ASCENDxTexas

INTERACTIVE SESSION DETAILED SUMMARY

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COMPILED BY:
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# INTERACTIVE SESSION
GOAL & OUTCOMES

An interactive session was held at 2023 ASCENDxTexas to engage attendees in meaningful discussion around breaking barriers and accelerating the space ecosystem. Small group leaders guided roughly 170+ attendees in 19 groups through a 60-minute session to provide their perspectives on the barriers and pathways to success for our nation's exploration efforts. Each group spent 10 minutes on each of the five topic areas: industry, policy/government, international, capital, and workforce.

A conference I/O tool was used to allow attendees to submit their ideas about the challenges and barriers to success in these areas. The tool also allowed attendees to up-vote other's submissions. These submissions provided the basis for the group discussions, and additions also were allowed during the session. The table captains captured comments and discussion in an interactive whiteboard tool, Mural, which allowed session leaders to quickly distill key information for an outbrief.

The outcome was a set of prioritized areas of emphasis to be pursued during the coming year that benefit the national exploration goals of the next 5 to 20 years. Attendees were encouraged recommend potential solutions in their sphere of influence that could impact these areas.

A high-level summary of each of the five topic areas follows, including some comments and discussion points from attendees. All content is anonymous and some debate between attendees was seen. This document does not represent the perspective of any one individual or organization, and is a compilation of many different viewpoints from participants who attended 2023 ASCENDxTexas.

INDUSTRY
SUMMARY
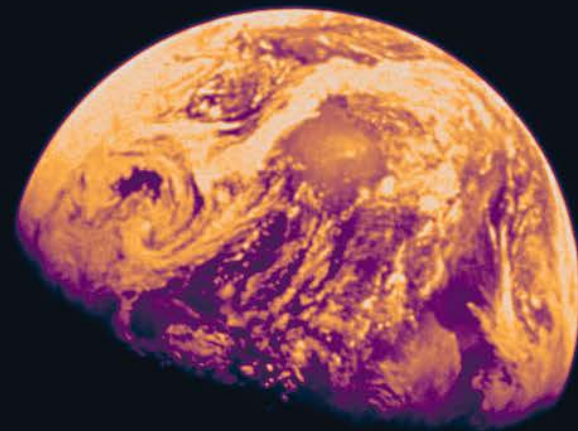
Between the I/O tool voting and discussion at the tables, several themes were highlighted by participants about barriers to industry, including increasing visibility with non-aerospace companies, examining industry concerns about cost-effectiveness and liability, establishing industry mentor/protege arrangements, protecting strong intellectual property (IP) rights, reducing barriers to entry, increasing outreach and engagement, and reducing government overreach and bureaucracy. There was a lot of discussion around how to increase the number of participants in the space industry by reducing some of the barriers to entry (such as cost-effectiveness and liability), cross-pollinating with other industries, and having more established companies mentor newer companies without taking them over. Participants perceived a need to increase visibility with non-space companies, to potentially improve cost-effectiveness and share processes. Other ideas were to increase collaboration with NASA Johnson Space Center (JSC) and industry clusters to support low Earth orbit (LEO) and lunar initiatives and establish industry standards for interoperability to facilitate cooperation and growth. On the government side, industry is asking the government to speed up processes and be more flexible with requirements and regulations. There are many more themes, and these are included on the list below.

1. INCREASE VISIBILITY WITH NON-AEROSPACE COMPANIES

a. Visibility – we need more non-space companies to understand why they should investigate space-based systems or solutions to improve their processes, etc. We've seen articles such as "Why Your Company Needs a Space Strategy" by HBS, but how do we get outside industry to participate?"

b. Communicating why non-aerospace or outside industry should invest and participate in space can provide cross-pollination, improved processes in their industry, more capital, and overall improvement. By communicating the commonality of technology across different industries, companies can see their technology applications to aerospace.

c. Space is a place to do business, not really an industry in and of itself.

d. Space literacy – when people understand what the opportunities are and how to get involved.

e. How do you get more people to the table? Look beyond the traditional providers to non-traditional partners. It's been mostly defense and aerospace participating in space, what about health, technology, retail, phone, and beverage industries?

f. Dual-use technologies expand the market. Companies need to see what's in it for them and how they can pivot their ideas to other industries. Better awareness of technologies that exist in other industries would also help aerospace companies potentially leverage those technologies.

g. This is a unique industry, so the market can only go so far.

h. Better visibility could help with the development of the supply chain. Subcontractors are already interacting with prime space contractors, but also many non-space vendors.

i. More visibility includes beyond the local areas around NASA centers or aerospace hubs.

j. More diversity in interested parties brings in more potential for cost sharing.

2. EXAMINING INDUSTRY CONCERNS ABOUT COST-EFFECTIVENESS AND LIABILITY

a. "Industry might be concerned about when space can be cost-effective for them. Industry might also have concerns about liability and if the government can protect them against it."

b. There are concerns surrounding the costs of the space ecosystem and the responsibility of the government to protect industries.

c. For cost-effectiveness, there is no incentive for large investments to build the market and the payouts are slow.

d. Industry is taking on risk, while insurance may not be available to protect investors' investments. Some businesses may be one failure away from collapse.

e. Profitability (both how to make money and how to spend less to make the same money) are key concerns.

f. The long-range commitment of a key tenant would help companies look out and plan for 5-10 years. NASA may not be this anchor tenant, as they have been historically.

g. Cost efficiencies may be found by looking across multiple business partners.

h. Competition should bring the best quality, but industry should find ways to share projects for the best cost benefit analysis. SpaceX and Blue Origin are spending a ton – is this efficient?

3. ESTABLISHING INDUSTRY MENTOR/PROTEGE ARRANGEMENTS

a. "How do non-JSC affiliated businesses located in other markets enter into a mentor/protégé arrangement. What/who are the entry points for businesses outside of the Bay Area Houston market? Is it Bay Area Houston Economic Partnership or JSC procurement? How do we open doors at one of the new commercial primes?"

b. Mentor/protégé arrangements are critical to success, while making sure that it is an arrangement, rather than the larger taking over the smaller.

