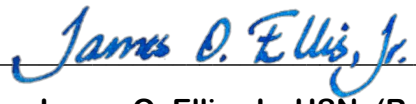
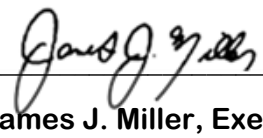
National Space Council
Users' Advisory Group
5th Meeting (Virtual)

July 30, 2020

MEETING MINUTES



Adm James O. Ellis, Jr. USN, (Ret.) Chair



Mr. James J. Miller, Executive Secretary

Executive Summary

The National Space Council (NSpC) Users' Advisory Group (UAG) held its 5th public (virtual) meeting. Dr. Victor McCrary (Vice Chair, National Science Board and Vice President for Research, University of the District of Columbia) presented a briefing, "Historically Black Colleges and Universities: America's Innovative Asset," and was followed by updates from the UAG's six subcommittees. Finally, the floor was opened for public comment. The UAG is chaired by Adm J. Ellis, Jr., and James Miller is the Executive Secretary.

The UAG voted on and approved, with no dissent, the following two recommendations:

1. The Departments of Defense and Commerce should work to create an interoperable approach on multi sourced space data modeling, data sharing, and curation architectures. Both departments should study lessons learned and fund studies and research around technical solutions and processes that allow incorporation of properly vetted international and commercial data into the space object catalog for military, civil and commercial uses. We further recommend that the Departments should report to the National Space Council regularly on their progress.
2. The Department of Defense, Department of Commerce, and NASA should work to jointly develop standards for space data protection and security plans, space data verification, and space data uncertainty quantification.

Other actions:

- UAG members to review the Strategic Space Propellant Reserve paper and provide comments back to Dr. Mary Lynne Dittmar and Mr. Eric Stallmer.

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Meeting Notes

Call of Order, Announcements
James J. Miller, Executive Secretary / Primary Designated Federal Officer, UAG

Mr. James Joseph Miller, Executive Secretary, National Space Council Users' Advisory Group, called the 5th public meeting of the UAG to order at 10:00 a.m. Eastern Time

Mr. Miller serves as the Executive Secretary of the UAG, supporting the Chair, Admiral Ellis, and all the expert members around the table. For more information about how the Space Council and UAG are organized, please take a quick look at the Agenda booklet, which is also available on the NASA website. All of the members have been nominated by the federal agencies and departments that comprise the NSpC, and were subsequently appointed by the NASA Administrator. They are serving based on their individual expertise, or to represent sectors of the American space industry. As a whole, the UAG is intended to be balanced and comprehensive. UAG members are formally categorized as Special Government Employees, or SGEs, or Representatives. SGEs are subject to Federal Ethics laws, and so we remind everyone that if a potential conflict-of-interest arises during our deliberations today, that you recuse yourself from that discussion for the record and not engage. It is important to note that the UAG is an advisory committee established under the Federal Advisory Committee Act, or FACA. As such, all our deliberations are open to the public. In compliance with FACA, deliberations and supporting material become part of the public record, and meeting minutes will be made available within 90 days. For more information on the National Space Council and the Users' Advisory Group, and ho interact with the group, please see the website:
https://www.nasa.gov/content/national-space-council-users-advisory-group

Also, as the meeting is being held virtually, if you have any comments for the public input part of the meeting please send your questions by e-mail to contact@spacecounciluag.org. Even though our time is limited today, we do commit to respond to all your inputs as we continue our work.

After the meeting all the agenda booklet, subcommittee reports, and Dr. McCrary's briefing will be posted on: https://www.nasa.gov/content/national-space-council-users-advisory-group_meetings

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Opening Remarks
Adm J. Ellis, Jr. (USN, Ret.), Chair, UAG

Welcome to the 5th public meeting of the Users' Advisory Group to the National Space Council. Congratulations to members that have been appointed/reappointed. To begin our second term, we now have 28 members representing all levels of the nation's space enterprise. Each of you brings a different and valuable perspective to our efforts in support of the NSpC, and the Vice President as its Chair.

When we first gathered the UAG on June 18, 2018, I described our remittance as support to the National Space Council, and reminded those of you in attendance of our role as an advisory body to provide inputs and ideas, and to identify issues and innovation. In ways large and small we can inform the process, discern the nuance, help those accountable to check and adjust, and as I've told the NSpC perhaps occasionally see where the conventional wisdom might, just might, be a bit too conventional and not nearly wise enough. As we enter this new chapter of the UAG service, that's an opportunity for us to refresh our goals and objectives, to incorporate taskings from the NSpC and its chair, and redefine and rescope our own focus areas. As an initial step in that effort, today I have invited Dr. Victor McCrary to speak about contributions from Historically Black Colleges and Universities (HBCU) to science an engineering, talk about current and future HBCU collaboration and possibilities with the government and the private sector, and finally to hear his thoughts on how these efforts relate to the nation's technical, and especially space, workforce.

Adm Ellis read Dr. McCrary's bio, which is available at:
https://www.nasa.gov/sites/default/files/atoms/files/5th_meeting_booklet.pdf

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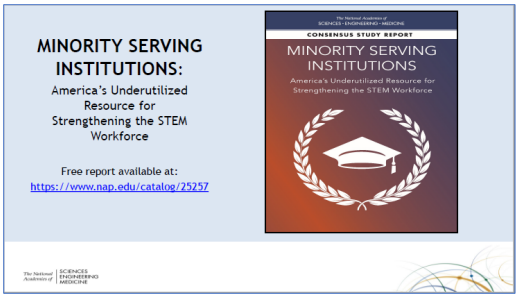
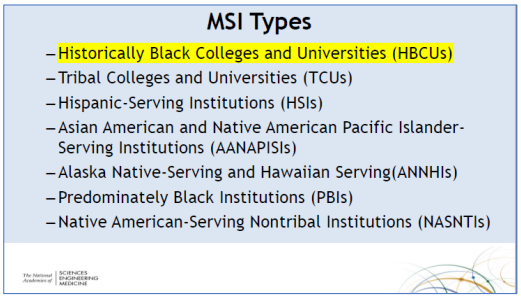
Historically Black Colleges and Universities: America's Innovative Asset
Dr. Victor McCrary, Vice Chair, National Science Board and Vice President for Research, University of the District of Columbia

Charts 1-2:



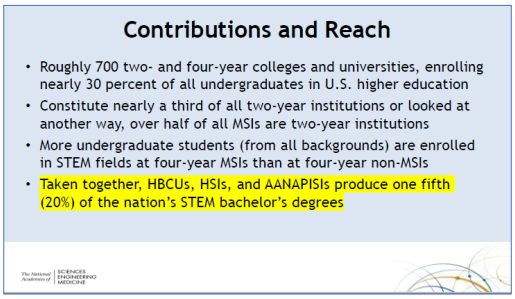
This briefing provides a summary of what is going on in our nation's Historically Black Colleges and Universities (HBCUs) and how they are really America's innovative assets. There is a report that came out in February 2019 by the National Academy of Sciences, "Minority Serving Institutions: America's Underutilized Resource for Strengthening the STEM Workforce. It talks about HBCUs.

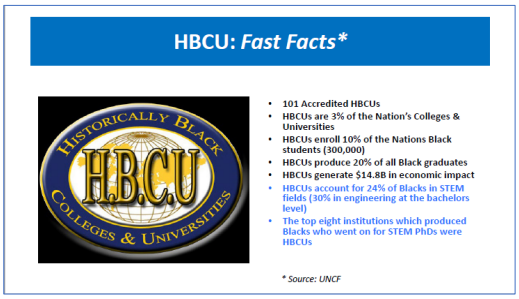
Charts 3-4:



One of the people that was on the authoring committee is Aprille Ericsson, a NASA Goddard Space Flight Center (GSFC) employee currently at NASA HQ, who had very good inputs in terms of how Federal Agencies can leverage HBCUs and other Minority Serving Institutions (MSI). As you can see there are many types of MSIs. Today I am just going to focus on HBCUs.

Charts 5-6:

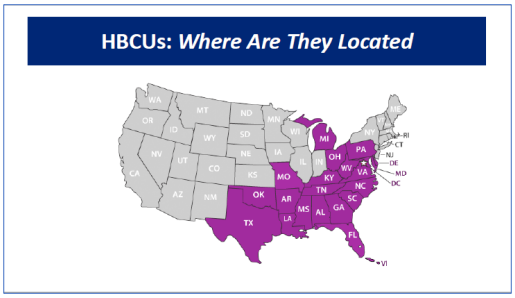




What came out of this study is that if you take together the HBCUs, HSIs, and AANAPISIs, they produce one fifth of the nation's STEM bachelor's degrees. HBCUs produce about 3% of the engineering programs and 30% of undergraduates. There are 101 accredited HBCUs, and compose about 3% of the nation's colleges. They enroll about 10% of the nation's black students, and produce 20% of all the Black graduates and generate close to $15 billion in

economic impact. What's particularly important for NASA is that about 30% of Black bachelor's level come from 15 of the accredited HBCUs, and the National Science Foundation (NSF) recently did a study that Black students who went on for STEM PhDs came from the HBCUs.

