Space Generation Fusion Forum 2023

Colorado Springs, Colorado, U.S.A
April 14-17, 2023

In support of the United Nations Programme
on Space Applications

c/o European Space Policy Institute (ESPI)
Schwarzenbergplatz 16, TOP 1
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Foreword from the Event Managers

SGFF 2023 once again brought together an incredibly talented group of 90 delegates from across the world to share their knowledge on the future of the space industry. Spanning interests of engineering, policy, business, science, law, and so much more, these delegates were able to network with one another and the most prominent leaders from the space sector to "fuse" their broad range of opinions towards recommendations for a better future. SGFF 2023 saw space agency leads, military generals, professors, CEOs, and startup founders present their vision for space and the actions that our delegates could take to help make those visions a reality. Breakout sessions focused on pressing issues from in-orbit servicing to climate change to mission planning for expeditions throughout the solar system. Building on the shoulders of past SGFF events, this year's conference once again showed the power that SGAC and its global community can have to shape the next generation of leaders in the global space ecosystem.

Simon Shuham
SGFF Manager

Madison Telles
SGFF Deputy Manager

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Space Generation Fusion Forum Overview

Held annually at the scenic Broadmoor Resort in Colorado Springs, Colorado, U.S.A., in conjunction with the Space Symposium, the Space Generation Fusion Forum (SGFF) is a multi-day, high-intensity, fast-paced professional development and networking event focused on the global space industry. Students and young professionals from around the world, who are working and participating in all facets of the space community, apply to attend SGFF each year.

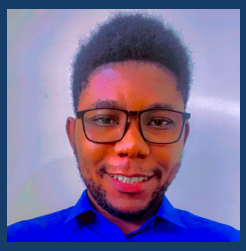
Through breakout sessions, expert panels, keynote presentations, and speed networking, SGFF delegates will “fuse” their unique perspectives and backgrounds to formulate solutions to global problems of interest and importance to the space community. By attending SGFF, delegates will learn from each other and from experts, share their knowledge, network with fellow students and young professionals in the space industry, and meet international leaders in the space field.

All output and content produced by the discussions held during the Space Generation Fusion Forum are compiled into a report for the United Nations Committee on the Peaceful Uses of Outer Space. This report is presented at the Committee’s annual General Assembly and at other conferences around the world.

Organising Team

Simon Shuham
SGFF Manager

Madison Telles
SGFF Deputy Manager



Abdul Sesay
Delegates Coordinator

China Hagström
Delegates Coordinator

Alex Drozda
Delegates Coordinator

Danielle Bierman
Delegates Coordinator

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Lily Allen
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Sapna Rao
Communications Coordinator

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Abbhinav Muralidharan
Programs Coordinator

Michael Barton
Programs Coordinator

Programme

Saturday, April 15th (Mountain Daylight Time GMT -6)

Time	Programme	Speaker / Sponsor
10:00 AM - 10:15 AM	Opening Remarks	Simon Shuham – SGAC
10:15 AM - 10:30 AM	Welcome from the Space Foundation	Steve Eisenhart- Space Foundation
10:30 AM - 11:00 AM	Keynote	AC Charania – NASA
11:00 AM - 11:40 AM	Lunch Keynote	Blake Bullock – Northrop Grumman
11:40 AM - 12:30 PM	Lunch Service and Networking	
12:30 PM - 1:00 PM	Keynote	SGAC Update
1:00 PM - 1:40 PM	Panel: Military-Commercial Space	Anna Gunn-Gulkin – US Space Force Barbara Braun – Aerospace Corporation Robert Kroeger – NATO Lt Col Walter McMillian – SpaceWERX
1:40 PM - 1:50 PM	Break	
1:50 PM - 3:50 PM	Breakout Sessions	

Time	Programme	Speaker / Sponsor
3:50 PM - 4:10 PM	Break	
4:10 PM - 5:10 PM	Panel: Space Sustainability	Josh Wolny – US State Department Jeff Schloemer – Astroscale Kevin O'Connell – Privateer Rich Dalbello – Office of Space Commerce James Bultitude – Orbit Fab
5:10 PM - 5:30 PM	Lightning Talk	Jordan Marks – Ball Aerospace
5:30 PM - 5:50 PM	Lightning Talk	Lynna McGrath – NASA SCaN
5:55 PM - 6:00 PM	Closing Remarks	

Programme

Sunday, April 16th (Mountain Daylight Time GMT -6)

Time	Programme	Speaker / Sponsor
9:00 AM - 9:10 AM	Opening Remarks	Madison Telles – SGAC
9:10 AM - 10:10 AM	Panel: Human Space Exploration	Darcy Elburn – NASA Ariel Ekblaw – Aurelia Institute Mark Kinnersly – Airbus U.S. Rick Mastracchio – Northrop Grumman Douglas Terrier – NASA JSC
10:10 AM - 10:30 AM	Break	
10:30 AM - 11:40 AM	Breakout Sessions	
11:40 AM - 12:10 PM	Lunch Service	
12:10 PM - 12:50 PM	Lunch Keynote	Melissa Sampson – Lockheed Martin
12:50 PM - 1:10 PM	Break	
1:10 PM - 2:00 PM	Breakout Sessions	
2:00 PM - 2:20 PM	Lightning Talk	Lori Garver – Earthrise Alliance

Time	Programme	Speaker / Sponsor
2:20 PM - 2:40 PM	Fireside Chat: Workforce Development	Dr. Ken Davidian – International Space University Via Van Liew – Aerospace Corporation Dr. Andrew Aldrin – Embry Riddle University Debra Facktor – Airbus U.S. Marcae Riggs – US Space Force
2:40 PM - 3:40 PM	Panel: Science and Exploration	Dr. Jason Kaliari – JHU APL Dr. Christy Edwards – Lockheed Martin Nicki Rayl – NASA Mariam Naseem – University of Maryland
3:40 PM - 4:20 PM	Break	
4:20 PM - 5:40 PM	Speed Networking Session	
5:40 PM - 5:45 PM	Closing Remarks	Madison Telles – SGAC

Programme

Monday, April 17th (Mountain Daylight Time GMT -6)