4. PROTECTING STRONG IP RIGHTS

a. "Strongest economic growth rates correlate robustly with the strongest patent/IP rights. How can we best overcome U.S. laws that allow willful infringement of domestic startup, government, and academic patents via Revised NASA Act 1982, as applied in Hughes Aircraft Co v US (1993)?"

b. IP rights need to be appropriately protected to drive economic growth and technology development.

c. IP and competitive advantage is in conflict with sharing information so that everyone can accelerate the space industry. Protecting IP in a collaborative environment is an issue. Open source technology is another.

d. No company wants to invest if IP will be stolen or taken. A company will lose their competitive advantage and profitability.

e. Patent and IP rights can cause issues as well, you can spend a lot of money on trademarking or patenting.

f. Industry is scared to put out their information, maybe more RFIs (requests for information) without their name being tied to it.

g. Exporting is also a problem. Some materials that go into products are covered by ITAR.

5. INCLUSION OF NON-GOVERNMENT IN STRATEGY

a. "There appears to be a lot of government-to-government discussions and agreements happening for lunar/cislunar, etc. Industry needs to be represented. How can that be done?"

6. SLOW APPROVAL PROCESS FOR NEW TECHNOLOGIES

a. "Approvals for technologies – when the approval and procurement process for new technologies is slow, we may preclude acting on lessons learned. How do we gain the trust necessary for faster approval and procurement of industry standard technologies?"

b. A better understanding of the approval process for technology may help.

c. Some technology infusion dies down despite successes, is this because of government funding being delayed?

7. IMPACTS OF AI/ML

a. "How are you dealing with the rapid rise and interest in AI/ML and how do you think that will affect the industry in the next 5 years?"

8. ESTABLISHING INTEROPERABILITY STANDARDS

a. "Standards, interoperability, and codes in industry such as AIAA, IEEE, and ASCE."

9. SUBSIDIZING LAUNCH COSTS

a. "NASA should commit to continue subsidizing launch costs in the commercial space station era until the industry is self-sustaining."

b. Other approaches to continuing to lower launch costs could also provide benefits.

10. NEW COMPANY BARRIERS TO ENTRY

a. "Testing in the industry seems to be a hurdle for small projects as the currently existing test sites are limited and high cost. Higher availability and lower costs in DIL testing would greatly expand the space ecosystem."

b. There's a high barrier of entry that keeps newer or smaller companies from entering the space ecosystem.

c. Collective partnerships working together would allow sharing the cost for infrastructure and other barriers to entry.

d. Companies, especially small ones, being able to test in expensive or limited access facilities would help overcome testing barriers.

e. Access to space is the number one barrier.

f. Initial start-up costs are high and a barrier to industry entrants.

11. PREDICTABILITY AND STABILITY TO SUPPORT INVESTMENT PLANNING

a. "Predictability - Consistent, planned development by anchor customers, like NASA, to provide a reliable roadmap against which industry partners can make their own investment plans."

b. NASA as the anchor tenant could provide stability and consistency for funding, which is currently lacking. But also, what happens if the government is not the anchor tenant? Understanding NASA's new commercialization approach is key, since it affects the customer base.

c. The stability of government contracts, government regulations, and changes is important.

d. Consistency and predictability is key to planning, manifesting, and getting investments.

e. "Bait and switch" – starting down a path and then switching to bartering and handing out (may be in reference to NASA procurement approach?)

12. A COMMON VISION FOR EXPLORATION

a. "No common vision for exploration, particularly lunar – it's either profits, science, or national security, but not a combination."

b. Customers need roadmaps that establish a common set of goals and make sure priorities are clearly communicated.

c. Customers for the lunar market need to be nurtured.

13. INCREASING OUTREACH AND ENGAGEMENT

a. The space literacy of the public and outreach to future generations is needed to spark their interest.

b. More universities should engage in the space industry.

c. Increase inclusion, reaching out to underserved communities and encouraging diversity in companies.

d. Provide public challenges.

e. "Getting out of the JSC bubble – big companies are nationwide."

f. Have a way for people to engage with NASA. Educating others is an easier way to enter the front door and engage with NASA.

14. GOVERNMENT OVERREACHING AND BUREAUCRACY

a. The government and NASA are too involved in requirements and design, overspecifying things and regulations. They want to control vendors too much. As a smart buyer, they still need to be involved, but engage less. It is almost impossible to get NASA to back away and let the process develop.

b. Pivoting to commercial services does not solve all the issues for the government getting out of its own way. The government becomes stagnant on bureaucratic problems. NASA needs to streamline processes.

c. With overspecification, it stifles industry and startups who need dual-use innovation. Specify outcomes and let industry find their own path to get there.

15. THE SPEED THAT THE GOVERNMENT OPERATES AT AND PRESSURE TO MOVE FAST

a. The speed at which the government works can be a barrier. Delivery readiness process. Vendor's mission priority. How do others get involved to improve the speed and approval process?

b. There is a need to move at the speed of business and not government. There is a need to accelerate agreements between industry and government to allow getting the data faster.

c. Going too fast and the pressure to do so can lead to failure. There is a concern about the level of safety, and dragging down safety enough.

16. MONOPOLIES PUSHING OUT SMALL BUSINESS

a. There is a concern that tipping points are controlled by the "mega" companies, which can push out small businesses and lead to a monopoly. This prevents innovation.

b. Domain sovereignty: too much vertical integration.

17. SUPPLY CHAIN ISSUES

a. Supply chain is a challenge, as well as export/ITAR control on the supply chain.

b. Some small businesses interact directly with prime space contractors and non-space vendors. Supply chain and visibility is a problem for them.

18. SHARING KNOWLEDGE

a. Regulations and knowledge sharing is a barrier. Sharing information allows everyone to accelerate; however, that is in conflict with IP and company competitive advantage.

b. Industry can be secretive, not sharing their projects.

c. NASA could be a better matchmaker.

d. An online database or marketplace for technologies could help provide visibility into the market and available systems.

e. Risk assessments should be publicized.