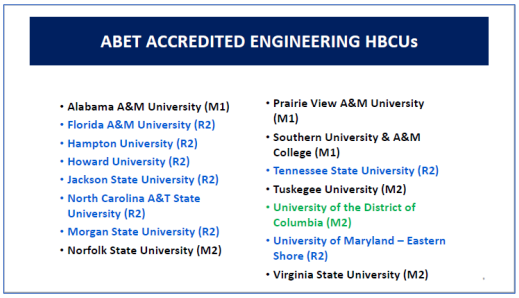
Charts 7-8:

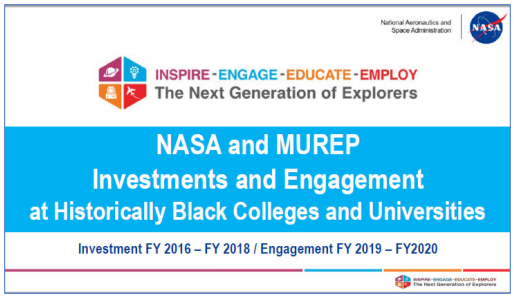


Entity	Carnegie Designation 2020	Moody's Rating	Research Expenditures (2018)	NSF Expenditures (2018)	NSF Expenditures (2016)	Endowment (2016-2019)
Clark-Atlanta	R2	Ba2	$8M	$1.9M	$1.5M	$69M
Delaware State	R2	Aa3	$21M	$3.3M	$5.4M	$28.6M
FAMU	R2	Baa1	$40M	$3.0M	$2.4M	$98M
Hampton	R2	Aa2	$14M	$3.2M	$3.8M	$263.2M
Howard	R2	Ba1	$46M	$6.7M	$7.8M	$692.8M
Jackson State	R2	Aa2	$19M	$6.5M	$6.0M	$60M
North Carolina A&T	R2	A1	$38M	$8.6M	$7.5M	$57M
Morgan State	R2	A1	$13M	$1.0M	$1.0M	$32.9M
Tennessee State	R2	Aa1	$18M	$1.7M	$1.6M	$51M
Texas Southern	R2	Baa3	$4M	$0.5M	$0.8M	$54M
UDC	M2	Aaa	$2.9M (FY19 = $4.8M)	$0.86M (FY19=$1.016M)	$0.86M	$51M (FY19)
UMES	R2	Aa1	$5M	$0.0M	$0.0M	$26.2M

HBCUs are mostly located in the southeastern part of the U.S. Chart 8 shows the top 11 research institutions. As a point of personal pride, the one highlighted in yellow is the University of the District of Columbia (UDC). It is an M2 (Carnegie Designation) institution, which means it does research but is mostly a master's institution. As you can see by the Moody's rating, most of them are in really good shape. The largest expenditure is Florida A&M University (FAMU), followed by North Carolina A&T. The largest endowment is Howard University.

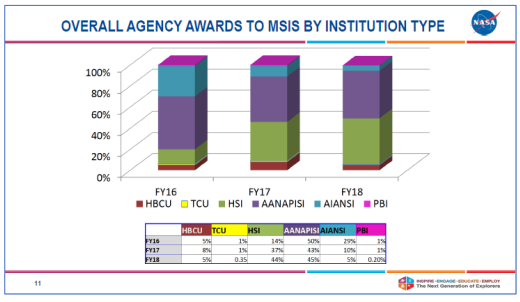
Charts 9-10:





There are 15 ABET accredited schools among HBCUs. They produce the majority of Black bachelor's across all engineering fields. Chart 10 shows some of the work NASA is doing with HBCUs. MUREP is the Minority University Research Experience Program. We're going to look at some of the investments that have been made.

Charts 11-12:



	HBCU	TCU	HSI	AANAPISI	AIANSI	PBI
FY16	5%	1%	14%	50%	29%	1%
FY17	8%	1%	37%	43%	10%	1%
FY18	5%	0.3%	44%	45%	5%	0.20%

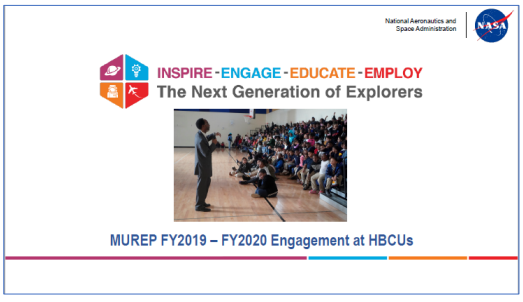
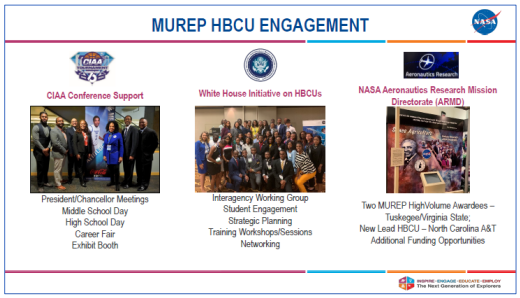
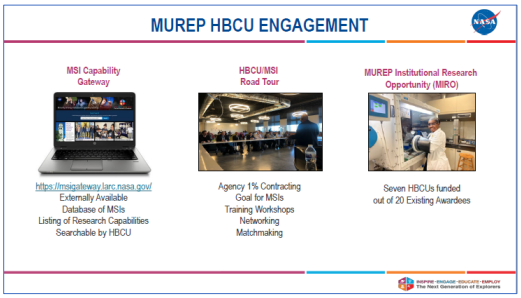


Chart 11 shows the distribution of agency dollars that go into these programs. This is not a percentage of total agency dollars. These are agency dollars that are poured into these new programs. You can see the percentage that is going into HBCUs between FY16 to FY18. In FY19 it actually kicks back up to 8%. Next, I'm going to talk about NASA's

engagement with HBCUs. This helps to build research capacity, keep students coming into the STEM area, and build partnerships so students are able to get into and fulfill good jobs.

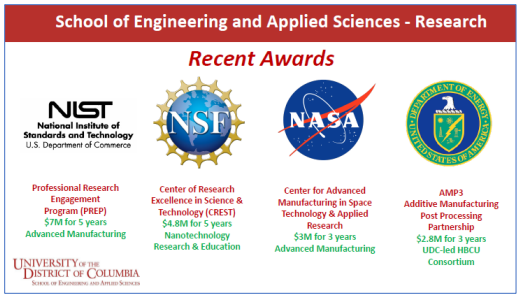
Charts 13-14:





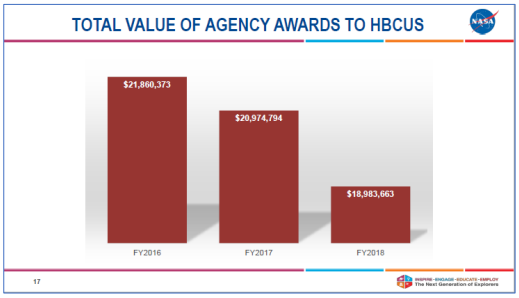
These are some of the engagements that are going on at NASA HQ, its mission directorates, and the White House. Students need to see other people that look like them and are successful. So, we go right there and start talking with them in Middle School and in High School to start seeding interest in STEM areas.

Charts 15-16:



These efforts have led to many awards for research, and foster growth in research capacity at HBCUs. Chart 15 shows recent awards to the School of Engineering and Applied Sciences of the University of the District of Columbia, and chart 16 shows the NASA External Advisory Board, and some of the people we are working with.

Charts 17-18:



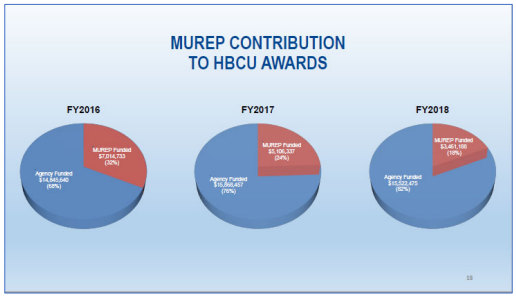
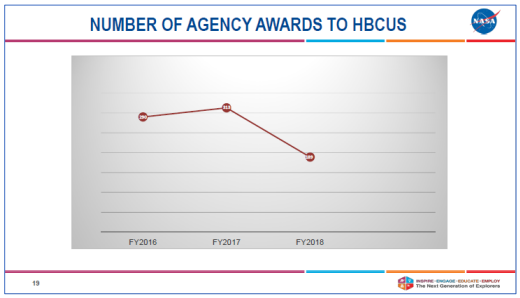


Chart 17 shows the total value of NASA awards to HBCUs. For 2016-2018 it went down, but it is going up for 2019 and we hope to see this trend continue. Chart 18 shows the share of the pie of MUREP contributions to HBCU awards.

Charts 19-20:



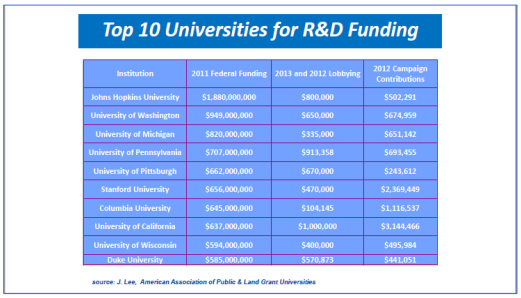
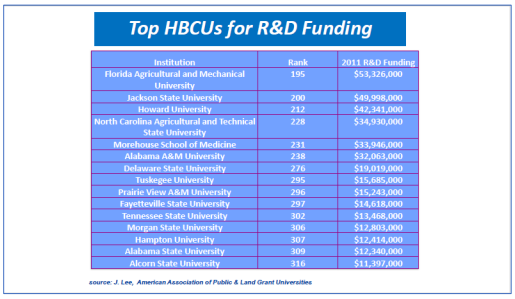
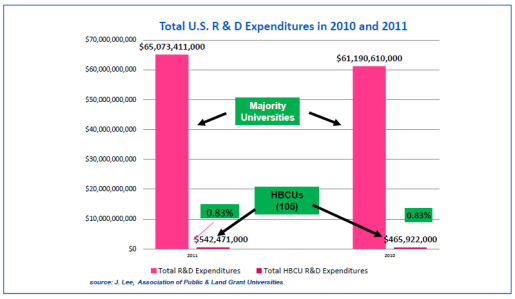


Chart 19 shows the trend of agency awards to HBCUs. Chart 20 shows the total U.S. R&D investment in other universities in 2011.