Time	Programme	Speaker / Sponsor
8:15 AM - 8:20 AM	Opening Remarks	Simon Shuham – SGAC
8:20 AM - 8:30 AM	Scholarship Presentation	Simon Shuham – SGAC
8:30 AM - 8:50 AM	Lightning Talk	Matt Desch – Iridium
8:50 AM - 9:10 AM	Lightning Talk	Nujoud Merancy – NASA
9:10 AM - 9:30 AM	Break	
9:30 AM - 9:45 AM	Opportunities with the IAF	Clay Mowry – IAF and Voyager Space Holdings
9:45 AM - 10:45 AM	Panel: Heads of Agency	Clay Mowry – IAF Dr. Josef Aschbacher – ESA Lisa Campbell – CSA Giorgio Saccoccia – ISA Dr. Walther Pelzer – DLR Rodrigo da Costa – EUSPA
10:45 AM - 11:00 AM	Club for the Future	General John Hyten
11:00 AM - 11:15 AM	Opportunities with SGAC	Davide Petrillo – SGAC
11:15 AM - 11:30 AM	Closing Remarks and Team Thanks	Simon Shuham and Madison Telles – SGAC

Garden of the Gods Walk 5:00 PM - 6:45 PM

An optional casual hike led by the SGFF team for delegates who arrived early into Colorado Springs. The hike took place in the stunning scenery at the Garden of the Gods Natural National Landmark in Colorado Springs, Colorado.

Opening Reception 7:00 PM - 9:00 PM

Upon arrival to Colorado Springs, delegates were welcomed by an opening reception at Ivywild School brewery. There, delegates were able to network, get acquainted with the Colorado Springs area, and get to know each other in an informal setting before the first day of the conference.

Sponsored by:

BLUE ORIGIN

Saturday Reception 8:00 PM

Michael Edmonds, Senior Vice President at Blue Origin, kicked off the Saturday reception with an opening speech. The evening unfolded with dinner, drinks, and networking at Phantom Canyon brewery, where sponsors, speakers, and fellow delegates had the opportunity to connect and engage in conversations .

Sponsored by:

REDWIRE

SPACE FOUNDATION

Euroconsult

SGAC Symposium Reception 5:00 PM

The Symposium afternoon reception, sponsored by Redwire, Euroconsult, and Space Foundation focused on NewGen attendees. The event included appetizers, caricature artists, drinks, and a pin-the-tail game presented by Euroconsult.

Breakout Session : NASA

NASA Exploration: Moon to Mars Objectives

Supported by:

Participants in this breakout session reviewed a portion of NASA's Moon to Mars Objectives, engaged in discussions about its content, and provided feedback to NASA. The working group collaborated to identify opportunities for iterative improvements, strategic communications, and increased accessibility of the objectives for an international and intergenerational audience.

Main Objectives

1. Spread awareness on the Moon to Mars objectives.
2. Collect feedback on the understanding and interpretation of the objectives.
3. Collect feedback on the current value and usability of these objectives.

Subject Matter Experts

Darcy Elburn | Communications Integration Manager for the Moon to Mars Program Office at NASA HQ

Clark Esty | Artemis III Integration Lead for the Mission Analysis and Integrated Assessments (MAIA) Group at NASA

Amelia Batcha| Executive Officer to the Associate Administrator Exploration Systems Development Mission Directorate at NASA

Ruth Siboni | Chief of Staff for the Moon to Mars Program Office in the Exploration Systems Development Mission Directorate at NASA

Samantha Rawlins | Graduate Research Assistant at University of Alabama in Huntsville

Moderator

Newsha Haghgoo | Master's Student at University of Toronto

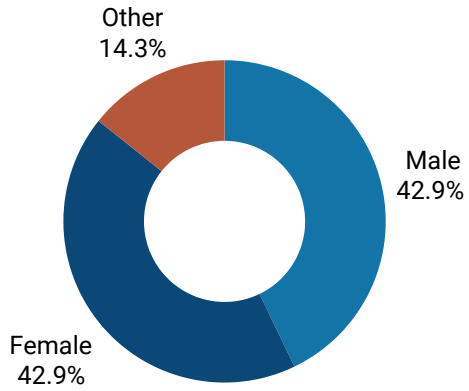
Rapporteur

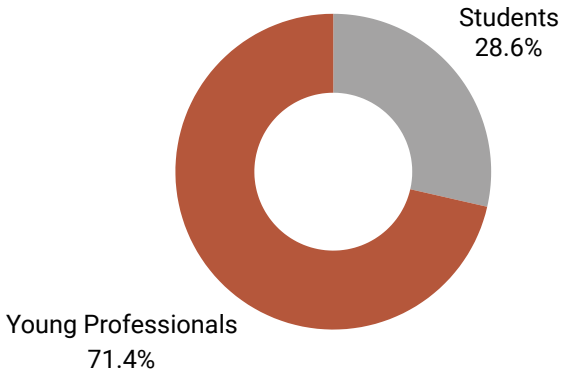
Marcos Eduardo Rojas Ramirez | Associate Systems, Product & PLM Engineer at Capgemini

Rapporteur

Statistics

14 Delegates
5 Nationalities





Questions

1. What section of the objectives is of most interest to you??
2. How would you execute reaching these objectives if you had unlimited resources?
3. What are the biggest challenges on Earth that might be overcome by fulfilling these objectives?

Answers

1. The conversation over this question showed consistent interest from the audience in all the objectives. However, the discussion demonstrated that the audience was more concerned about how the objectives were expected to be implemented.
2. Overall, the answers to this question highlighted certain interests and concerns of the audience on what should be the priorities and drivers for the successful implementation of the objectives.
3. This question allowed the audience to provide their opinion on the different methods of communication and expected challenges as the objectives are shared with diverse audiences. Overall, the discussion led to the conclusion that a solid next step for NASA should be disseminating information that enabled simple and efficient access to national and foreign entities to support the Artemis Program.

Recommendations

Recommendations to the Space Generation Advisory Council and the United Nations Committee on the Peaceful Uses of Outer Space

- The United Nations could work with NASA and its partners in defining how the Moon to Mars objectives can be used to achieve the UN sustainable development goals.
- The United Nations should work with NASA and its partners to ensure that the policy required to collaborate within the framework of the Moon to Mars objectives is defined and verified.
- The United Nations should work with NASA and its partners to spread awareness of the Moon to Mars objectives and encourage nations to take an interest in contributing to the objectives.