19. DIFFICULT CONTRACTS AND PROCUREMENT PROCESSES

a. The procurement process can be difficult to understand and hard to navigate. The perception is that it is very difficult to get a NASA contract. There should be a "cheat sheet" for making a budget and schedule.

b. There are conflicts with procurement, having a hard time with OCI.

c. Startups fear the contract mechanisms and that the proposal process is mysterious. Small business offers some tutorials and help, but some of the set asides can hold other startups back.

d. RFIs (Requests for Information) are a one-way street. There should be a way for people to submit ideas beyond RFIs. Better feedback needed from contractors across industry, and being proactive with feedback.

e. NASA contracts for supporting contracts

20. LACK OF REGULATIONS AND ENFORCEMENT

a. No one is paying attention to regulation. There is a difference between the government and non-government and controlling the regulation level.

b. There are no enforcement capabilities.

c. Small companies cannot produce all the data and struggle to deal with the regulations.

d. There is a parallel example of airports having higher standards and extra attention versus other manufacturing spaces.

21. INTEGRATING ALL THE PLAYERS

a. With the idea of a space economy, it can't just be the integrators, but how do we also pull more people in?

b. There are lots of government-to-government discussions that industry could engage in.

c. Whose job is it to integrate all of this?

22. OTHER

a. "Front door access" and needing a cheat sheet.

b. Commercial companies being more flexible and limber.

c. Cybersecurity

d. Liabilities and maintaining safety across industry.

e. As the climate changes, how do you adapt without growing too fast, such that you're blocked from applying because you're too large.

f. Difficulty maneuvering through the industry as a whole.

g. Lack of knowledge of OCI, wanting to avoid instead of mitigating.

23. CONNECTIONS TO OTHER TOPIC AREAS:

a. Policy/Government – Companies are looking to the government to provide protection and guarantees. Collectively represent itself.

b. Policy/ Government – Why is NASA the only U.S. government agency involved in financing space infrastructure? We need more U.S. government involvement.

c. Policy/ Government – Common legal framework

d. International – International communication

e. International – Getting involved with international chambers of commerce.

f. International – How can international and industry work together to get beyond restrictions?

g. Capital – Getting the right balance of capital

h. Capital – What's the right balance of capital to create a healthy industrial base?

i. Capital – Needing to have money on R&D

j. Capital – What is the available market, funding?

k. Workforce – Being able to train people, specialized in manufacturing

l. Workforce – Finding talent.

m. Workforce – The age of the workforce

n. Workforce – Lots of focus on STEM, but what about business programs – who are not represented here (e.g., Harvard, MIT, USC)

o. Workforce – Reaching out to underserved communities, diversity in companies

p. Workforce – Not enough talent (ex., blue collar workers) need to be able to work in the industry

q. Workforce – Education opportunities in universities. Some people have programs, some don't.

POLICY AND GOVERNMENT
SUMMARY

Between the I/O tool voting and discussion at the tables, several themes were highlighted by participants in the topic area of policy and government. These included the lack of stable policy and funding, a balanced regulatory framework, NASA shifting focus toward strategy, and a procurement model/policy that reduces risk for industry. Participants thought everyone should increase advocacy for stable policy and funding for space programs, both within the government, as well as within industry. People are struggling to understand, allow, and support NASA's shifting focus from technical to more strategic with service-based procurements. This shift in acquisition model puts more risk on industry, and industry is looking for government protection. Additionally, balanced regulatory frameworks that support appropriate standards without limiting innovation would support progress. There are many more themes, and these are included on the list below.

1. LACK OF STABLE POLICY & FUNDING

a. "Lack of stable policy and funding for programs that need to go beyond one administration's tenure. Too often the plan "whiplashes" due to a change in the political party, instead of building a successful coalition to weather the winds of change."

b. We should address concerns about strong political influences and how its presence affects the availability of long-term, stable policies and government funding.

c. Multi-year funding is helpful. Or a NASA Administrator that crosses between administrations. If your investment doesn't pay off for 7+ years, you don't know what the administration's viewpoint will be by then. Because the development timeline for systems is much longer than administrations, the four-year cycle is damaging to NASA. Programs need to last longer.

d. Policy development outside the government could help with the stability of policies with administrative changes.

e. The speed of the government and relevant policies is an issue, as well as making them with long-term thinking. Policy needs to be adaptable and flexible, and not take so long.

f. A compelling story with strategic planning would support stability. Policy has to start globally.

g. Lack of stable policy is noticeable, particularly with nuclear propulsion.

h. How do you make policies accessible to everyone (e.g., community and academia)?

i. Consistency of mission and purpose (e.g., commercial aviation would not have happened without airmail)

2. BALANCED REGULATORY FRAMEWORK

a. "How can the government set a regulatory framework that addresses future space activities and lays out the rule book without hindering innovation and progress?"

b. We should focus on balanced regulation that supports appropriate standards without squashing innovation.

c. Government framework needs to provide regulation and flexibility without impeding progress and industry growth. A lack of flexibility hinders new businesses. Regulation should balance the interests of industry and government. It should focus on supporting speed while minimizing risk. Regulations should be protective rather than overrestrictive.

d. More seats at the table to inform the decision making (providing a diversity of thought) could help.

e. Interface standards should be set for all customers, not just one government contract option. Interoperability is so all the pieces are built and work together. Can you adapt an international space treaty and other frameworks to align all the players?

f. Think of regulations framed around business to balance policy with innovation. Reframe the mission in terms of the business case to grow the market beyond just the anchor tenant. This goes back to NASA as the anchor tenant, which is not the only way to prop up and help the business case close. How do we help NASA get the business mindset?

g. You have to make sure the regulatory framework is not outpaced by the current environment.

3. ESTABLISH NEW POLICY

a. Apply "international waters" rules to the moon and Mars.

b. Policy is between countries. What's left on the surface of the moon, who can use it, who can repurpose it, how is it protected? Are there salvage policies in place?

c. Who is the policymaker when no one owns it?

d. Fund a global park, conservation before we start mining.

4. CONFLICTS OF INTEREST

a. "How best to revise the approach to deal with conflicts of interest as we move from a government centric to a broader "government is one of many customers' model"? The classical conservative approach needs adjustment to cope with workforce realities and national economic objectives."

b. How do we reduce conflicts of interest? Some companies have a conflict by providing oversight and support at the same time.

5. NASA SHIFTING FOCUS TOWARD STRATEGY

a. "NASA is shifting from a heavier technical focus to more of a strategy and acquisition-driven focus."

b. NASA needs to do what NACA used to do – investing in difficult technologies that help overcome long-term technical barriers.

c. NASA's shift from the technical focus is damaging. NASA is supposed to be leading the forefront.

d. The shift of the NASA model truly is a key problem – people don't know how to let NASA's role change.

e. There is a challenge in having such limited customer markets. Is it realistic to think that it will go beyond NASA?

f. NASA HQ and more folks should have a holistic view of industry and government.