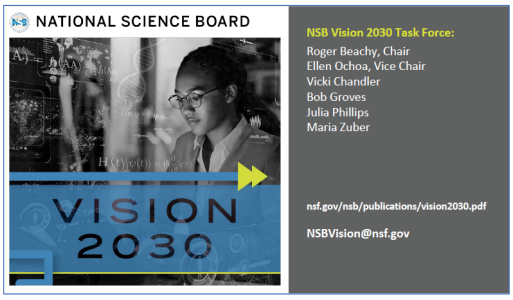
Charts 21-22:





In contrast, chart 21 shows the R&D funding to the top HBCUs in 2011. Note the significant difference compared to the R&D funding shown in the previous slide. Chart 22 shows difference in funding between major universities and HBCUs in 2010 and 2011, where HBCUs received less than 1% of the total. NASA expenditures were less than $12M.

Chart 23-24:



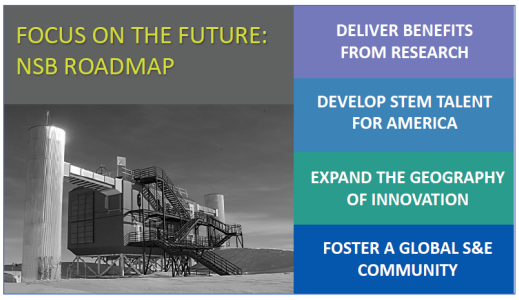
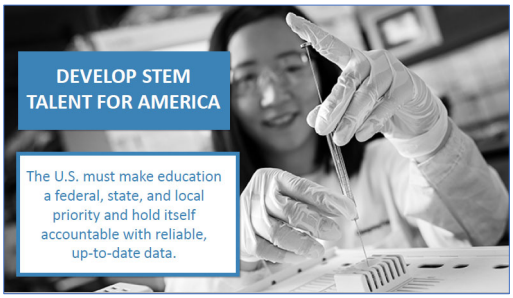
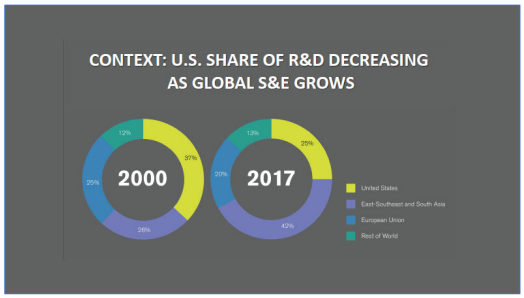


Chart 23 highlights the National Science Board Vision for 2030. As of May 2020, Ellen Ochoa is the chair of this board. She is also the former Administrator for the Johnson Spaceflight Center, and first Latina astronaut. Chart 24 shows the four areas in the NSB roadmap for the future: (1) delivering benefits from research, (2) develop STEM talent for America, (3) expand the geography of innovation to the entire country, and (4) foster a global Science and Engineering (S&E) community.

Charts 25-26:



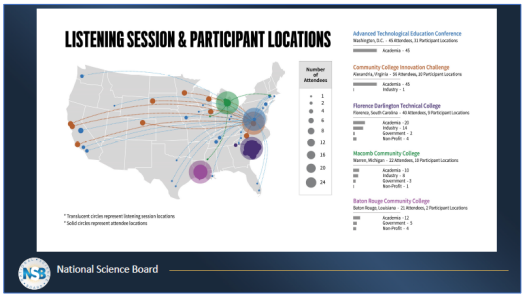


What we see as most urgent to address is developing STEM talent for America, specifically domestic STEM talent. The U.S. must make education a federal, state, and local priority and hold itself accountable with reliable up-to-date data. It is also a national security imperative. Chart 26 shows what we're talking about. Twenty years ago, the U.S. was dominant in its share of R&D compared to the rest of the globe. But if you look at 2017, you can see how our share has decreased, while the share in East and Southeast Asia has increased considerably. The bulk of this share is China, including significant investment in artificial intelligence, biotechnology, advanced materials, and quantum computing.

Charts 27-28:

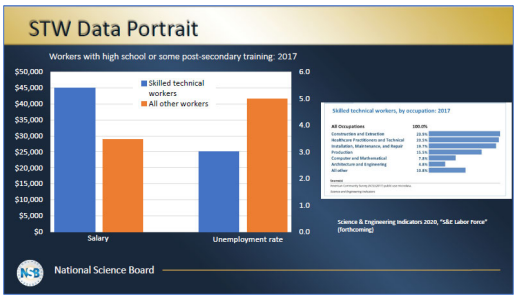
The bigger picture is that, looking forward, we're missing on future talent at a time when the country will be minority-majority. Those people must be American citizens for, say, military systems. As shown in chart 24, if you look at the Black and Latino population over the past 10-20 years in STEM, it has only doubled from 2% to 4% relative to the total U.S. population. Women have done a lot better, but it's still not enough if we are going to address the needs and stay competitive. So, how do we do that? One of the entry/pathways we can do that, and that being the MSIs, and particularly the HCBUs. Chart 25 shows a report that came out last year, "The Skilled Technical Workforce: Crafting America's Science & Engineering Enterprise." This study looked at those groups of workers which use STEM-capable skills that do not require a bachelor's degree.

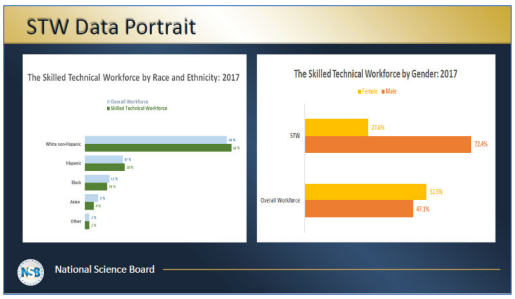
Charts 29-30:



And why are we focusing on a skilled technical workforce (STW)? We are because the National Academy of Sciences (NAS) a few years ago noted that by 2022, if you look at the many industries (automotive, gas and oil, healthcare industry, materials industry, chemical industry, etc.) there is going to be a shortage of about four million workers. Again, these are workers with STEM-capable skills such as technical qualifications, or two-year degrees, but not bachelor degrees. This is a real imperative from a national prosperity, security, and long-term health of the science and engineering enterprise, and requires opportunities for all Americans. Chart 30 highlights the National Science Board (NSB) events over about 18 months across the country in terms of listening sessions. An interesting anecdote regarding the automotive industry is that in 5-10 years we will be all driving vehicles capable of autonomous-driving, and we were at a technology conference in Detroit, where representatives from that industry told us that in the next 3-5 years they are going to need a million workers, but these are not the same workers who descended on Detroit back when Henry Ford built his plant. What these workers need now is to know how to code, they need to know sophisticated electronics, but they don't need a bachelor's degree to get these high-paying jobs.

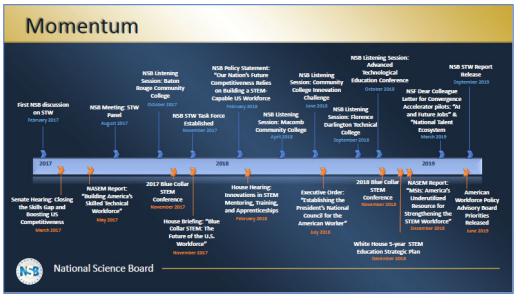
Charts 31-32:





In chart 31, if you look at the salaries and unemployment rate, the STWs come out very good. Again, at the University of the District of Columbia we are fully integrated, we have a community college, we have a four year ABET-accredited school, we have graduate school, and we even have a school of law. In our community college we have a workforce development program, and even have a hangar at the National Airport where students can get an FAA certificate in two years and then go on to work at an airline and make $70K per year. So, you can see the premium and attraction. Chart 31 also shows the STWs by occupation. Chart 32 shows that, when we look by race and ethnicity, it matches that of our nation's demographics. However, in terms of gender the STW is still male-dominated, but I hope to see that change over the next years.