Recommendations to the Sponsor(s)/Partner(s) and/or the Industry at large

- NASA can translate the objectives in order to expand even more the audience that is able to access and understand the Moon to mars objectives.
- NASA can begin to work with its partners into linking their capabilities and expertise with the objectives.
- NASA should create simple and efficient documentation that allows entities to better understand the different ways in which they can get support from NASA in case they are interested in supporting the accomplishment of certain objectives.
- NASA should ensure that funding opportunities are available and accessible to all entities wanting to contribute to the moon and Mars objectives.

Breakout Session : LOCKHEED MARTIN

Climate and Weather Intelligence

Supported by:

LOCKHEED MARTIN

This Lockheed Martin Breakout Session focused on Climate and Weather Intelligence, emphasizing the delegates' perspectives on the focus area. The core of Climate and Weather Intelligence lies in leveraging data, analysis, and AI/ML techniques to generate insights about climate and weather events. The working group aimed at exploring and discussing concerns delegates hold and determined the type of intelligence that can be collected to address these concerns.

Main Objectives

1. Determine the climate and/or weather events that should be focused on for different regions.
2. Assess the climate and/or weather events that would be addressed in the next 1 year, 5 years, and 10 years.
3. Discuss methods in which data can be used to address these problematic events.

Subject Matter Experts

Sajit Jumani | Business Development and Finance at GEOshare (Lockheed Martin)

Michael Gauthier | Manager for Weather and Earth Science at Lockheed Martin

Sapna Rao | Senior Systems Engineer

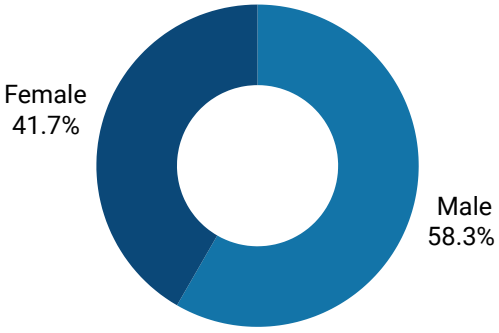
Moderator

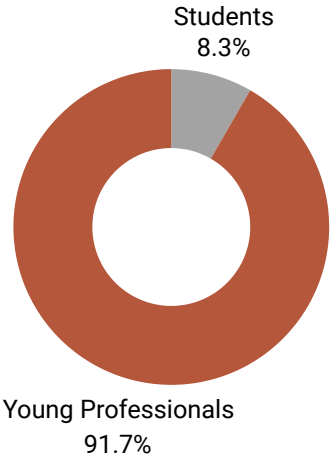
Antonio Stark | Asia-Pacific Regional Coordinator at SGAC

Rapporteur

Statistics

12 Delegates
6 Nationalities





Questions

1. What are some climate and/or weather events that impact you now and what are some that may impact you in the future in the next year?
2. How about the next 5 years?
3. How about the next 10 years?
4. What additional information about these events can reduce their impacts?
5. What are some data sources available and who owns them?

Answers

1. Currently, the impact of climate and weather events is evident in the form of wildfires, floods, and droughts. They will continue to represent problems in the next year and will increase in severity.
2. In the next 5 years these challenges will get heightened and we will start to witness longer-term impacts such as sea levels starting to rise and extended droughts/flooding.
3. In the next 10 years farms will be severely impacted and several regions of the world will be submerged due to rising sea levels. The world might be severely impacted.
4. There are ground and space based data sources that currently exist around IR data, topography, weather, and climate. Instead of additional sensors, the proposal is to leverage technology to better analyze existing data to produce insights.
5. Most data is owned by space agencies but is open source, thus, available everywhere. The interesting addition would be to produce analysis from existing data to produce new insights, especially using AI/ML.

Recommendations

Recommendations to the Space Generation Advisory Council and the United Nations Committee on the Peaceful Uses of Outer Space

To the UN: Support the analysis of data and sharing data internationally by promoting an open source database and code repository.
To SGAC: Create standards for measuring environmental impacts to better track and compare the impacts of different countries. Publish a paper on these standards to present at conferences to communicate what can be done.
To the UN: Provide recommendations for countries to adhere to environmental impact standards to help mitigate the root of climate change.

Recommendations to the Sponsor(s)/Partner(s) and/or the Industry at large

Industry should aim to make data and analysis tools open source and available to the international domain. This includes making these products understandable by all.
Industry should continue to grow and innovate in the intelligence domain to help tackle weather and climate impacts.

Breakout Session : NORTHROP GRUMMAN

Satellite Servicing

Supported by:

NORTHROP GRUMMAN

The first satellite servicing mission took place in 1984 when astronauts manually repaired the Solar Max spacecraft. However today, 39 years later, robotic satellite servicing remains a novelty, facing obstacles in tech maturity, prohibitive costs, commercial adoption, and regulatory congestion. The objective of this year's Northrop Grumman Breakout Session on Satellite Servicing was to discuss how the space ecosystem/economy would change if satellite servicing between two space objects became a mainstream capability. If these capabilities were readily available today, the most meaningful advantage to operators would be dramatically increased flexibility in their operations. Once available at scale, satellite servicing will improve the economics of the orbital economy as a whole, opening doors to new players and enabling new use-cases. The technologies underlying these mission types enable life extension of satellites, ability to upgrade assets already in orbit, debris cleanup, in-space manufacturing/assembly, orbit adjustment, asteroid mining or re-direct, and much more both in LEO and far beyond where humans have explored.

Main Objectives

1. Discuss how making satellite servicing mainstream would change the space ecosystem/economy.
2. Delegates take away an understanding and ability to explain the importance of satellite servicing.
3. Identify what future milestones or missions in space will need some form of satellite servicing to be successful.