6. JSC WORKING WITH OTHER MARKETS

a. "How is JSC working across other regions of Texas, and the United States, to scale its reach and leverage other markets with industry clusters that could support LEO and lunar initiatives? In particular, markets with significant DoD aviation and military space crossover: AFWRX, Space Force."

7. SCALING ARTEMIS BASE CAMP

a. "How do we grow Artemis Base Camp beyond 2–4 crew for 2–4 weeks per year to viable, sustainable surface activities and creating markets?"

b. We need a defined architecture for Artemis, including power generation and general infrastructure.

8. SPACE DEBRIS & PLANETARY PROTECTION

a. "How about space debris and 'junk' hardware left on the surface of the moon? Will there be a national park or conservation area on the moon? How to protect the sites for science missions?"

b. Space debris is a number 1 risk to Artemis. Space debris issue will matter sooner rather than later. There needs to be ways to protect sites, and general planetary protection of the moon.

9. GROWING SMALL COMPANIES

a. "Should NASA generate a firm policy to help build and grow the commercial space market for smaller companies and to not compete with commercial offerings?"

b. How do you manage small companies getting consumed by larger companies?

10. PROCUREMENT MODEL/POLICY, REDUCING RISK FOR INDUSTRY AND NO INDEMNIFICATION

a. "How can the government move from the traditional acquisition model to a more progressive model, where they reduce the risk encumbered by industry in order to enable more investment and confidence to build the lunar space economy?"

b. Government thinks that they know what is best for industry, while they may not. Every conversation used to revolve around NASA requirements, it doesn't anymore.

c. The government is trying to be better with procurement. There is a huge shift in the way things used to be done to where they are now. No longer a "prime contractor model". Longer term, established partners should have that taken into account as a positive for them. However, this model puts a lot of risk on industry, should we be so constrained?

d. How do we address shareholder risk and get commercial to continue to come in behind NASA and fill in the gaps?

e. No indemnification in an immature market. The government can indemnify all the industry participants, this is what they've done so far. At some point, there will be insurance issues.

f. Open bid concept limits the NASA matchmaker concept.

g. NASA's process for deciding who gets projects is no good. There needs to be an ombudsman to support the bidding process.

11. PROTECTING STRONG IP RIGHTS

a. "Strongest economic growth rates correlate robustly with the strongest patent/IP rights. How can we best overcome U.S. laws that allow willful infringement of domestic start-up, government, and academic patents via Revised NASA Act 1982, as applied to Hughes Aircraft Co v US (1993)?"

b. We need to protect assets. It doesn't make sense to invest time and money to do a thing if it's not protected. Need help from the government on that protection.

c. ITAR and export control for international and commercial partnerships is connected to this.

d. Conflicts of interest are a huge barrier, firewalling can help, but a more logical approach is needed to what is really a conflict of interest. Protecting IP and avoiding it is fine, but let's not be overly burdensome. How do we streamline processes and tracking?

12. DATA SHARING

a. We also need to make information accessible. Data sharing of government data is not similar to commercial. Commercial entities own their data.

13. OTHER SUCCESSFUL GOVERNMENT AGENCY MODELS OR COLLABORATIONS

a. Should NASA consider adopting the DARPA rapid capabilities office model? B-21 came out of the Rapid Capabilities Office. The Rapid Capabilities Office does things faster, cheaper and better.

b. Is there a market for shared resources? How do NASA and non-civilian space overlap? What is the Space Force role? Can we learn from the Space Force policies? Or how the aviation industry matured?

c. With many agencies (FAA, NASA, DoD), balancing the policies can hinder progress. Some of them can be in conflict.

14. OTHERS

a. Speed of government

b. Foreign government not buying

c. NASA not understanding the monetary value

d. Go outside the system to create change and progress

e. Academic and political collaboration

f. Outsourcing

g. Is nuclear in space a way to support nuclear on Earth?

h. Ownership and responsibility

i. Diversity

j. The "fair use" program

k. Focus on the nation, not only "space city". The culture of politics, specifically in Houston

l. Political issue – need academic validation and investments.

15. CONNECTION TO OTHER TOPIC AREAS:

a. Industry – Leveraging different industries

b. International – Global politics

c. International – Enable fair play in global industry, an equal playing field

d. International – Where does ITAR fit in this for international partners?

e. International – International corporations, what happens with a McDonald's on the moon? Who do they answer to?

f. International – More involvement with the UNOOSA

g. International – International policy – we can't share certain tech without fear of it being used against us. Limiting factor for emerging markets.

h. International – Foreign governments buying from American companies

i. International – Competition with China

j. Workforce – Student visa to participate in STEM

k. Workforce – Federal folks are being "poached" by companies, so how does the government keep the skills to be a good customer?

INTERNATIONAL
SUMMARY

Between the I/O tool voting and discussion at the tables, several themes were highlighted by participants when it comes to international barriers. These included the issues of having technical conversations within the ITAR system, the Artemis Accords and their boundaries, and how to balance government-to-government (international) agreements with supporting U.S. companies. ITAR is perceived as an impediment that companies spend a lot of time and money to understand and appropriately work within. While there is support for the Artemis Accords, there is a desire to have more detail about the legal mechanisms and boundary conditions as well as the potential implications of them being non-binding. Additionally, with international collaboration and agreements that support our exploration goals, U.S. companies desire for there to be an ability for them to compete and provide system elements and important technologies. There are many more themes, and these are included on the list below.

1. HAVING TECHNICAL CONVERSATIONS WITHIN ITAR

a. "How do we get agreements that allow more technical conversations with trusted partners in light of ITAR?"

b. We should work on facilitating technical discussions with partners, utilizing the ITAR regulations more efficiently, and eliminating roadblocks to collaboration.

c. ITAR can be viewed as an impediment to allowing conversations. How do we balance protection with having necessary conversations? ITAR/EAR and penalties hinders both small and large companies. The restrictions are difficult to overcome. How do we appropriately "circumvent" ITAR? Too much work and money is being invested to understand this.

d. ITAR is perceived as very conservative on export regulations. Additionally, how do you protect ITAR when the large corporations you'd like to partner or collaborate with are international?