Charts 33-34:



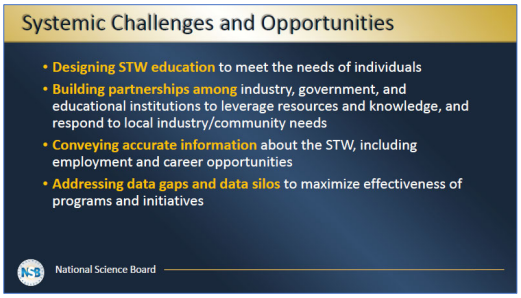
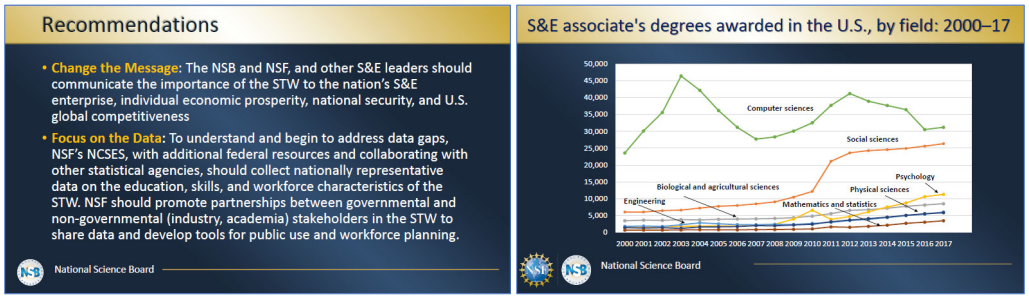


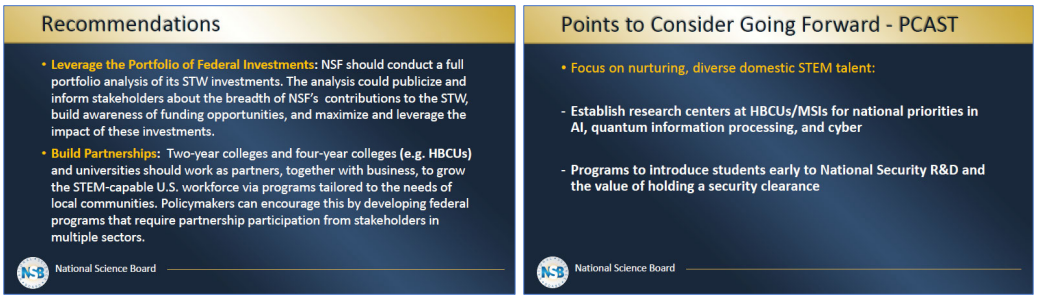
Chart 33 shows a chronological timeline of all the work we have done. At the hearings at the House we have gotten bipartisan support and, in fact, in 2018 the President established the Council for the American Worker, which involves the head of the NSF, secretaries of Labor, Education, Commerce, and the Department of Veteran Affairs. Right now, they are looking at the messaging and how to get more funding through partnerships with community colleges and technical schools. In fact, recently the President relaxed the requirements for entering the Federal workforce to pursue degrees that do not really need a bachelor's degree, particularly in Information Technology. Chart 34 shows some of the challenges we have, such as designing STW education, building partnerships, conveying accurate information about STW about employment and career opportunity, and addressing data gaps. This leads to the next slide in terms of recommendations.

Chart 35-36:



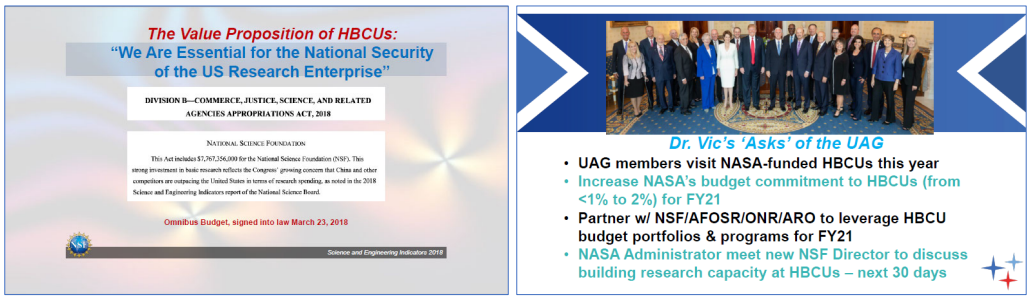
So, what is "Change the Message?" Thirty years ago, it might have made sense to tell someone not going to college to become an electrician, or similar profession. However, that makes no longer sense. Also, pushing people towards college is harder because of its cost and resulting high levels of debt. Therefore, we are focusing on the data and how to get accurate information to inform young people on potential career paths. We recommend promoting partnerships between the government, industry, and academia to share data and develop tools for public use and workforce planning. Were trying to update the data pipes that the government can have for people to make better choices. Chart 36 shows how since 2010 there has been an upwards trend of people in associate degrees in STEM areas. The differences in salary with bachelor degrees is also shrinking. In fact, in petroleum and gas fields a starting operator's salary is around $100K.

Charts 37-38:



The other two recommendations are to leverage Federal investments and build partnerships. A lot of times the Federal investments are fragmented. We need to start working together to talk about leveraging our investments, not just NASA's investments but also those at DoD. And, finally, we need to build partnerships between two-year colleges, four-year colleges, and universities. Therefore, HBCUs are a national priority for establishing research centers. Also, they introduce students early to national security R&D and the value of holding a security clearance. A high percentage of HBCU students are U.S. citizens. We have talked to them about good behavior, and if they pass their background checks that starts to build their career.

Charts 39-40:



HBCUs are essential for the national security of the U.S. research enterprise. I recommend that the UAG members visit the NASA-funded HBCU's. It'd be also wonderful if, say, NASA could increase its budget commitment to HBCUs from under < 1% to 2% in FY21, and that will pay dividend in terms of a qualified workforce available to NASA. It is also important for NASA to partner with other agencies in order to leverage its portfolio.

Q&A:

- Adm J. Ellis, Jr.: Do the trends in the affinity of students for STEM education and careers mirror those in other academic institutions? Is overall interest in STEM growing, or is it shrinking?
- Dr. McCrary: We have a panel on HBCUs where institutions can talk about their experience with STEM and, yes, the interest is growing. Most of our students are going in for careers and opportunities. However, it is always an issue of access, that is, students being able to get a chance in internships and moving on to permanent jobs.
- Adm J. Ellis, Jr.: My other take from your briefing is the complexity in number of organizations, etc. Are you satisfied that we have a system that allows to assess which levers are most effective to support this effort?
- Dr. McCrary: Yes, we do have such ability. The question is, we need to have the conversation. A lot of people have good ideas, and so they are not being able to leverage what they can do. We must have difficult conversations such as, for example, at non-minority institutions having a faculty that better mirrors the racial distribution in our society. Note that only 10% of Black students go to HBCUs, and the rest go to predominantly white institutions. We've seen this with women in science, and it is not different with race.
- Col Eileen Collins: I've heard how disciplined and strong work ethics HBCU students have. What is the secret and/or culture at HBCU to accomplish this, and how are they going to keep doing this as classes move online because of COVID-19?
- Dr. McCrary: There are kids that may have few means, and maybe are the first generation in their family to go to college, and we tell them how as long as they work hard this is what they can accomplish. We also bring them to conferences where they can meet people from similar backgrounds that have become successful. The secret is constant nourishment.
- Gen Lester Lyles: Are you coordinating with the DoD research and engineering community?
- Dr. McCrary: I have just facilitated a meeting with the Director of the National Science Foundation and the Chief of Naval Research to start talking on this issue because when you look back at a lot of the investments in science the DoD has made, while the mission may be different the science is the same as well as the need for a workforce. Similar meetings are happening with other folks at the Department of Defense (DoD).
- Gen Lester Lyles: As a graduate of an HBCU, I am very interested in all that is going on. Please count me in to make sure the top leadership in the Air Force is aware of this.
- Lt. Gov. Jeanette Nuñez: I serve as Lt. Gov. in Florida, which is home to a wonderful HBCU, Florida Agricultural and Mechanical University (FAMU). The governor last year issued an order to put FL on the path to become number one in career and technical education. In regards to building partnerships, you mentioned the two- and four-year colleges. I wanted to get your sense on the partnerships that are around the Cape and how they are moving forward on this initiative.
- Dr. McCrary: It is difficult to talk a 17-year-old student into STEM, as they're likely to have already made their mind on a career path. That's where HBCUs in places such as FAMU reach out to K-12 and also to teachers that teach students on math, etc. That's where we are going to rely on partnerships.

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<u>UAG Summary of Meeting Goals</u>
Adm J. Ellis, Jr. (USN, Ret.), Chair, UAG

As the UAG enters its second term it remains very engaged in addressing many of the areas it was asked [by the National Space Council] to examine, as well as those the UAG has identified for our own detailed review in the areas of civil exploration and national security. We have often challenged the status-quo and asked probing questions on levels of regulatory oversight, obstacles to space commercialization, architecture for Lunar exploration, enhancements to education and outreach, and how to best involve our international partners in the nation's space enterprise. And, in all cases, we have assessed the realities of proposed technological timelines and the adequacy of allocated resources. In other less public conversations, we've offered what we believe are constructive refinements for organization framework, assignment of authorities, prioritization of tasks, and enhanced procurement policies as the nation reshapes

its national security space capabilities as the nation meets new challenges. The objectives of the UAG, as explained in the charter, are intentionally both broad and deep. In part it reads, "the UAG shall provide advice to the Chair of the National Space Council and its membership on government wide space-related activities including, if applicable, interagency coordination and cooperation." Virtually anything related to space, and the American space enterprise, is within our remit to offer advice and assistance, if required. We are now going to move into discussion of specific UAG subcommittee activities, past, present, and future, and where appropriate also subcommittee findings and recommendations. The subcommittees are really the essence of where the work is done. The COVID-19 restrictions have not stopped the work of the subcommittees, and at least three [of the six subcommittees] are ready for some public deliberation as detailed in the FACA for arriving at findings and recommendations.

