: Costa Rica, Ecuador, Mexico and United States; There are 2 PhDs, one MSc and one MEd. on the roster. All of them, except for the mission commander, are Professors, each of them will carry a set of payloads from their countries



IAF Industry Relations Committee

In light of the ongoing Covid-19 pandemic, when physical meetings are near-impossible, the organization of the 71st International Astronautical Congress, IAC 2020, as a Cyberspace Edition, was of major importance for the Industry Relations Committee, in order to continue providing the entire space community with an exciting and successful Industry Day. The flexibility and the commitment demonstrated by members of the Industry Relations Committee, in planning this next edition of Industry Day was remarkable. Through bi-weekly teleconferences and continuous exchanges, the Committee was able to shape once again a programme that represented a highlight for this edition of the Congress.



One of the most successful initiatives launched by the IRC kicked-off the 2020 edition of Industry Day: the **IAF Excellence in Industry Award** Ceremony. This Award is intended to distinguish an industry organization, member or non-member of the IAF, for introducing innovative space technologies to the global marketplace and being recognized throughout space industry for successfully executing a landmark space mission. This year, this prestigious award has been awarded to **Airbus Defence and Space** for its excellent achievements over the years, and in particular in 2019, for managing to deliver world-beating space technology to customers around the world: from the 2400 spacecraft equipment's, to the 18 satellites successfully placed in orbit. Amongst some of the key achievements of Airbus, worth of mention are the successful hot firing test conducted in the US on the Orion ESM, the delivery of the active antenna for Quantum – leading the way to fully-flexible satellites – and the shipping of Solar Orbiter to its launch site and the start of testing for the Sentinel-6A ocean-monitoring satellite, and for the Rosalind Franklin ExoMars rover. Aside from the technical achievements, Airbus distinguished itself for the impressive efforts put in creating a more sustainable space environment, by actively supporting university research, by ensuring that its products meet space regulations to avoid generation of debris in orbit, and by ensuring a diverse and positive work environment for its employees all over its 180 sites worldwide.

The programme for this edition of Industry Day, featured one main Plenary Session on the topic of “*Small and*

Medium Sized Companies - Strategies for Survival and Recovery in the Age of COVID-19” where company CFO’s, leading financial advisers and global economists discussed the financial strategies and practices of SMEs that were able to weather the economic storm resulting from COVID-19. This session also reviewed unsuccessful strategies that led to the demise of other companies, and assessed the current situation of the marketplace and finally, tried to identify key opportunities for growth and expansion.



The programme for Industry Day also included one Highlight Lecture, organized by Space Logistics LLC, a subsidiary company of Northrop Grumman, on the “*MEV 1: The World’s First Commercial On-Orbit Servicing Mission*”, reviewing the history of the mission, illustrating the climatic event of the first docking between two satellites, and explored what this means for the future of space activities.

IAF International Project/Programme Management Committee (IPMC)

It is my great pleasure as Chairman of the International Project/Programme Management Committee (IPMC) to provide highlights of our activities, which have focused on an exchange of information, mutually beneficial activities, and sharing of best practices. Our goal is to enhance the management of space programs and projects through training and curriculum development, knowledge sharing, lessons learned, and related research activities.

IAC 2020 IPMC Membership Status – This year we welcomed new members Anthony Murfett, Deputy Head, Australian Space Agency and Steve Angelillo, Deputy Director, NASA Academy of Program/Project & Engineering Leadership Knowledge Services (APPELKS). The IPMC held two virtual meetings, the 2020 Spring IPMC on 25 March 2020 and the fall session on 8 October 2020.

Mr. Roger Forsgren, NASA Chief Knowledge Officer and IPMC Chair is retiring at the end of this year and has relinquished his IPMC duties to Ms. Petra Georgi, DLR. Ms. Georgi, IPMC Vice-Chair, has accepted the duties of IPMC Chair (acting) and plans to hold an official vote at the 2021 IAF IPMC meeting in accordance with the General Terms of Reference for Administrative Committees.

Mr. Forsgren thanks all members for bringing their expertise and experience to the IPMC and engaging in constructive and open exchanges throughout the past few years via special studies, International Project Management courses, and Young Professional Workshops. Roger would also like to thank the Vice-Chairs for their leadership and continuous support.

International Project Management (IPM) Course managed by NASA in collaboration with IPMC – This course provides project practitioners with an understanding of cultural challenges, legal concerns, and teaming issues that are likely to be encountered when working with international partners. Two distinct facets of successful international project management are addressed: technical knowledge and cultural understanding. Through lectures, small group discussions, hands-on practical exercises, and case studies, participants gain insight into the characteristics

of international teaming that have the potential to make or break a project.