2. GOVERNMENT-TO-GOVERNMENT FRAMEWORK ALLOWING FOR COMMERCIAL INVOLVEMENT

a. "International partnerships to date, like ISS and Gateway, have been a 'divide and conquer' approach. What is the right framework to allow government-to-government agreements that allows for commercial investment and cooperation?"

b. Sustainable space exploration is not something one country alone can do. While we need space collaboration with other countries, the right framework would allow government-to-government and government-to-private opportunities. Also more business-to-business global exchange instead of having to go through NASA. The government needs to be more open with international industry.

c. Ownership of the collaboration and partnerships and figuring out ways to reach out to new partners. Making sure that the international stakeholders are getting something out of the partnership too. While we prioritize domestic affairs, international stakeholders are important too.

d. Partnering with universities may be an avenue, they are much more open to international collaboration, providing a non-traditional pathway to partner internationally.

3. ARTEMIS ACCORDS AND BOUNDARIES

a. "How do the Artemis Accords allow U.S. entities to engage in collaborative agreements with non-U.S.-based business entities where the focus is on supporting the Artemis Program. What are the legal mechanisms and/or boundary conditions?"

b. We need to work to describe in detail the legal framework and limitations applicable to collaborative agreements under the Artemis Accords.

c. Clarity on how the Artemis Accords help should be provided. While the Artemis Accords set the "sandbox" for those who want to play together, how do they lead to shared regulations? You have to be careful to not limit acceleration by creating binding things. There is also a concern about the non-binding aspect and potential implications.

d. It seems that to participate as an international person, your government has to put money in.

e. What if other countries land first?

f. Countries that are not part of the accords, how do they play?

4. EVER-CHANGING POLITICS

a. "Sadly the United States leads and the others follow because they don't want to go alone. But sometimes the U.S. desires are framed more to appease Congress than really based on what makes sense for the broader international community. They go along to get along."

b. This ever-changing political environment, and essentially making "our politics" everyone's politics, is a damaging Western perspective. "The United States needs to jump off their high horse." Need to be careful about being driven from an American perspective only.

c. Some disagree with the word "sadly" in the initial statement and that the United States being the sole leader is maybe a thing of the past. It may be a mixed bag on leadership, some countries follow, while others don't. Some don't see a difference in the leadership for LEO and lunar.

5. MANAGING BARTERING OF TECHNOLOGIES AND SYSTEM ELEMENTS

a. "How do we get NASA to stop bartering away important technologies and system elements that U.S. companies could provide?"

b. There's lots of talk about commercial opportunities being squelched by international partners. Meanwhile, some disagree with the comment on NASA bartering. It should be about who is most able to make the system, not just the United States. We need to focus on getting humans to space. There are lessened financial opportunities for industry when pursuing international opportunities for space.

c. Most of the money is spent in the United States, you can't make a procurement and spend in your own country.

d. NASA has to release control to allow industry to provide the innovation. The perception is that NASA is doing that in LEO.

e. Bartering is what we've done with Russia, other countries can't get in on that.

6. PROTECTING STRONG IP RIGHTS

a. "Strongest economic growth rates correlate robustly with the strongest patent/IP rights. How can we best overcome U.S. laws that allow willful infringement of domestic start-up, government, and academic patents via Revised NASA Act 1982, as applied to Hughes Aircraft Co v US (1993)?"

b. We need asset protection from foreign attacks. There is a lack of international protection of IP and compliance. We lack insight into other company's technical expertise and IP. How do you make agreements when you have technology that comes from different countries? How do you protect IP while more openly collaborating internationally?

c. IP rights are a challenge with international companies. IP/patent protection is a big barrier. There is a concern about getting "ripped off". You can't really just share technology, you have to share proprietary information.

d. How do you navigate wanting to share information with some countries and not others?

7. ESTABLISHING INTERNATIONAL LAW AND ENFORCEMENT

a. "Without international law to enforce anything, how do you ensure accountability from a company's actions?"

b. There needs to be rules of engagement, how to "play nice" with each other. International coordination of regulations and policies should be established, who has rights to what, make a predetermined agreement. Without international law to enforce anything, how do you ensure accountability? We need to find time/space to be proactive and not reactive.

c. All the treaties are written between countries without involving or thinking about companies and how it impacts them. Is it trade policy or some other mechanism? Does the country of origin vet the company or make the company follow the rules?

d. We need to share policies for gathering data on international territory, making information easier to share.

e. How do you allow vehicles to be operated by international crew (international waters)?

f. Global recourse on availability

g. Government has to lead for the small companies.

8. GEOPOLITICAL EVENTS

a. Geopolitics and political events are barriers. Navigating the politics of other countries, international threats, international relations, and global conflicts.

9. CULTURAL UNDERSTANDING

a. Cultural understanding and differences when it comes to international involvement. How do you convey the language gap between scientists, politics, and countries? Dealing with cultural differences is important and difficult.

10. "RACE" WITH CHINA

a. What if China lands first? It seems to be a giant race to the moon. Who gets what? First-come, first-served?

11. LACK OF INTERNATIONAL STANDARDS

a. There are different standards across the world. They can be slow to get adoption, especially across ESA because all of the individual agencies/countries need to buy-in on the standard or proposal first. Streamlining the international conversations and having more timely processes would help.

b. We want reliable and consistent information, and are sometimes getting misinformation. There is misleading information because people have personal and competitive agendas. Perspective is specific for Latin America: forums for Latin American countries in Latin America.

c. Domestic source requirements are not the same and it can affect the entire process and ability to cooperate.

12. NON-TRADITIONAL OR SMALL COUNTRY PLAYERS

a. How can we let small countries do the same thing? Examples for international astronauts from non-traditional countries.

b. How to get more players and countries to feel included? Companies and countries have different incentives, how do you find common ground?