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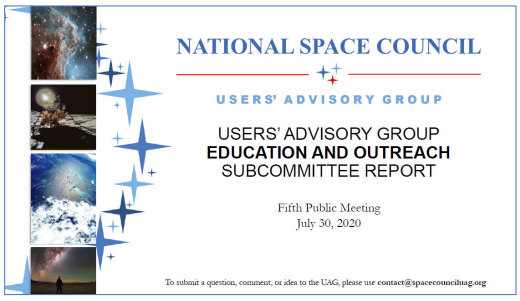
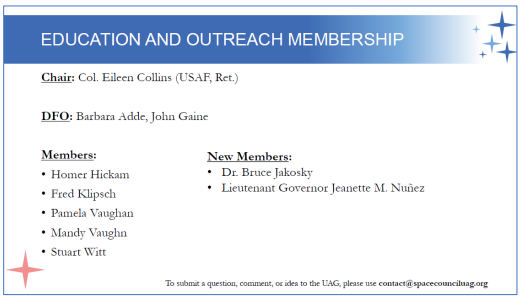
Education and Outreach Subcommittee Report
Col Eileen Collins (USAF, Ret.), Subcommittee Chair

Charts 1-2:





The Education and Outreach subcommittee has a new designated federal officer, Ms. Barbara Adde, five reappointed members, and two new members: Dr. Bruce Jakosky and Lt Governor Jeanette M. Nuñez.

Charts 3-4:

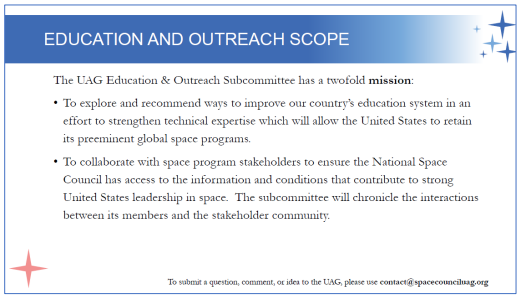
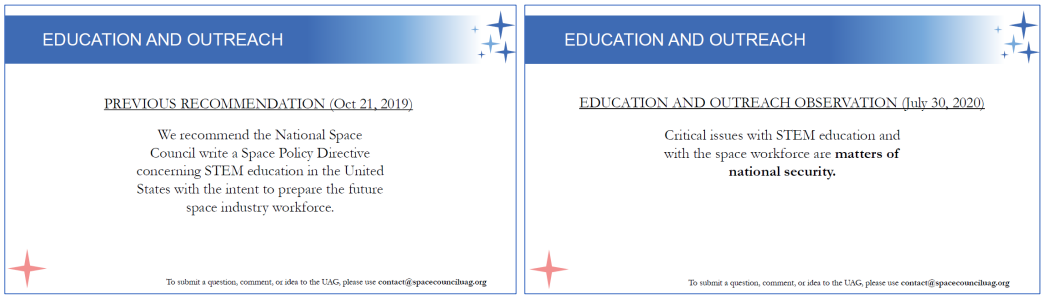


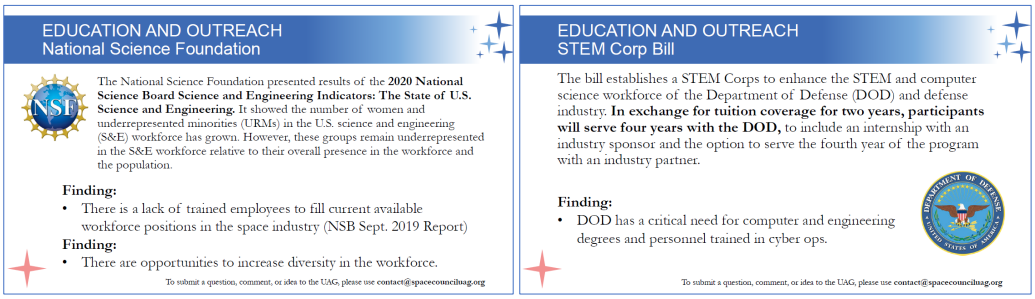
Chart 3 shows the subcommittee's mission, and chart 4 is a summary of the activities over the last several months. In March we talked to the National Science Foundation (Dr. Karen Marrongelle, who's the NSF Director for Education and Human Resources). In April we talked to two U.S. representatives (Jim Banks from Indiana, and Andy Kim from New Jersey) on the bipartisan bill called the STEM Corp Bill. In May we spoke with the President of Arizona State University, Dr. Michael Crow. In June we spoke with Space Camp, (Dr. Kay Taylor, VP Education & Dr. Kim McCain, VP Sales, Marketing, Strategic Development). The meeting on July 15 was not a subcommittee activity, just an event that I did at the Glenn Symposium where I sat on a panel on the aerospace workforce, sponsored by the American Astronautical Society (AAS). On that panel discussion I went over what I'm going to talk about today. On July 16 we talked with Dr. McCrary in a similar pitch for what he just briefed to the UAG.

Charts 5-6:



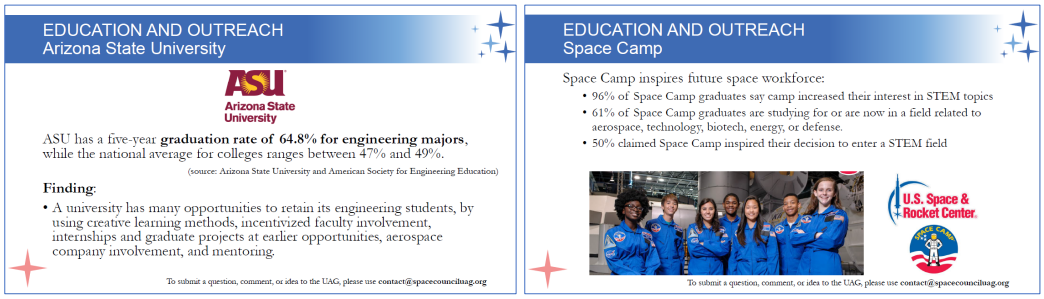
Before we get into each of the topics, I wanted to let the new members to be aware of the recommendation that our subcommittee put forward on Oct. 21, 2019 (UAG 4th Meeting), "We recommend the National Space Council write a Space Policy Directive concerning STEM education in the United States with the intent to prepare the future space industry workforce." This was no small recommendation, and we realize that the NSpC has put out four Space Policy Directives so far and, as an Executive Order (EO), there is quite a bit of work that goes behind these. We focused on the workforce because education overall is just too broad. We met with the NSpC staff back in April and discussed how the process to develop an EO works. I just wanted the UAG know that there is some work going on in that area. The future presentations that the subcommittee is scheduling are part of the effort to support this recommendation. I also wanted to make an observation up front, "Critical issues with STEM education and with the space workforce are matters of national security."

Charts 7-8:



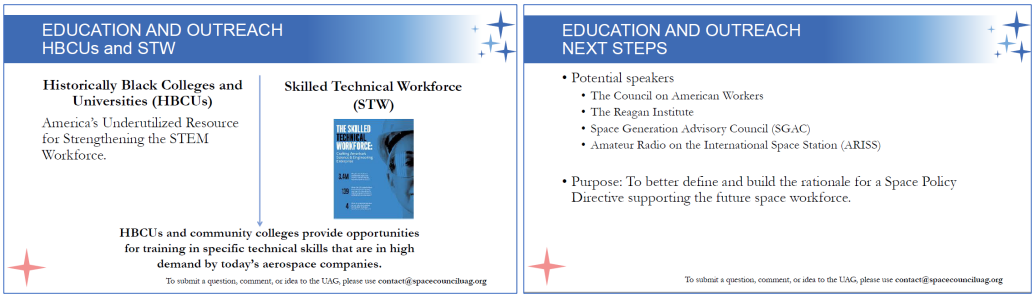
As shown on chart 7, the first briefing we did was with the NSF. The key finding from this meeting was that there are opportunities to increase diversity in the workforce. This finding came from Dr. Marrongelle's presentation to our subcommittee. There are good trends in the workforce, but more needs to be done to make the workforce more representative of the population. The other finding was that there is a lack of trained employees to fill current available workforce positions in the space industry, per the NSB Sep. 2019 report. One of the conclusions in that report is that by 2020 there would be 3.4 million unfilled skilled technical jobs (machinists, electricians, welders, computer technicians, programmers, etc.) in the U.S. Chart 8 summarizes the bipartisan STEM Corp Bill introduced by Jim Banks (Indiana) and Andy Kim (New Jersey) in August 2019. Primarily, what this bill is doing establishing a STEM Corps to enhance the STEM and computer science workforce of the DoD and defense industry. It would fund two years of college for a student accepted into the program, and upon graduation would serve four years with the DoD, including an internship with an industry sponsor and the option to serve the fourth year of the program with an industry partner. The bill was introduced to address the DoD's critical need for computer and engineering degrees and personnel trained in cyber ops. This bill has a lot of support within Congress. It should be noted, however, that as a FACA board we are not allowed to endorse legislation. What we can do is to inform the rest of the UAG about this bill. This is another example of how education and training crosses into national security. And, by the way, it is not just cybercops. There is also data analysis, artificial intelligence, and other needs at the DoD. If anyone is interested in this program, I have a one-pager I can forward to you.