- IPM #24 (23-28 February 2020) – The course was held at the Kennedy Space Center Visitor’s Complex, Center for Space Education. 55 participants (14 International and 41 NASA) attended the course from 6 countries.
- IPM #25 (19-24 July 2020) and IPMC #26 (21-26 February 2021) – Both offerings were cancelled due to the COVID-19 global pandemic.
- 2021 IPM Course Dates: IPM #27: July 2021, Kennedy Space Center Visitor’s Complex, Center for Space Education

2020 IPMC Virtual Young Professionals Workshop – On 11 October 2020 Ms. Eleonora Zeminiani facilitated two virtual workshops with 31 delegates, with an average age of 30.3 years (45% females and 55% males) from 14 countries (Angola, Australia, Belgium, Benin, Canada, France, Germany, India, Italy, Japan, Kuwait, Romania, UK, and the United States):

- **Theme 1:** How do fragmented, remote, delocalized, and virtual teams affect the way space projects are managed?
- **Theme 2:** Which are the key leadership and planning aspects of PM in a time of crisis?
- **Theme 3:** What is the role of space programs, and the space community at large, in shaping the societal impacts of forced social isolation and economic lockdown?
- **Theme 4:** What is the impact of the current international crisis for the future of space projects, and how can PMs shape this impact into successful progress, ensuring acceptable risk and pioneering a new way forward?



The IPMC would like to thank the IPMC Workshop Organizing Committee (WOC) for their dedication and outstanding work on the 2020 IPMC Young Professional Workshop. We owe much gratitude to Eleonora Zeminiani, IPMC Young Professionals Project Manager, for the structure of this year's program and for organizing the virtual workshop.

WOC members:

- Linn Boldt-Christmas – Communications Manager
- Mark Fittock – Operations Manager
- Birgit Hartman – Strategy and Implementation Manager
- Andreas Lyder Pedersen – Delegates Manager
- Eleonora Zeminiani – Project Manager

part of these formats and in addition to the above-mentioned webinars the committee arranged a "Scientific Writing Series" with the aim of educating YPs and even the general public on how to write and submit abstracts, prepare manuscripts and present their papers at the IAC. With these series that we plan to continue annually in one form or another, we want to help new congress attendees in their first steps.

for the YPP experience that is part of the IAC for more than a decade. To achieve the wealth of different topics, the WD/YPP committee regularly works with other committees like SEOC, GEOSS, EIC, and IPMC, to name just a few.

Developments related to IAC 2020

For the IAC 2020, the CyberSpace Edition, the IAF WD-YPP Committee has worked with the Space Education and Outreach Committee, as well as the Space Generation Advisory Council, and the International Space Education Board to organize the NextGen Summit on the Saturday prior to IAC.

Together we organized a four-hour live event, that was a big success. The WD/YPP portion was called "Saturday Space Live" and combined video snippets of committee members that were sent in beforehand, live polls and interaction with the audience, as well as a panel that provided insights into how we all contribute to the space community. A replay of the event can be viewed on the IAF YouTube channel: <https://www.youtube.com/watch?v=1AWhCOIlgS4>

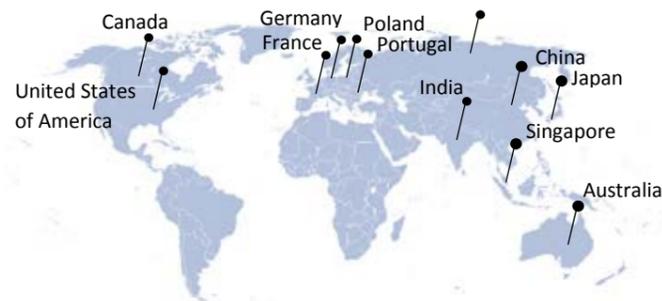
The overall committee consists of four different teams:



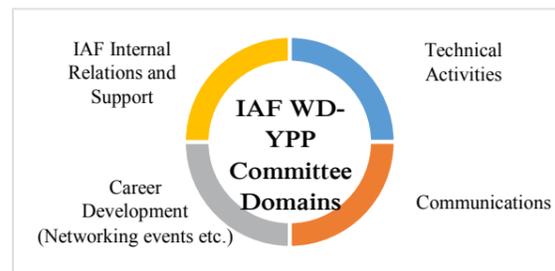
Each committee member contributes to at least one of those four teams. Together the teams are responsible

IAF Workforce Development-Young Professionals Programme Committee (WD-YPP)

WD-YPP Committee Highlight Report 2020	
Committee	IAF Workforce Development-Young Professionals Programme Committee
Goal/Motive	Workforce development, career development and guidance to young professionals from international space community.
Leadership	One Chair and Four Vice Chairs
IAF Information	http://www.iafastro.org/committees/workforce-development-young-professionals-programme-committee-wd-ypp/



Members from around the world (Diversity)



Each domain is taken care by its vice chair

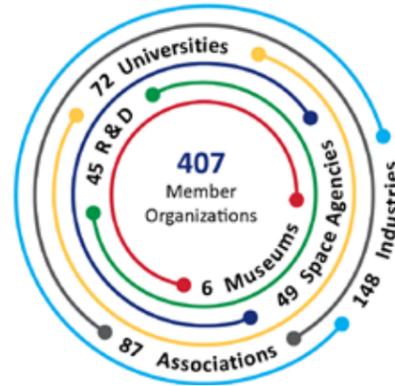
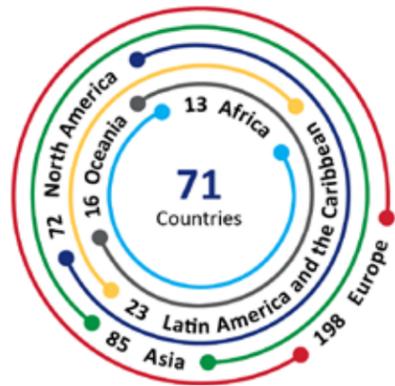
An Overview of the Year