13. OTHERS

a. Divide and conquer traditionally versus commercial diversity

b. Elon –- he can do what he wants because he's privately funded.

c. Balance of value

d. System fails to support on a macro level

14. CONNECTION TO OTHER TOPIC AREAS:

a. Industry & Capital – People getting information from NASA and not using it. They're holding the patent because they have a lot of money. The government has high transparency with patents (e.g., purifying water for ISS). How do we get commercial to share too?

b. Industry – Supply chain issues with international partnerships

c. Industry – Be more selfish regarding supply chain needs/wants, not just host

d. Policy/Gov't – Having rules of engagement (e.g., policy). Is the moon international territory?

e. Policy/Gov't – Agile and flexibility for regulations

f. Policy/Gov't – Role of space force? Understand the overlap.

g. Policy/Gov't – Pace of business, speed up government

h. Policy/Gov't – My company doesn't want to be limited by my government

i. Capital – Funding structure should reflect more like Europe or overseas competitors before we fall behind.

j. Capital – What about space stocks? VC investments?

k. Capital – High cost

l. Workforce – Immigration laws, not able to have or keep international workforce

m. Workforce – International might be one of the solutions to workforce. Countries that don't have a strong space presence.

CAPITAL
SUMMARY

Between the I/O tool voting and discussion at the tables, several themes were highlighted by participants in the topic area of capital. These included scaling capital investments beyond Venture Capital (VCs), realistic expectations for Return on Investment (ROI), early monetization and path to profitability, clear risk posture, and the role of NASA as the buyer. Participants saw a need to attract institutional capital such as private equity and traditional investment banking to invest in the space sector. Minimizing or sharing risk between government and industry could encourage these more risk-averse investments. Improving the timeline to return on investment and establishing realistic expectations could motivate more investments, especially with VCs. Developing a reasonable understanding of where the risk is, and how it is shared and balanced would also help address barriers. Lastly, creating new products and services that can turn a profit right away, potentially from Earth-based applications or leveraging space resources could continue and sustain the market. There are many more themes, and these are included on the list below.

1. NEW KINDS OF FUNDING/SCALING CAPITAL BEYOND VENTURE CAPITAL (VCS)

a. "Venture capital is great. But it doesn't scale to space exploration programs. What needs to be done to get more institutional capital (private equity, traditional investment banking, etc.) involved in the space sector?"

b. We need to work to increase VC funding while seeking and scaling to other types of funding. There isn't enough money in the VC system to support significant space spending. Increasing space literacy for VCs could increase their willingness to invest.

c. "VC's appetite for failure is unknown or variable." Better business cases will find the venture capital companies to take the risk. The company needs to diversify (parts, systems, etc., and not have a singular focus). More exposure and outreach to VCs and explaining the value of space research would increase the space literacy in the financial community about space and space ventures.

d. "How do we lower costs to enable better use of venture capital/ private funding?" SpaceX used the trust of NASA to prop up the commercial case for satellite launches. Then once launches got routine, SpaceX spun up Starlink to provide more capital for funding the real endgame of Mars, without having to go public.

e. Why is it so expensive to go to space? Does it have to be? Is it primarily the regulations or effort to get approvals? It's hard to get into the space industry since it's a big commitment and effort, making it expensive, with a slow timeline and no need for mass production.

f. We should structure capital from multiple sources and scale up capital investment, getting more traditional funding sources involved besides just looking to VCs. Getting more private capital, and looking at if there are different forms of capital that would be better for a longer period of time.

g. Another potential source is crowdfunding or fractional ownership – getting a very large group of people to invest a small amount of money. Fractional ownership, like the Intuitive Machines model, could be a solution.

h. An analogy is tech companies 20+ years ago. It was only the VCs investing, and once the risk decreased, other types of funding stepped in. A potential solution is to increase the tempo of missions to get more evidence or proof of the decreased risk.

i. Another example is Lockheed spinning off their space corporation (not needing a subsidy), but you need deep pockets to be able to do this.

j. Another potential source is more funding allocations, potentially NATO?

k. To continue/sustain the market, a better understanding of the investment of improving future profits and company growth is needed.

2. REALISTIC EXPECTATIONS FOR RETURN ON INVESTMENT (ROI)

a. "What is a typical expectation regarding ROI margins as well as an exit strategy for a venture capitalist looking to engage in the commercial space market? Particularly LEO and lunar initiatives."

b. We should work to identify shared (primarily VC) ROI expectations and exit timelines.

c. For space, the delayed or longer term ROI (long cycle of space) doesn't meet typical VC expectations. How do we lower costs to enable VCs or reinterpret the expectation around ROI? The timeline to ROI is so long that the exit strategy is hard to sell, and

it isn't seen as lucrative by many investors. Quick return is typically important to them. Additionally, it is not as attractive, the bargains are not going to be huge numbers.

d. There is a lack of high probability of long-term ROI.

e. Companies overcoming the hurdle rates (or ROI requirements) is big. If expectations for ROI were relaxed, it would accommodate the time it takes to develop space systems. VCs in these new space companies are looking to get their return when the company goes public instead of when they land on the moon.

f. While VCs couldn't fund whole exploration programs, there are plenty of opportunities still.

g. What is worth investing into? ROI over things we subsidize that we don't need to forward the mission. NASA continues no matter what.

3. NASA CONSIDERING COMMERCIAL PROFITS

a. "Profits drive commercial decisions. What needs to be done to get NASA to the point where it considers healthy contractor profits to be one of its priorities?"

b. NASA needs to prioritize accounting for company profits, include it in decisions and understand the bottom line for business profitability. Contracts should consider the health of the company (turning a profit). Business cases should identify where you can drive your profits from. Right now in LEO, it's mostly from communication. A business endeavor is not sustainable if it's also not profitable. Generally, companies do not get rich off NASA.

c. As government seeds industry, it will require more tax dollar investment to help the companies do more. Profit is not a dirty word, but let the companies be held accountable. The commercial company's constraint (commercial being about profit) also becomes the government's constraint.

d. NASA only makes things for NASA for everyone (e.g., google glasses, VR), which affects profitability. Think of drivers like water and food depots and asteroid mining, this is where the profits come in for commercial.

e. How can you lower cost by defining profits first?

4. PROTECTING STRONG IP RIGHTS

a. "Strongest economic growth rates correlate robustly with the strongest patent/IP rights. How can we best overcome U.S. laws that allow willful infringement of domestic start-up, government, and academic patents via Revised NASA Act 1982, as applied to Hughes Aircraft Co v US (1993)?"

b. Revise our IP position in our agreements. Resources only for domestic patents.

5. CREATING OR PROVIDING COMMON, AVAILABLE CORE INFRASTRUCTURE

a. We need to develop common, available, accessible core infrastructure (test facilities, etc.) so that companies do not have to create their own. Many core facilities are overbooked, and companies (especially small ones) do not have the capital to create their own.

b. Avoid too much investment in the same things. NASA could use commercial instead of government, and vice versa.