Subject Matter Experts

Lauren Smith | Program Manager, Satellite Servicing Operating Unit at Northrop Grumman

Danielle Bierman | SGFF 2023 Organizing Team & Delegates Team at SGAC

Moderator

Ryan Udell | Systems Engineer (Satellite Systems Engineering Rotation Program) at Boeing

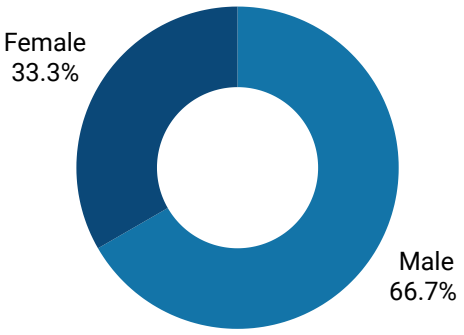
Rapporteur

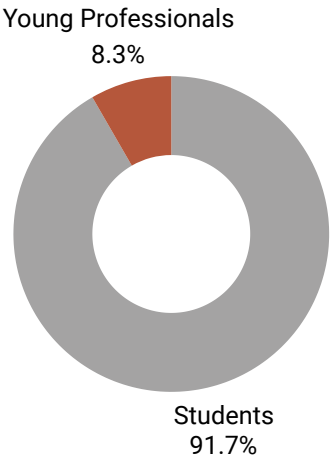
Alex Coultrup | Director of LEO Business & Public Policy at Starfish Space

Rapporteur

Statistics

12 Delegates
4 Nationalities





Questions

1. What is satellite servicing? What is constituted as satellite servicing?
2. If satellite servicing capabilities were readily available today, how would the current space ecosystem be different?
3. What future milestones or missions in space will need or at least benefit from some form of satellite servicing to be successful?
4. Is satellite servicing important? Why or why not?

Answers

Answer 1

Satellite servicing is defined as the in-space interaction of any human-made object with any other space object, human-made or otherwise. Examples of this include but are not limited to, re-fueling, life extension, vehicle/payload upgrades, debris cleanup, and on-orbit manufacturing/assembly. Historically, satellite servicing has been performed by humans via spacewalks such as on the Hubble Space Telescope and IntelSat. Programs such as NG's Mission Extensive Vehicle (MEV) demonstrate that this capability is evolving and that is possible to perform these highly complex and risky operations autonomously through use of robotics. Other commercial companies are also pioneering these capabilities, including Starfish Space, Astroscale, and ClearSpace. Satellite servicing is a new, evolving, and disruptive technology.

Answer 2

If satellite servicing capabilities were readily available today, it would afford remarkable flexibility to the processes of planning, design/build, and operation of space vehicles. Customers can choose to extend the life of their current assets or upgrade the technology on-orbit, rather than launching replacement infrastructure. New use cases for operators would include relocation and re-tasking of satellites once the primary mission is complete, "reanimating" spacecraft out of graveyard orbit, and in-space assembly, manufacturing, and maneuver of assets. The future of policy that governs this emerging industry segment ought to accommodate the variety of use cases possible by satellite servicing vehicles, and enable rapid decision making, and smooth movement from one operation to the next. Commercial satellite servicing capabilities' entry to market should not be delayed by ongoing policy deliberation - rather policymakers should seek and incorporate input from satellite servicing providers as they modernize licensing, spectrum allocation, and governance frameworks.

Answer 3

The activity of satellite servicing is enabled by the core technologies of rendezvous, proximity operations, and docking (RPOD). RPOD capabilities can be applied to a variety of use cases, enabling new missions including Orbit change, modular upgrades to hardware, End of Life Disposal (EOL-D), Repurposing of existing hardware into new assets, relocation of assets to new orbits, in-space assembly, in-space Manufacturing, and acquisition/movement of space-derived resources.

Answers

Answer 4

Fundamentally, satellite servicing is important because it is an enabling technology that will open doors to a wide array of future operations in space. These capabilities will enable accelerated action in solving the industry's biggest challenges today, including as space debris remediation, protecting national security assets, enabling deep space exploration through in-space assembly and manufacturing, and even mining of asteroids for research and utilization of space resources. These new mission types will directly contribute to economic growth on Earth and can protect valuable assets already in place (GPS and weather satellites, for example), preserving and improving modern standards of living worldwide. This working group also acknowledged the inherently dual-use applications of satellite servicing technology and identified the continued development of norms and incentives for geopolitically stabilizing behavior as a key gap for future analysis and development.

Recommendations

Recommendations to the Space Generation Advisory Council and the United Nations Committee on the Peaceful Uses of Outer Space

- UN COPUOS should facilitate regular (2x/year) working groups on developing satellite servicing norms and incentives, and encourage that industry be the leader of these discussions.
- UN COPUOS should discourage implementation of hardware standards for satellite servicing. Rather, future standards developed (if any) should be performance-driven, focusing on the capabilities and end-uses of this technology.
- UN COPUOS should champion an initiative to catalog on-orbit assets and define a registration convention.
- SGAC should consider starting a new project group on satellite servicing to continue this conversation and development of recommendations to all organizations and stakeholders (UN, CONFERS, Industry, etc.)

Recommendations to the Sponsor(s)/Partner(s) and/or the Industry at large

The Industry needs to take a more active role in developing policies/standards/best practices and not leave everything up to the manufacturers to define.

Breakout Session : BALL AEROSPACE

Climate Change and Environmental Stewardship

Supported by:

During this breakout session, the discussion delved into the existing gaps within the understanding of climate change and its repercussions on aerospace companies. The main objectives were identifying the most critical challenges associated with climate change and, subsequently, proposing actionable solutions tailored for aerospace companies.

Main Objectives

1. Identify: What are gaps in climate change data and research?
2. Address: How can aerospace companies actively contribute to global warming efforts?

Subject Matter Experts

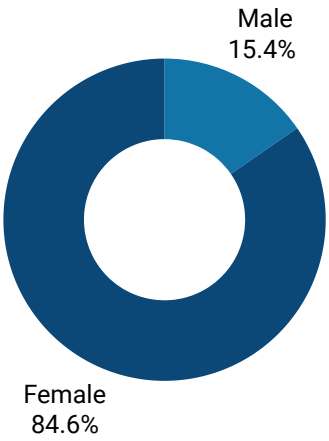
Jordan Marks | Advanced Systems Manager at Ball Aerospace

China Hagström | PhD Candidate at MIT

Moderator & Rapporteur

Statistics

13 Delegates
5 Nationalities



Questions

1. What are gaps in the current measurements for climate change and how can aerospace companies help close them?
2. How can aerospace companies support environmental stewardship - either creating technologies that measure/monitor climate change or by taking actions to reduce their own sustainability footprints?

Answers

Answer 1

To address gaps in climate change measurements, aerospace companies can focus on several key areas:

- Quantifying Impacts

Companies can analyze supply chain impacts using Scope 3 data and frameworks like SASB. Moreover, regarding technical data, analytics take time and effort, consequently, they get stuck only processing client data. Aerospace companies can contribute by leveraging advanced technologies like machine learning and AI to interpret data faster and more accurately. Additionally, investing in research and technology can help enhance the utilization of current data. Lastly, there's a need to recognize the "tragedy of the commons" phenomenon, where the environmental toll often doesn't immediately impact companies capitalistically...