Charts 9-10:



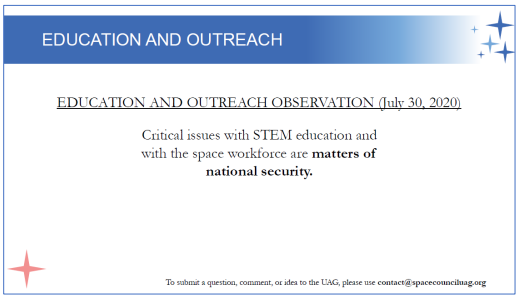
Our next meeting was with the President of Arizona State University (ASU), Dr. Michael Crow. One of our first issues in 2018 was to understand why there was such a high dropout rate in engineering majors across colleges in the country. We thought it was a tragedy to see a student who's interested in becoming an engineer get disillusioned and drop their major in the first year. We did quite a bit of outreach in our first year, talking with students themselves and their professors. Along the way we found out of the incredible success at ASU. Around 2005 the ASU president made a number of changes to correct this issue. Under the finding you can see what we learned from ASU, and some of the programs they introduced to improve their retention rate. This included using creative learning methods, incentivizing faculty involvement, incorporating internships and graduate projects at earlier opportunities (even in the freshman year), involving aerospace companies, and mentoring. In June we met with Space Camp (Chart 10). They are currently having difficulties because of COVID-19, but that was not the reason why we scheduled the briefing. We wanted to talk to them to ensure we stayed in touch with the younger students. Most of our work has been with higher education, and we it would be important to know what excites younger students. Space Camp really inspires the future space workforce. A key finding is that experiences like Space Camp has inspired student's decisions to enter the STEM field. Twelve astronauts are Space Camp graduates, we have two subcommittee members who went to Space Camp, and even Elon Musk went to Space Camp. We are going to keep in touch with programs like this.

Charts 11-12:



Our final briefing was with Dr. McCrary. You just had a shorter version of the briefing we were given on HBCUs and the STW. We don't have a finding yet, but we probably will for our next UAG. I do have a summary point, "HBCUs and community colleges provide opportunities for training in specific technical skills that are in high demand by today's aerospace companies." Another finding is that many students in advance degree programs come from other countries, and only a smaller percentage remain in the U.S. after completing their degree. I asked the NSF for some numbers, and between 62-78% of science and engineering PhD's stay in the U.S. This is, again, something that the UAG can track in the long term. Another thing that Dr. McCrary mentioned are public service announcements to encourage the STW. This is something I hope our subcommittee can discuss with the UAG on whether it is a possible recommendation. As shown on slide 12, going forward, potential speakers could include the Council on American Workers (which was established by EO), and the Reagan Institute (who were critical in developing the STEM Corp Bill). We are always open for UAG members to provide suggestions on who, or what organizations, we can invite to brief us. How will we select those speakers? Basically, it will be those that help us better define and build the rationale for a Space Policy Directive recommendation that we made last year.

Chart 13:



Finally, I wanted to repeat our earlier observation for education and outreach, that we believe the issues with STEM education and workforce are matter of national security, especially in the space industry.

Q&A:

- Adm J. Ellis, Jr.: Back to your point about a space policy directive, you've sampled a lot of entities working these issues. What's your sense about coordination and alignment of national efforts to improve STEM education? Who should actually be in charge of that and what may be a path forward?
- Col Eileen Collins: Yes, we've had discussions with NSpC staff and went through the process to develop an EO. Our subcommittee can be called in for help, but process to write EO will initially take place without our involvement. That would involve bringing a group of experts together. I'd like to remind everyone that we make recommendations, not demands, and what we think the NSpC should prioritize. The process to develop a Space Policy Directive (SPD) will be long, but I've been assured it has begun.
- Adm J. Ellis, Jr: Thanks for your work. You're one of our most active subcommittees.

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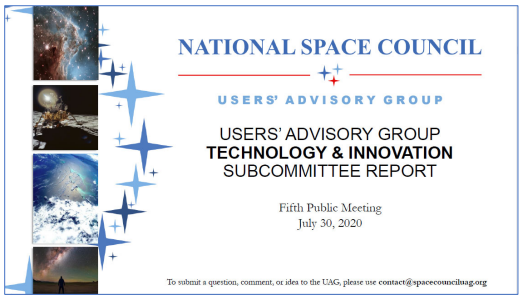
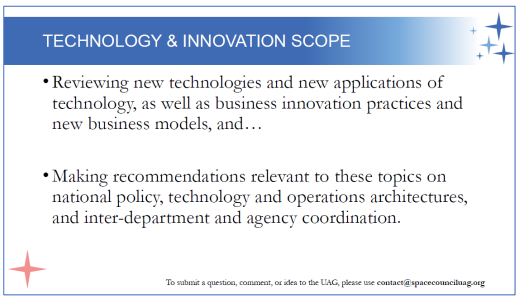
Technology & Innovation Subcommittee Report
Colonel Pamela Melroy (USAF, Ret.), Subcommittee Chair

Charts 1-2:



Col Melroy noted her subcommittee has two recommendations to bring forward today, and a lot of material to cover. She also welcomed the subcommittees new member, former congressman the Hon John Culberson.

Charts 3-4:



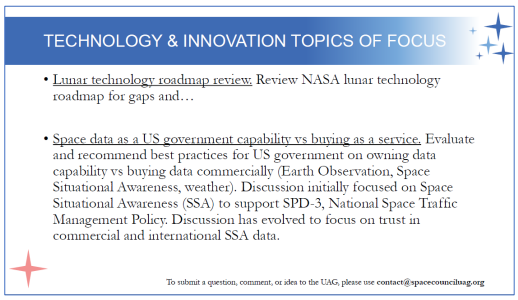
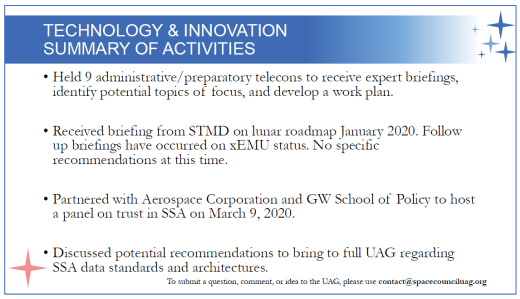
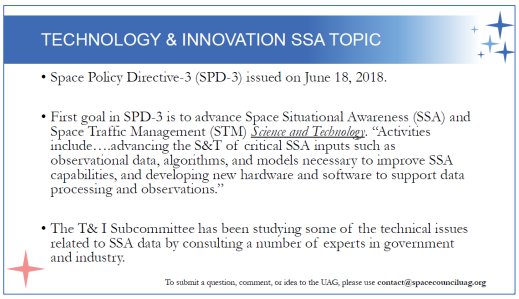


Chart 3 shows the scope of the subcommittee. We are looking at new technologies and new applications of technology, as well as business innovation practices and new business models, and making recommendations on this topic. Over the last 6-8 months we have been focused on two areas (Chart 4). The first one is the lunar technology roadmap review for gaps, and the second one is to review space data as a U.S. government capability vs. buying the data commercially, including remote sensing, space situation awareness (SSA), and weather data. This subject is very interesting, but also broad, so we started looking at SSA in support of SPD-3, "National Space Traffic Management Policy." This effort evolved into focusing on trust in commercial and international SSA data.

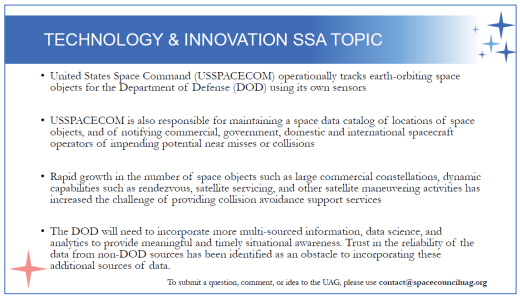
Charts 5-6:





Since the last UAG meeting in the Fall we've had nine administrative and preparatory meetings/telecons, and have received many expert briefings and in-depth discussions (Chart 5). In January we received a briefing from the NASA Space Technology Mission Directorate on the STMD on lunar roadmap. We've had some follow-up briefings on the exploration spacesuit (xEMU), but don't have any specific recommendations at this time. On March 9 we partnered with the Aerospace Corporation and George Washington School of Policy to host a panel on trust in SSA. Also, we have discussed potential recommendations which we are bringing forward to the UAG today regarding SSA data standards and architectures. As shown in chart 6, the first goal in SPD-3 is to advance SSA and Space Traffic Management (STM) Science and Technology (S&T). The subcommittee has been studying some of the technical issues related to SSA data by having conversations with experts.

Charts 7-8:



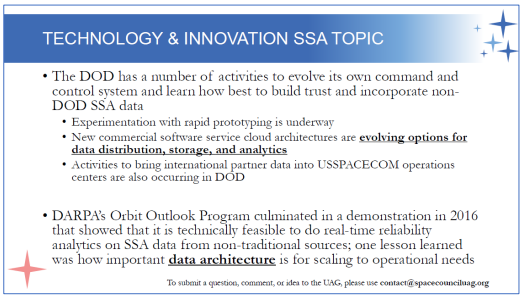
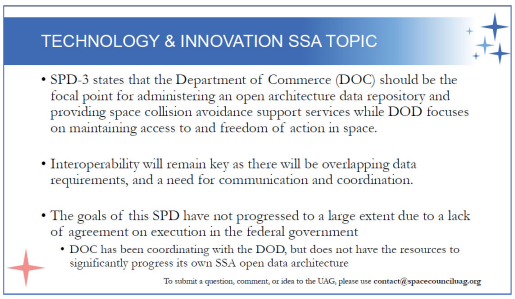
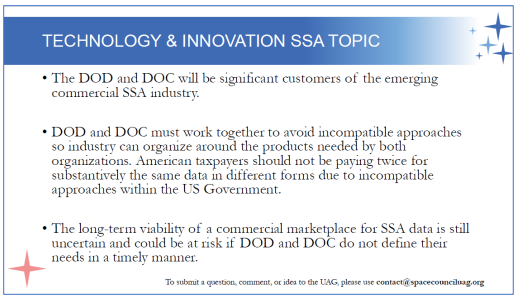


Chart 7 provides context. The United States Space Command (USSPACECOM) is operationally tracking earth orbiting space for DoD, and has its own sensors to do that. USSPACECOM maintains a space data catalog of locations of space objects, and if there is a potential near miss or collision, they are also responsible for notifying commercial, government, domestic and international spacecraft operators. This job has gotten much harder in recent years, first because we have a lot more objects in space, and second because there are many more dynamic opportunities occurring such as satellite servicing. As such, the DoD will need to incorporate more multi sourced data, not just from their own sensors, and analytics to provide meaningful and timely situational awareness. The DoD calls this Space Domain Awareness (SDA), but this term is not yet widely in use so I will call it SSA. So, if the DoD needs more data, trust in the reliability of that data has been identified as an obstacle for moving forward to incorporating such data. As shown on chart 8, the DoD absolutely understands this, and has many activities going on to evolve the command and control system. This how to build trust and incorporate non-DoD SSA data. There is a lot of experimentation going on right now inside DoD, and they are looking at commercial software services cloud architectures. That is a rapidly evolving area of business, and with many layers of service. There have also been important activities to bring international partner data into USSPACECOM operations and evaluating it in real-time. We took some time to look into the Defense Advanced Research Projects Agency (DARPA) Orbit Outlook Program. The goal of that program was to provide real-time data vetting for non-traditional data sources. In a demonstration in 2016 the program proved that it is technically feasible to do real-time reliability analytics, however the data architecture is really critical to enable scaling to large scale operational needs.