6. EARLY MONETIZATION AND PATH TO PROFITABILITY

a. "First sets of products or services that can turn into profit right away."

b. We need to work to understand what will turn a profit and close a business case, and where the margins will (and won't) be.

c. Could we monetize issues on Earth compared to off planet? Earth-based applications grow the market.

d. People struggle to recognize what will turn a profit. How do you monetize things like mineral use, etc.? And once we get places (like the moon), what do companies get – do they have property rights, mineral rights, etc.? How do we get to market-driven needs? Is mineral the only interest that we get capital gains from (besides science experiments)?

e. Rideshare or other first sets of products to turn profit right away.

f. Lack of attention to different world sectors.

7. ESTABLISHING MARKET VALUE

a. We haven't established the market value of space assets. We need to explain the human value of what we do and explain the cost.

8. CLEAR RISK POSTURE

a. We need to develop a reasonable understanding of where the risk is, where the tolerance is, how it is shared and balanced, potentially revising our risk perspective.

b. Not mature or fully established markets can make developments and investments risky. Usually insurance is not available, so industry has to be highly risk tolerant. Can NASA facilitate the risk of doing business (essentially providing "insurance")?

c. Is there a way to share the financial risk between government and industry? Or more than one company?

d. Balance the portfolio risk with the size of the company – risk aversion (or appetite for failure) is different for big versus small companies. The critical mass for investment is too large for small companies.

e. Only billionaires want to take these risks right now.

f. Not only are there higher risks, but the risks are longer term than companies/investors are typically used to. When no one has done it yet, it's very risky.

9. ROLE OF NASA AS THE BUYER

a. The role of NASA as a guaranteed buyer can be a challenge or solution. Large government investments allow small players to be successful. However, shrinking government budgets, and less government investment in space, causes hesitations.

b. NASA needs to be really clear on what they are expecting from a firm fixed price contract.

c. NASA needs to continue to subsidize for longer than what they are currently expecting. The space industry is still in need of government subsidies since it's in its infancy. Look at the example of the government building the railroad.

d. Shift the regulations away from NASA to help streamline?

e. NASA does not want commercial systems interfering with their mission systems.

f. SBIR can develop for NASA purchasing.

g. NASA funding is not diluted. Startups get to keep their IP.

h. Government gets fair use and does not compensate. Vendors get to charge the cost of producing.

10. ENCOURAGING INTEREST AND SUPPORT IN SPACEFLIGHT

a. Spaceflight is not typically a kitchen table topic, how do you grow that interest and support? More visibility will increase the political support, which can grow the market.

b. Think things similar to: my space investment can cure a disease.

c. Or a lottery for a spaceflight seat.

d. Science is a good investment.

11. SMALL COMPANY VISIBILITY

a. The ability to see smaller companies is a barrier. Sometimes small companies are overlooked compared to large companies.

b. Small businesses gain knowledge capital and it becomes capital.

c. Smaller companies don't know how to get into the business.

12. OTHERS

a. Innovation time cycle is too long.

b. SPAC model is a good thing to look at.

c. Could we have a special space currency?

d. Looking at the here and now – Food shortages, housing, competing funding priorities, inflation.

e. Bitcoin

f. Commercial gives us much more diverse perspectives.

g. Earth focus, make sure we keep a global view

h. Lack of outside competitors that want to participate in aerospace

i. It's a good forcing function

j. People don't want to commit to capital when the government can just take it and not pay for it

k. Lego-based environment

13. CONNECTION TO OTHER TOPIC AREAS:

a. Industry – Make industry and the environment relatable

b. Policy/Government – Not a specific vision

c. Workforce – STEM, people, students, workforce

WORKFORCE
SUMMARY

Between the I/O tool voting and discussion at the tables, several themes were highlighted by participants about workforce issues. These included new education models, promoting the space industry with younger generations through education and curriculum, and retention and compensation in aerospace compared to other industries. Participants saw a need to promote space careers and opportunities to a diverse spectrum of students (elementary through university, those located nearby NASA centers to those far from aerospace hubs). To address some of the workforce supply and retention issues, solutions could be to upskill the current workforce, or leverage non-traditional workforce pathways, as well as incentivizing current workers through wages and non-monetary incentives. There are many more themes, and these are included on the list below.

1. NEW EDUCATION MODELS

a. "Workforce strategy is heavily tied to our education system, which seems to be broken and in need of a paradigm shift. What does a new education model look like from the eyes of industry? Integrate middle and high schools, junior colleges, universities, and on-the-job training programs?"

b. We need to think about new paradigms to drive STEM education that includes job training and engagement. We need to get involved on the ground level of education. How can we adjust models with the space industry in mind? The state needs to add funding.

c. We could start with younger STEM awareness and engagement, potentially even middle school internships.

d. There are bottlenecks at every level of education and the school system is slow to evolve. There are basic issues in the school systems that need to be addressed.

e. We need to build engineers with more entrepreneurial mindsets, and not just solving problems. Implement workforce strategies into the education system.

f. Companies need to collaborate when it comes to the workforce. We could have industry directly invest in high school/universities and work with the school boards.

2. PROMOTING THE SPACE INDUSTRY

a. "How could/should the space industrial base work together to promote space careers and effectively market the opportunities in our industry to a diverse, eager generation of middle school students who are beginning to consider their future careers?"

b. We need to get kids in STEM because of STEM, and be better about interacting with younger generations, the education, and curriculum. STEM investment is often distracted by advertising for companies. We could try using multidisciplinary teams to support STEM outreach (ex., human resources, public affairs, engineering). Now is the time, it's a better investment because there are more aerospace companies and the need is greater.

c. We should make aerospace sound more attainable, where it doesn't sound like rocket science.

d. Outreach to schools not close to NASA or aerospace centric communities has been a challenge. Also making sure community colleges share potential roles.

e. We need to do a better job of explaining non-technical career paths in space. In the shortage, the focus has been on STEM and technicians, but there's also the supporting business functions (and associated knowledge) which are important. Share these other types of available opportunities.

f. Social media has helped make things cool and there's a lot more excitement in the last few years to increase the education pipeline. Think of the "mohawk guy" from JPL – he was professional and very personable. It's important to tell our career stories.

g. We do not know how to marry education and workforce.

h. Reach out to the younger generation (elementary school).

i. Changed the focus that kids had, a small satellite conference from a tiny thing into a massive thing.

j. Focus on more specific space degrees or translational degrees (e.g., general engineer or space engineer).