- Global Availability of Data

Areas most affected by climate change often lack sufficient data and means to communicate it globally, leading to inequities. Coverage gaps, export control issues, and the lack of standardized metrics further hinder comprehensive analysis and comparison of climate data. Additionally, transparency in reporting climate data is crucial for fostering trust and accountability.

- Social impacts and communication

Measurements show continuously falling behind our goals due to poor pacing and dissemination. Therefore, there's a crucial need to enhance how information is distilled and distributed to ensure stakeholders are well-informed and engaged in climate action efforts.

Answer 2

- Regulatory Measures

Companies can: implement a “credit score” to evaluate their environmental impact; standardise and centralise reporting mechanisms; establish industry groups/consortium of companies to hold each other accountable; ensure that board members have a vested interest in adhering to SEG regulations

- Technical Measures

Companies can provide data cheaply to companies that will use it for advancing climate solutions; develop abstract data for launches to provide average impact baseline (incentives for companies to surpass baseline)

Answers

Answer 3

- Companies can improve the availability of data in under-surveyed regions is crucial. This can be achieved by investing in Non-Profit Organizations (NPOs) to conduct assessments and by facilitating the adoption of local technologies in affected countries. Moreover, enhancing data transparency is essential for informed decision-making. This can be encouraged through a combination of government regulations, providing the "stick" to enforce transparency, and industry incentives, offering the "carrot" to motivate compliance. Additionally, increasing public awareness through information campaigns and investments in public education can foster greater engagement and support for environmental initiatives.

Recommendations

Recommendations to the Space Generation Advisory Council and the United Nations Committee on the Peaceful Uses of Outer Space

- Accountability
  - Reporting standards for companies to standardize reported ESG data.
- Transparency
  - Unified database to share abstracted company data and information
  - Follow in footsteps of civil aviation.
  - Categorizing launch and program impacts → rating system for programs and companies.

Recommendations to the Sponsor(s)/Partner(s) and/or the Industry at large

- Accountability
  - Report and be held accountable to each other, consortium.
  - Board members with vested interest in ESG.
- Transparency
  - Public visibility of ESG data.
- Collaboration with academia
  - Give academics data to process and create modeling programs. Researchers provide information about the data to the company.
- Global outlook
  - Provide recommendations that work for countries with varying industry and governing infrastructures.
- Educating the public
  - Share lived experiences of those affected by aerospace programs and steps being taken to mediate those effects.
    - Hire a third party company to solicit local responses.
  - Center work on often overlooked communities.

Breakout Session : ATOMOS SPACE

Startups: From Idea to Fundraising to Deploying

Supported by:

ATOMOS

The Atomos Space Breakout Sessions aimed to brainstorm with delegates about the tools, steps and awareness needed to identify real gaps in the sector for potential startups to fill in.
The sessions were structured as follows:

- The first session discussed gaps in (aero)space for startups to fill in, with the delegates asked to brainstorm and identify current unmet needs in the sector. Then, the session focused on turning the gap into a business. Delegates brainstormed on how to turn a need/idea into a company worth investing in.
- The second session was a short pitch competition/shark tank with Atomos playing the role of investors, to give feedback on what investors want and what startups should focus on to be well grounded when raising funds. The shark tank style pitch competition was also used as a simulation to help identify gaps where startups can have a role in advising on space policy.

Main Objectives

1. Outline a set of best practices for future startup founders and space investors alike to help identify and better understand what kind of ideas should be funded today for a more thriving and healthy space sector tomorrow

Subject Matter Experts

Vanessa Clark | Co-Founder and CEO of Atomos Space

William Kowalski | Co-Founder and COO of Atomos Space

Ariann Duncan | Director at Connections Idt

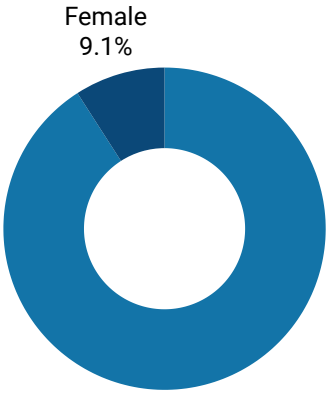
Moderator

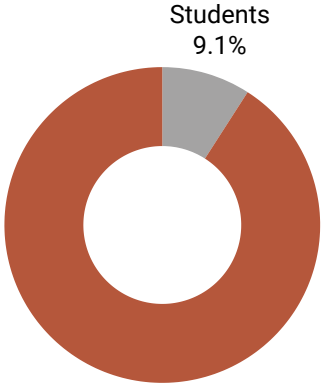
Jake Siegel | Spacecraft Mission Operations Systems Engineer at Ball Aerospace

Rapporteur

Statistics

11 Delegates
5 Nationalities





Questions

1. What are the gaps in the aerospace sector that startups can fill in?
2. How do we turn these gaps into actual businesses worth investing in?
3. How can founders pitch these ideas in a well grounded way to investors?

Answers

1. Highly contested ground operations, RPO (Rendezvous and proximity operations) becoming more prolific in the space industry, future demand for agricultural products in Space, “picks and shovels” opportunities.
2. Clearly identify the problem, determine if there is commercial demand, hire the right people (ensure good company culture fit), get involved in Space policy if necessary to improve success for the company. Foster innovation in international collaboration to stimulate economic activity.
3. It is important for founders to identify their ideal customer, have conviction in their idea and go-to- market (GTM) strategy. For Space, founders should ensure that the TAM (total available market) is $1B for venture investors. This can be done by assessing and combining all potential services, and adjacent markets. Evaluate ROI for investors - hard to do in Space.

Recommendations

Recommendations to the Space Generation Advisory Council and the United Nations Committee on the Peaceful Uses of Outer Space

Question 1: What are best practices for SGAC members considering becoming a startup founder?