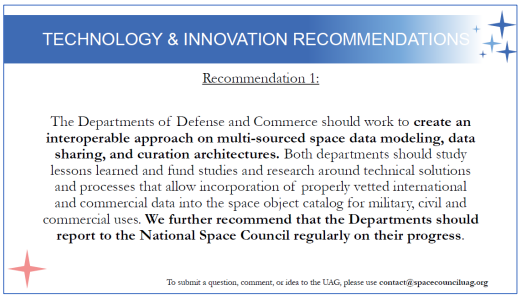
Charts 9-10:





I'd like to focus for a moment on the DOC's (Department of Commerce) role (Chart 9). SPD-3 states that DOC should be the focal point for administering an open architecture data repository, and take over [from USSPACECOM] providing space collision avoidance support services. This will enable the DoD to focus on maintaining access to and freedom of action in space. DoD is going to continue to need to operate its own sensors and have a command and control function, and inseparability is absolutely critical. I often give the example or air traffic services, where the DoD and the Federal Aviation Administration (FAA) interface seamlessly, such as when an aircraft taking off out of an Air Force Base gets handed off to an FAA controller. That's the kind of interoperability that we have to expect from the DOC and DoD. Unfortunately, of all the SPDs, this one has not progressed as significantly because there is a lack of agreement on execution in the federal government in regards to space traffic management. Last week, and completely independent of UAG activities, the NASA Aerospace Safety Advisory Panel (ASAP) made a recommendation to Congress to designate a lead federal agency for civil space traffic management, and provide that agency with resources to do the job. I thought that was interesting because we made the same observation, but obviously we don't make recommendations to Congress. So, going forward, DoD and DOC will be significant customers of those emerging commercial SSA industry (Chart 10). It is very important that they work together to avoid incompatible approaches. As an example, when you are asking for very slightly different things, the U.S. government is going to essentially pay twice for the same data but in slightly different form. The long-term viability of a commercial marketplace for SSA data is still uncertain, so it is going to be important for DoD and DOC to define their needs so that the commercial SSA community can understand what is actually the size of the U.S. government market.

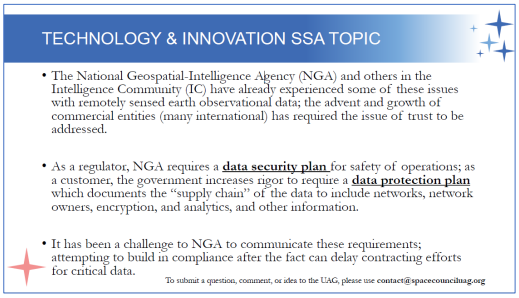
Charts 11:

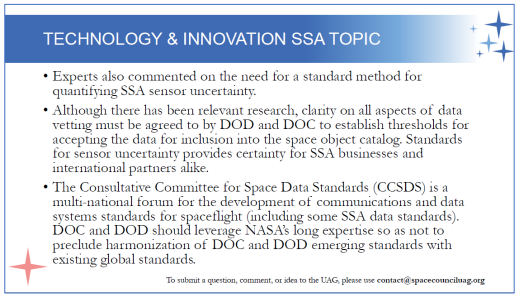


This leads to our first recommendation, "The Departments of Defense and Commerce should work to create an interoperable approach on multi sourced space data modeling, data sharing, and curation architectures. Both departments should study lessons learned and fund studies and research around technical solutions and processes that allow incorporation of properly vetted international and commercial data into the space object catalog for military, civil and commercial uses. We further recommend that the Departments should report to the National Space Council regularly on their progress." I would like to throw it open to the UAG for discussion at this point:

- Adm J. Ellis, Jr.: Any comments from participants? We've had these slides for several days now.
- Gen Lester Lyles: How similar is this recommendation from the one that the ASAP address to Congress last week?
- Col Pamela Melroy: I think the recommendation they made is similar, but I thought one of the very relevant comments was requiring whole of government engagement, public-partner partnership, and collaboration between industry, government, academia, and the international community. There is going to be more relevance in our follow-on recommendation.
- Adm J. Ellis, Jr.: Pam, let's discuss your second recommendation before voting on both.

Charts 12-13:

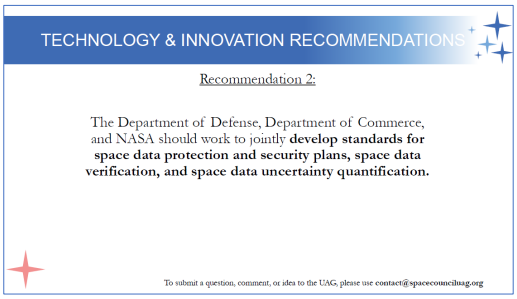




Another interesting briefing was from the National Geospatial-Intelligence Agency (NGA), who has been grappling with some of these issues on how you trust data from sources that you don't own and operate (Chart 12). For them it's been remotely sensed earth observational data, and in a lot of way they're further down the path than the rest of the government on the issue of trust with commercial and international entities. It's really about the safety of the operation in order to get a remote sensing license, which is one of the requirements regarding the supply chain of the data such as who provides the data, what network is it transmitted on, who owns those networks, encryption, who provides the analytics, and so forth. The objective is to establish an end-to-end protection plan. It has been challenging for the NGA to communicate these requirements to us. Another area where standards came up was the need for standard method to quantify the uncertainty in the orbital position (Chart 13). That is usually provided with SSA data, but there is no standard for the certainly of the sensor itself. We got an example of three different orbital positions from three different sensor networks, and the uncertainly bubbles didn't even overlap. If there were standards for sensor uncertainty, that would make the ability to test and compare different sources of data and understand what level of accuracy and reliability they have. One of the interesting discussions we had was with the Consultative Committee for Space Data Standards (CCSDS), a multinational forum of all the space agencies and some affiliates. NASA is

heavily involved in that. CCSDS is very important for the development of common communication standards for spaceflight, and they do have some SSA data standards. It's obvious to us that DOC and DoD should get engaged in that. What you don't want is DOC and DoD going off on their own to develop standards on their own that are not strong enough internationally.

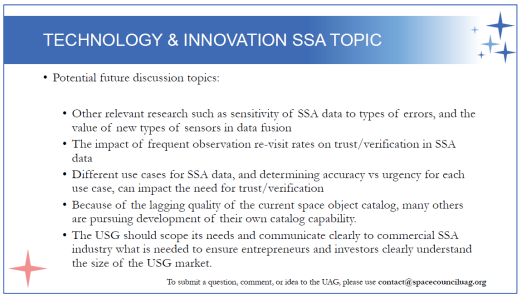
Chart 14:



To sum up these findings, our second recommendation is for the DoD, DOC, and NASA to work to jointly develop standards for space data protection and security plans, space data verification, and space data uncertainty quantification. Before we open this up for discussion, I'd like to point out that the ASAP last week recommended that NASA, in collaboration with other government agencies and industry, develop and publish guidelines for STM, and develop proposals for an STM technology roadmap. Again, this is remarkably similar, but we went a little bit deeper.

- Adm J. Ellis, Jr.: Any comments on this part of the presentation?
- Col Eileen Collins: I just have a quick comment. NASA may have standards for their astronomy data from Hubble, Chandra, and other missions which could be useful. Otherwise, I fully support this recommendation.
- Mr. Eric Stallmer: Recently we have been working with four standard developing organizations (SDOs) on the work going on with the space community. This may be helpful to this effort. I'll share these standards with you.
- Adm J. Ellis, Jr called for a vote on the two recommendations. *[Result: all ayes, no nays]*
- Adm J. Ellis, Jr: Ok, now let's move to Pam's last slide.

Chart 15:



I'll just point out that there are other areas for discussion and research. If you frequently re-visit an observation, that has a big impact on trust. There are different use cases for SSA data, with different levels of precision and urgency. I also wanted to note that because of the lagging quality of the current space object catalog, others internationally are pursuing develop of their own catalog capability. That's significant because the U.S. is currently the leader in this area, but because we're not able to incorporate international data the way we'd like to, others are off doing their own thing. This is a point of urgency. These are future topics that we will be discussing in the subcommittee.