3. RETENTION AND COMPENSATION IN AEROSPACE AND NOT ENOUGH SUPPLY

a. "Aerospace industry is not competitive compared to the tech industry (pay and overall compensation-wise). The cost of living hasn't matched wage growth for decades and the tech industry can potentially double workers income from day 1. Excitement of space missions is not enough to retain anymore."

b. We need to develop a competitive compensation model to support workforce engagement and retention. Inflation is a factor when it comes to compensation. Aerospace is competing with big tech companies and oil and gas companies for workforce. Many companies are losing workers due to financial incentives in other markets. Compensation is the perceived big disconnect (paying market rates). It is hard to keep good talent.

c. "Aerospace drought" – there is not enough supply to meet the demand. There are not enough people focused on aerospace to fill the amount of jobs. Are there less and less graduates from STEM or are they going to other industries, or is the sector just growing faster?

d. How do we "make space sexy again" so that motivation is independent of pay? How can we keep the "wow" factor and be "cool" relative to tech companies? Other potential incentives include having modern technology that is supported, student loan repayment, etc.

e. The lowest bidder winning a contract, and squeezes on company profit, do not improve or benefit the workforce.

f. The longevity is not there anymore, workers go elsewhere after a few years. There are other companies to work for now, besides NASA, so "poaching" is now an issue.

g. There is some perception that the compensation disconnect is already changing compared to tech.

h. There is a perception that NASA only hires people that are already in NASA.

4. GOVERNMENT/COMMERCIAL SHARING INSTEAD OF COMPETITION

a. "Government and commercial spaceflight companies are all competing for the same resources. How can we make it easier for these resources, particularly those that are hard to find or are only needed to address shorter term projects, to be shared or have mobility across the industry?"

b. Companies are fighting over shared resources. Is there a way to do a talent exchange? NASA is taking all of the costs with training people up, and then they are being "stolen away".

5. UPSKILLING WITH AI/ML/DATA

a. "What skills do you find necessary for new and current employees to obtain in a world that is starting to be dominated by AI/ML/data? Do you think that it is useful to have people "up skilled" to leverage these technologies? And how do you go about upskilling an entire workforce?"

b. Will AI/ML dominate in the future?

6. NON-TRADITIONAL OR EXPANDED WORKFORCE PATHWAYS AND UPSKILLING FROM OTHER INDUSTRIES

a. "As companies compete for the same experienced workforce, is it important to give direction to technical managers to invest in training college graduates and experienced personnel from other industries, instead of creating a bubble by only pursuing those with aerospace experience?"

b. We need to integrate technical and non-university pathways for upskilling and cross-training from the earliest years.

c. How to reach the kids and let them understand non-traditional industry impact and jobs? There are welders, biomedical, and other fields that folks don't generally associate with the space industry.

d. Space is competing with other industries for the technician and non-university workforce. If companies are more open to accepting translatable skills from other industries, this could increase the workforce pipeline. We could focus on attracting mid-career non-space industry people to the space industry. Aerospace companies should hire "non-aerospace" degrees for internships, to get those people into the aerospace industry and have greater exposure to other pipelines.

e. Education requirements for jobs are too strict/rigid (or even impossible) and don't allow students or non-students without specific degrees or specific training to be hired. We need more on-ramps for non-traditional workers from other industries, acknowledging that it takes time to learn the industry.

f. Some perceive that it is more difficult to hire technicians than engineers, that the technician skilled workforce is even tighter. Additionally, technicians make more money in other industries.

g. We need to upskill, but in a balanced way. Training programs could be unique to individual companies. Training programs could even be for specific positions.

7. CAPITAL INTENSIVE FACILITIES

a. "JSC has many capital intensive facilities that are no longer in use or outdated, utilizing budget that could be better served for spaceflight initiatives, what is JSC's plan to offload those facilities and/or land?"

8. USING GENERATIVE AI

a. "What are the smart regulations or policies needed to allow our workforce to use generative AI in product development?"

9. HYBRID/REMOTE WORK CHANGES

a. We have to be open-minded about new ways of doing business, like remote work. COVID and other factors have changed the perspective on returning to work. Quiet quitting and startups are poaching folks away. How do you recruit new folks or grow them? Knowledge can be thin in certain areas, so how do you grow that at your company or agency?

10. GENERATIONAL DIFFERENCES

a. We should let younger employees bring value with modern tools and techniques.

b. We also need to be more applicable to today's problems and culture.

11. MENTORING AND KNOWLEDGE TRANSFER

a. Hands-on, all-around mentoring for people is a barrier. We have a need for mentoring, especially for early career folks who will need more to bridge gaps. We need to give them early opportunities.

b. Some benefits are knowledge transfer and retention, more seasoned folks are 1-3 career changes, while 'young people' are more likely 10-12 changes.

c. When Shuttle retired and Constellation was canceled, there was a big knowledge gap that walked out the door, so how do you develop the new folks without the mentorship and past flight experience? How do you increase the pipeline from schools and such?

12. DIVERSITY AND EXPANDING COMMUNITY REACH

a. There is not enough diversity in aerospace.

b. We need to create regional hubs outside of the big cities. We need to reach out to places that don't have JSC in "their backyard".

c. How do we reach out to diverse communities or blue-collar communities?

d. Diverse eager generations

e. Demographics of diversity to tap into

f. Industry is not working with other industries

g. Universities can't use DEI in their applications

13. OTHER

a. Need more access to space for more people

b. Searching for unicorns

c. HR structure is old school

d. Access to resources

e. Cherry picking

14. CONNECTION TO OTHER TOPIC AREAS:

a. Industry & Capital – Parallels with nuclear industry

i. "The investment in a restaurant vs. space that Kirk Shireman brought up was similar to the issues in the nuclear energy industry. For that industry, we barely see new nuclear power plants built in the United States. Given the similarity, what is your confidence regarding commercializing the space industry?"

b. Capital – Outdated facilities

c. Industry – IP practices and owning patents, opportunity