- Be passionate about the problem, not the technology. Might have to pivot from a particular technological approach over time.
- Determine if there is real commercial demand. “Who is the customer?”. There are a lot of areas that fall into the tragedy of the commons. E.g debris mitigation.
- Technology is not what makes the business, execution is everything.
- Can use an accelerator to determine if co-founders are a good fit. Important to note: Top tier investors have no problem finding ventures to invest in/funding.
- Reducing cost can often be a race to the bottom. There’s an exception in the LEO market currently in some sense, in that you can initially use low cost as a flywheel to build up/demonstrate your reliability.
- Solve small problems so you can demonstrate to people that you are making progress. What is the most solvable problem *today?*
- The Minimal Viable Product (MVP) becomes a Minimal Viable Spacecraft.
- Conduct due diligence on investors. Consider/protect information rights
- Re-invest any money made into development

Recommendations

Question 2: What can startup founders and space investors alike do to help identify and better understand what kind of ideas should be funded today for a more thriving and healthy space section tomorrow.

It is important for founders and investors to address the following key questions.

- What is the problem?
- What is the solution?
- Why you?/ Why are you the right person/team to address/solve this problem?
- Why now?

Startups founders and space investors should foster innovation. International Cooperation on Space Activities will help to funnel more investment into industry. Enable frameworks to work together/collaborate as an international community.

Question 3: What role can Space startups play in advising on policy?

Startups usually have innovative approaches and are working with new technologies that have not been previously demonstrated in space (low TRL) and should be involved in advising on Space policy frameworks.

- Startups need to be part of the industry advisory groups.
- Startups should be involved in global policy
- “Where are we going next” - Clear direction established by the international space community and policy-makers so startups can support.
- Apply lessons learned from the aviation industry.

Breakout Session : ORBIT FAB

Refueling for Unlimited Maneuverability

Supported by:

ORBITFAB

Since the advent of artificial satellites, it has been accepted practice to plan for the development of a satellite that will be entirely self-sufficient after launch, there will be no adjustments, no modifications, no opportunities to improve anything physical about the vehicle after it leaves the launch pad. Notably the maneuverability of a vehicle is highly fixed by the amount of propellant it carries. Due to a confluence of technology improvements across the cislunar ecosystem, it appears that a change to this paradigm is imminent. While these technological improvements will allow a variety of changes in orbital operations, this working group focused on the changes brought about by a single development - the ability to refuel a vehicle after it has been launched. Goals and inquiries have been identified with the objective of taking a lead in the commercial adoption of this technology, aiming to speed its integration into the ecosystem. Unlimited maneuverability enabled by refueling will change the entire industry and our recommendations bridge that gamut.

Main Objectives

1. Create norms of communication around servicing and refueling particularly RPO activities.
2. Make sure legal frameworks are sufficient for the operational space as activities evolve.
3. Assess how maneuverability will enable greater sustainability

Subject Matter Experts

James Bultitude | Senior Consultant at Orbit Fab

Alex Drozda | Mechanical Engineering Consultant at Cislune

Moderator

Annika Salmi | Simulation Engineer at Starfish Space

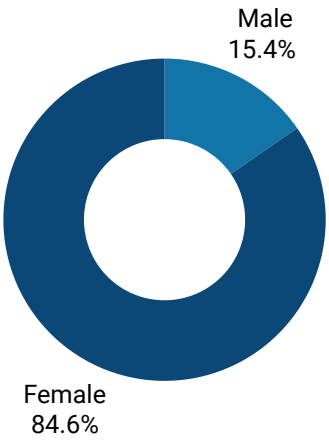
Rapporteur

Jordan Fuse | Structural Dynamics Enginee at The Aerospace Corporation

Rapporteur

Statistics

13 Delegates
5 Nationalities



Questions

1. How do we establish standards for operation and communication?
2. How does liability work for client and servicer?
3. How do spacecraft change hands internationally?
4. Does maneuverability increase sustainability of on-orbit operations?
5. How do we track progress across these lines of inquiry?

Answers

Answer 1

- Rendezvous, proximity Operations and Docking activities are required in order to provide refuelings services. These operations are complex and will always present some level of danger. The dual use nature of these technologies demands clear communications, between the parties conducting them, allied and opposed nations, third party space observers, nearby space vehicles and the general public.
- Standards must be developed from operations, not operations from standards; thus companies need to be in the loop to assist with determining what would be good for the industry.
- Communication requires, first, an accepted place to communicate, before expectations for how communications occur can be established. Thus, industry involvement will similarly be necessary eventually, but first there needs to be a commons in which communication, both domestic and international, can occur.
- Other industries may be used as reference points for how these standards are established. The aerospace and maritime sectors have already established a number of standards for operations similar to those which would be undertaken on-orbit; they can be used as guides for what would be appropriate to expect.
- When these standards are established, it is necessary that acceptable consequences be determined for not following the standards. Such appropriate and immediate consequences might include adjustments to insurance agreements or limitations on spectrum allotment, for example.

Answer 2

- The potential for hazard drives a need for clear liability. Currently liability is assigned along the basis of the launch state. This is clear when a satellite has a limited lifetime and set of mission activities it is designed, built, and launched to accomplish. The reality of unlimited maneuverability enabled by in-space refueling and other servicing activities means this paradigm will shift, spacecraft may end up changing hands in space, and undertaking activities not specifically known at the time of launch and licensing.
- Further, if a servicer and client are engaged in activities risk is shared, if these vehicles belong to separate launch states, how will this liability be determined? Is the launching state paradigm still the best paradigm in an unlimited maneuverability future?
- One solution may be to present an alternate criteria for national ownership, that is not derived from the launching state, some mechanism to allow for the transfer of such liability between nation states. This may also be accomplished by streamlined practices like we see with some legal and licenced inter country arms distribution in today's world.

Answers

Answer 3

1. If spacecraft can refuel, the life expectancy may become long enough to be considered indefinite. In that case, it is possible that a nation, likely a relatively small nation, would want to purchase a satellite from another, relatively large, nation, when that satellite has passed it's useful period for the large nation. While this has been done in other areas- military aircraft, for example- a method for doing so has not been established in the orbital arena. As above, new mechanisms may be needed.

Answer 4

- Orbital refueling operations include a number of separate industries and components, from satellite bus manufacturers to launch providers to fuel producers to the refueling servicers to the end user of the hardware. When all of these are established, is there a net benefit to sustainability? This is something that will need to be studied to determine if continuing on-orbit refueling is worthwhile or not.
- The most valuable thing we could do now is develop a clear measure of space sustainability. Current best measures tend to exist in a pre planning/pre launch manner and data collected and represented once in space and operating does not play a clear part in these metrics. The development of future metrics which assess in-space activities and their effect and score based on performance to these and documented proof may become relevant. These could be used to provide a carbon credit like incentive program within or between nation states.