The IAF Workforce Development-Young Professionals Programme Committee has continued to work throughout the year to create a high quality programme, despite the impacts of the COVID-19 pandemic. Our committee generally holds virtual meetings throughout the year, but this year all meetings were virtual, for obvious reasons. To still being able to organize events for Young Professionals, we have increased our online offerings. Our teams organized

several events on our new YouTube channel (<https://www.youtube.com/channel/UCDFhQ7uOvflarTrO53fxuNg>). The Career Development team held one panel discussions on the impacts of COVID-19 in different parts of the space industry, and the committee organized a series of events with information on how to prepare abstract, paper, and presentation for the IAC.

The Communications team continued to send out monthly news blasts, and created a new quarterly YP newsletter that went out at the end of 2019 for the first time. As

IAF Membership Initiatives



The IAF is an outstanding network of 407 members from 71 countries, most of them reside in Europe (198), some in North America (72), some other in Latin America (23), but they also come from Oceania (16) and Africa (13). We strongly believe that every member contributes directly to the growth and success of the IAF because they have the most variate backgrounds, we have 148 Industries entities, 87 Associations, 72 Universities, 45 Research and Development organizations and 6 Space Museums. This allows us to develop one of the world's largest network between all the people of the Space Community. The Federation is also constantly growing, this year we welcomed 19 new member and the last five years saw a considerable increase, with the addition of 140 new members, 42 only in 2019, a record number of new members. But it is also interesting to see that 19 of our 407 members are with us since the 1950s!

Being a Member in the Federation means being a part of an active network promoting dialogue on ideas and issues critical to the public and to research communities. The force that drives the IAF is its members. IAF Members are truly the heart of the organization that is why the IAF has focused most of its promotional activities in 2020 in promoting its Members. The IAF has created an advert promoting all its IAF Members logo that has been used in all IAF publications. A video on IAF Membership was shared on IAF social media channels. The IAF also used the occasion of the 7th International Astronautical Congress – The CyberSpace Edition to hold an IAF booth where IAF Members were showcased through a newly created [IAF Members Handbook](#).

The forced division of the past months made us even more conscious of the importance of the fundamental

and original role of the Federation: **Connecting @ll space people**. In a year where the world was physically divided, we did our best to foster our sense of community. Our brand-new IAF Members Handbook and our IAF Proud Members logo aim to not only give further visibility to each single organization that decided to join the Federation, but strengthen the connections between those organizations by making explicit their openness and will to cooperate through the Federation.

The **IAF Members Handbook** was “designed” to shortly presents each of our members by giving basic information of the various organizations and by providing the general public with the basic contact details of of each IAF member. The goal is that of showcasing our members and easing the contacts within the whole space community.

Specularly, when share by the member organizations, the **IAF Proud Member** logo will immediately define them as part of the Federation, and, thus, part of one of the biggest global space networks. Signalling their will to connect, share and grow together with the rest of the community.

2020 has been a difficult year for many of us, it forced us all to be apart and to look for new solutions and possibilities. Re-thinking what we considered granted. However, the past few months have increased our will to work together, to cooperate, and we hope that all the new tools designed to reaffirm the IAF as a strong and wide network will be welcomed by all of you. Please, take full advantage of the new website, the Handbook, the advert and all the new initiatives we developed over the past months, and do not hesitate to get in touch with us to be even more engaged within the Federation.





THE INTERNATIONAL ASTRONAUTICAL FEDERATION

Connecting @ll Space People

WHO WE ARE

Founded in 1951, the International Astronautical Federation (IAF) is the world's leading space advocacy body with over 407 members from 71 countries including all leading agencies, space companies, industries, research institutions, universities, societies, associations, institutes and museums worldwide.

Following its motto *"Connecting @ll Space People"* and its vision of *"a space-faring world cooperating for the benefit of humanity"*, the Federation advances knowledge about space, supporting the development and application of space assets by promoting global cooperation. As organizer of the annual International Astronautical Congress (IAC) as well as other thematic conferences and workshops, the IAF actively encourages the development of space activities for peaceful purposes and supports the dissemination of scientific and technical information related to space.

WHAT WE DO

- Promoting cooperation
- Advancing international development
- Sharing knowledge
- Recognizing achievements
- Preparing the workforce of tomorrow
- Raising awareness

The IAF Secretariat



BECOME A MEMBER

Membership in the IAF is open to all companies and organizations working in space-related fields.

If you are interested in becoming a member, please complete the "Application for IAF Membership" form (which can be found on our website: <http://www.iafastro.org/membership>) and send it together with your company's by-law, statutes and any other requested material to the **IAF Secretariat**.

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IAF Alliance Programme Partners:



IAF EVENTS 2021

Connecting @ll Space People



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