Answer 5

- When a goal is set, it's necessary to be able to tell when it has been approached or met, so we need some idea of what an established ecosystem would look like in order to determine if we've hit our goals or not. Fully exploring an established cislunar ecosystem is difficult because it requires a full imagining of a world that does not yet exist, an activity normally left to the science fiction writers. Thus, some effort needs to be put forward to determine how to proceed in this area, potentially as a practice of a future working group.
- As above at this time clear metrics would be very powerful.

Recommendations

Recommendations to the Space Generation Advisory Council and the United Nations Committee on the Peaceful Uses of Outer Space

- Establish a means by which space operators can maintain standard communication on their movements or advise other operators on concerns. This may, and ought to be, completed as soon as possible, and could be as simple as an online forum, though a more intuitive and specific standard of communication would be advisable.
- Develop specific clear metrics for space sustainability that include actual performance/action in space and the amount of information that any party has shared about their activities. These could build upon the work of the Space Sustainability Ratings.

Recommendations to the Sponsor(s)/Partner(s) and/or the Industry at large

- Continue to establish norms and good practices via industry collaboration organizations like CONFERS and elsewise.
- Continue open communication on hazards and approaches to solve these to enable an unlimited maneuverability future.

BREAKOUT SESSION : LOCKHEED MARTIN (VIRTUAL)

Missions to Venus

Supported by:

LOCKHEED MARTIN

In the space domain, the race to develop the most advanced technology is fierce. Countries worldwide compete to attract the brightest scientists and engineers to work on their projects, crucial for achieving military, economic, and scientific dominance in space. However, the interests of scientific researchers, and national governments, aren't always aligned: the scientific community benefits greatly from open collaboration with international colleagues, while governments would prefer to keep new developments guarded. The VERITAS and DAVINCI missions to Venus have been a testament to what can be achieved through international collaborations with American counterparts in France, Germany, & Italy.

The Deep Atmosphere Venus Investigation of Noble Gases Chemistry and Imaging (DAVINCI) mission seeks to study the origin, evolution, and present state of Venus in unprecedented detail from near the top of the clouds to the planet's surface. Instead, the Venus Emissivity Radio Science InSAR Topography and Spectroscopy (VERITAS) mission seeks to study the secrets of a lost habitable world on Venus, gathering data to reveal how the paths of Venus and Earth diverged. Although a NASA-led project, the scientific results from this mission serve to benefit the international community through a better understanding of our planet's future by understanding Venus' past.

This group recommended scientific missions to be used as a facilitator to increase international collaboration. Although increasing the number of participating entities can complicate a mission, it has the competing benefit of outsourcing components like data analysis or sensor design to institutions that have that as their core competency.

Main Objectives

1. How do science missions lead to increased international collaboration?
2. What scientific understanding does DAVINCI provide?
3. What scientific understanding does VERITAS provide?

Subject Matter Experts

Pieter Kallemeyn | Chief Engineer and Senior Manager at Lockheed Martin

Olivia Billett | Systems Engineering Manager at Lockheed Martin

Michael Skeen | Systems Engineer Senior Staff at Lockheed Martin

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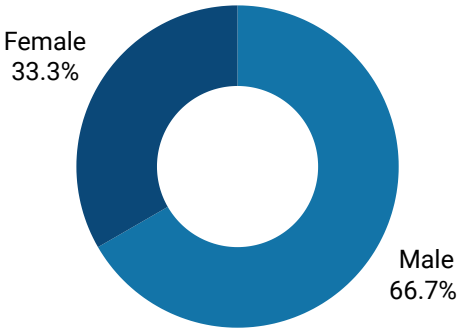
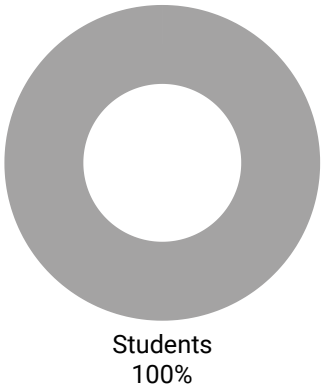
Moderator & Rapporteur

Statistics

6 Delegates





Questions

1. In what ways can space science missions be used to facilitate international cooperation? How does liability work for client and servicer?
2. Can commercialization of missions increase international Cooperation? How?
3. What is the scientific importance of taking scientific observations of Venus?
4. How can third parties contribute in meaningful ways to current and future missions to Venus?

Answers

Answer 1

Data collected within scientific missions informs international problems, such as climate change and environmental concerns; the effort to collect this data should therefore be supported through international collaboration due to the vested interest that each nation has of protecting its people. Through international cooperation, more science can be collected as specialists from all over the world are able to extract new insights, and this increased collection will benefit the full global community. International cooperation within scientific missions will increase the validity of the data as well. It will always be seen through a geopolitical lens, but as an example, if the US and China collected data together through a single mission, the resulting data set would be more palatable to and accepted by both the US and Chinese scientific communities.

Answers

Answer 2

Commercial entities may enjoy greater innovation freedom due to reduced bureaucracy compared to governmental agencies. Enhanced international collaboration not only fosters more technological solutions but also drives cost-effective options in scientific mission architectures. Despite lower profitability in science missions, the absence of national or government backing offers benefits such as protection from political shifts and streamlined processes. The prospect of a framework providing incentives for private entities to lead scientific programs holds significant promise for the scientific community. NASA sometimes will mandate and incentivize incorporating international entities in a program. If we privatize, why would a company still use international entities? Possible reasons include potential tax incentives for private corporations and the broader advantages of increasing international partnerships, fostering competition, and reducing costs through diverse suppliers.

Answer 3

Studying planets beyond Earth provides valuable insights into our own planet's atmosphere and geology, enhancing Earth-based climate models and understanding geological evolution. In the era of global warming, this data is crucial for safeguarding our home planet and its inhabitants. Venus, with its similarities to Earth, holds particular interest in this regard.

Answer 4

Third parties can enhance scientific missions by offering services like data analysis and mission formation, bringing a more diverse perspective. To encourage collaboration, regulatory and contractual incentives, such as incentive fees and tax breaks, are necessary initially. Academia, as part of the User Community, can contribute intellectual input through scientific proposals and innovative design challenges for targeted problem analysis.

Recommendations

Recommendations to the Space Generation Advisory Council and the United Nations Committee on the Peaceful Uses of Outer Space

- SGAC acknowledges that having governments as the primary investor of science-based missions leads to heightened financial risk due to their reliance on limited funding from governmental entities, but the business use cases for commercial organizations are currently limited. SGAC therefore recommends that Member States evaluate how scientific missions or components thereof can be privatized to expand funding opportunities and availability of these critical missions.
- SGAC recommends the development of an overarching international collaboration policy to incentivize private industry to participate in international partnerships within future scientific missions. To this end, SGAC also recommends establishing a system/framework to streamline relationship formation between international partners based on desired skills/product needs.
- SGAC believes that studying Venus provides invaluable benefits by helping us better characterize Earth's own atmosphere and geology and thus improve Earth-based climate and geological evolution models, due to Venus' similarity and vicinity to Earth. These insights help in the era of global warming, where understanding becomes increasingly critical in protecting our home planet.

Recommendations to the Sponsor(s)/Partner(s) and/or the Industry at large

- SGAC commends the use of common spacecraft architecture as a way to reduce mission costs and lead times and encourages the scientific community to continue to explore using common hardware to reduce complexity.

Unavailable Breakout Sessions

During SGFF 2023, alongside the previously mentioned breakout sessions, two additional sessions were held:

- SGAC Policy Breakout Session supported by SGAC
- "Outfitting Commercial Space Stations" Breakout Session sponsored by Redwire.

Unfortunately, the content and outcomes for these sessions are not available, thus limiting our ability to provide a comprehensive overview of all discussions and outcomes from the event.

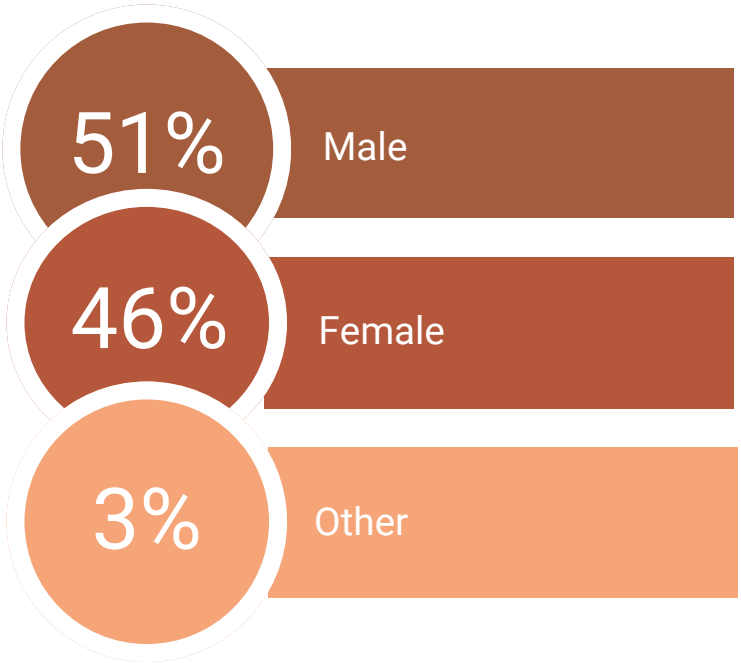
Event Statistics

90 Delegates

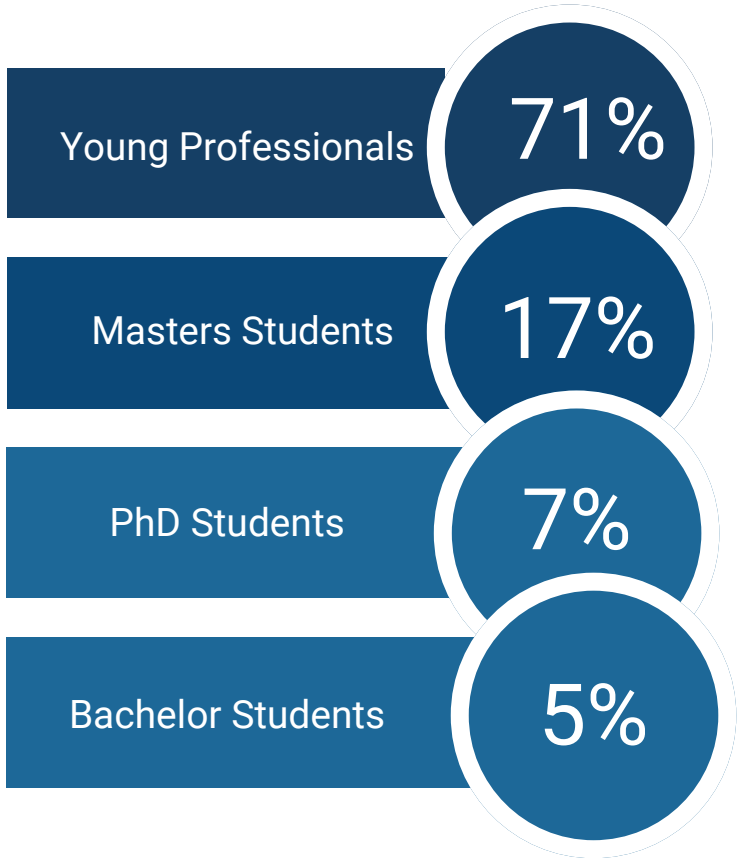
28 Nationalities

9 Breakout Sessions

GENDER DISTRIBUTION



ACADEMIC BACKGROUND OF PARTICIPANTS



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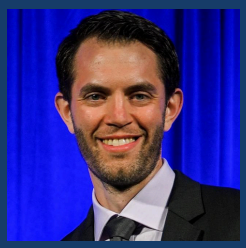

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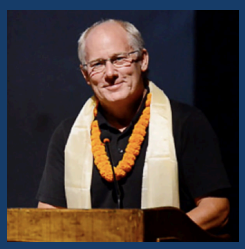
Dr. Ken Davidian
Vice President of North American Operations
International Space University

Via Van Liew
Principal Director of Diversity Equity and Inclusion
The Aerospace Corporation



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Buzz Aldrin Space Institute

Dr. Christy Edwards
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Debra Facktor
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Clay Mowry
President
International Astronautical Federation

Giorgio Saccoccia
President
President Italian Space Agency (ASI)

Lisa Campbell
President
Canadian Space Agency (CSA)

General John Hyten
Former Vice Chairman of the Joint Chiefs of Staff

Event Host

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