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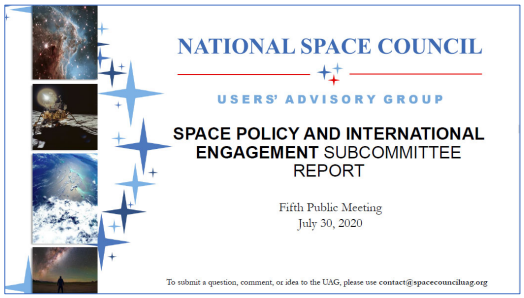
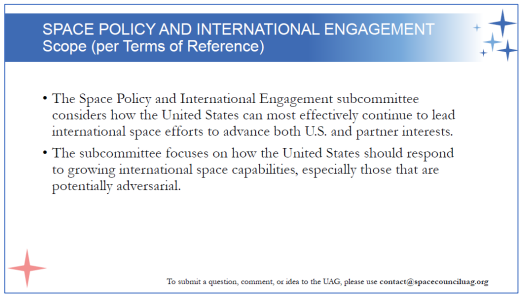
Space Policy and International Engagement Subcommittee Report
Dr. David Wolf, Subcommittee Chair

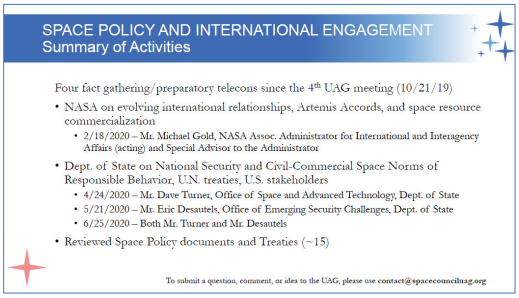
Charts 1-2:



Dr. Wolf welcomed the new subcommittee member, Mr. David Calhoun, and new DFO, Dr. Ben Ashman.

Charts 3-4:





The subcommittee has the following overarching goals: (1) to consider how the U.S. can most effectively continue to lead international space efforts to advance both U.S. and partner interests; and (2) focus on how the U.S. should respond to growing international space capabilities, especially those that are potentially adversarial (Chart 3). The subcommittee had four external meetings/conversations, one with NASA and three with the State Department, and reviewed great lengths of documents pertaining to space policy (Chart 4).

Charts 5-6:

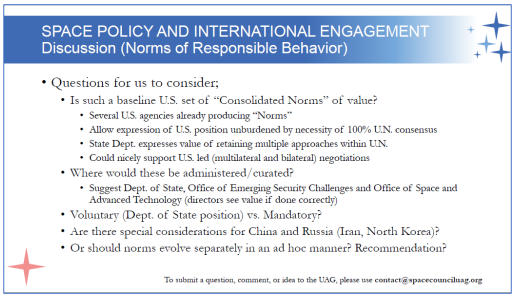
The subcommittee's areas of focus are to promote: (1) U.S. global leadership; (2) norms of responsible behavior in space; (3) deterrence, attributability, and stability in the space domain; and (4) unique considerations for China, Russia, and possibly Iran and North Korea (Chart 5). I'd like to read through some observations that are representative (Chart 6). The role of space in the national security, commercial, and civil sectors is rapidly evolving, as we all know. Allies and adversaries are rapidly advancing in all sectors. NATO has recognized space as a new operational domain, or war-fighting domain, in its 2019 Space Policy. China and Russia are actively weaponizing space, even very recently. There is high competition to attract global commerce, and there are many new emerging state participants

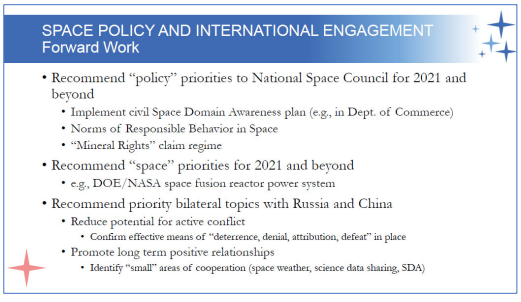
to be garnered. Multiple diverse stakeholders exist for various "Norms of Responsible Behavior" (NRB), and within the U.S. alone there are also multiple stakeholders. In maritime and arctic domains, the NRBs are very mature and understood by the various parties involved in international waters. With the United Nations (UN), there are voluntary measures. Two of the main ones are: (1) Transparency and Confidence Building Measures (which focuses on National Security); and (2) Guidelines for the Long-term Sustainability of Outer Space Activities (which focuses on civil and commercial aspects). These two heavily overlap, and we have two offices in the Department of State that address each of those and coordinate to a large degree. These UN curated norms are necessarily slow to evolve (for decades in some cases) and their scope is adjusted to get agreement by all the nations unanimously. For example, there was a European Union (EU) attempt over some years to create some norms of behavior, but in 2015 they were not able to get consensus. Within the U.S, we have the NASA Artemis Accords, which are beginning to address Deep Space issues, such as mineral right claims. Even this Monday in Vienna, Austria, was the first U.S. bilateral Space Security Exchange (SSE) with Russia to advance NRBs in the space warfighting domain to avoid misperceptions and miscalculations. So, we crossed over to the national security sector. Also, the U.S. Space Warfighting Doctrine is about to roll out from the DoD. As noted earlier, we have two State Dept. offices that address all of this at the UN: (1) Office of Emerging Security Challenges (focusing on national security issues); and (2) Office of Space and Advanced Technology (focusing on civil/commercial issues). These offices also coordinate with U.S. stakeholders

Charts 7-8:

I want to get into a bit of a discussion on the NRBs. An opportunity exists for the U.S. to lead by establishing Norms of Responsible Behavior in space, and the 50-year-old legally-binding UN space treaties did not contemplate scope and scale of activity (Chart 7). So, we can consider a recommendation that reads something like, "Establishing U.S.-validated NRBs in space to promote security, stability, and sustainability across the national security, civil, and commercial space sectors." It would be valuable to coordinate the multiple U.S. stakeholders. There are more examples on how this is being done by the NSpC (Chart 8). We are looking to produce a recommendation that would bring these together.

Charts 9-10:





There are a number of questions we can consider (Chart 9). Is such a baseline U.S. set of "Consolidated Norms" of value? Several U.S. agencies already producing these kinds of norms. This would allow expression of U.S. position unburdened by the 100% necessity of UN consensus. In talking with the State Department offices mentioned earlier, they see the value in doing this if done correctly. This could nicely support U.S. -led multilateral and bilateral negotiations. There are other questions you can read later, such as: Where would these be administered/curated?

Should they be voluntary or mandatory? Chart 10 shows the subcommittee's work going forward. We can leave the briefing here and open for discussion.

Q&A:

- Adm J. Ellis, Jr.: As you noted, there are efforts underway as recently as Monday, continuing in Vienna. One of the frustrations is the balance one sees in these things, and I wonder what your experience tells you. If you want it quick it's almost unilateral and declaratory, but if you want it by consensus it involves negotiations and extensive conversation over many month or years. What is your sense of the optimization of that kind of a process? Have you talked much about that?
- Dr. David Wolf: The State Dept. would like to pursue its current approach for interacting with the UN, where they do it separately for national security and civil/commercial. But, essentially, they're working off a common set of books. The alternative would be to have it be ad hoc for every agency involved, such as the Artemis Accords, which were very good. These could be put together into a U.S. book that the State Dept. can work from. That seems like an optimum.
- Adm J. Ellis, Jr.: I see what you mean. It would consolidate our own positions before we attempt to engage the international community. Recognizing that there are not recommendations, they're a good indication of the direction this subcommittee is moving.
- Fatih Ozmen: I have a quick comment for consideration later. Listening to this briefing, it reminds me of the early days of the internet (early 90's) and ICANN (Internet Corporation for Assigned Names and Numbers). The Dept. of Commerce took over from ICANN, and eventually it went back and forth in the UN. You may want to look at this as a potential model to review and understand the plus and minuses. This also ties in with Col Melroy's earlier comments on STM and SSA, how we deal with Big Data as threats and policies continue to quickly evolve around the world.
- Adm J. Ellis, Jr.: That is a great point, and it works on both sides too. You can examine that as a process for evolving or achieving accords, but you can also look at it and see where it has arguably not worked as we might like, with some of the challenges we've had on security and misuse of the technology. This kind of gives you a lesson from both sides.
- Dean Cheng: I still remember way back in high school when I participated in a NASA-sponsored initiative to get students to come up with experiments to fly on the Space Shuttle. And, building off the discussions from the Education and Outreach subcommittee, one of the things to think about here as part of international engagement might be for NASA and other parts of our space enterprise to think about outreach to the international high school level, for example, experiments to fly on the space station, on the Lunar Gateway, or on the surface of the Moon. Offering such opportunities around the world helps to highlight the international nature of the U.S. space enterprise, and it also plays off the NASA brand name. This might offer very important public diplomacy.
- Adm J. Ellis, Jr.: Yes, that's a great point. I know there is some effort domestically. I was talking to someone yesterday about a middle school student that is working on a microsatellite. That's amazing. But how can one expand that globally? I also wonder if you can engage at the high school level on the policy conversation on rules and norms of behavior. David, what do you think? Is there a way we can go beyond hardware into the policy piece as well? Are there any other thoughts form the UAG?
- Congressman John Culbertson: I think Dr. Wolf's observations are right on target. I hope we move on a recommendation that the U.S. will only cooperate with nations that would adopt similar standards on norms of responsible behavior like NASA has done, with absolute transparency and instant sharing with all the world of everything that we've learned. I also recommend to expand these norms of behavior to include planetary protection to make sure we don't carry Earth organisms to other worlds we visit.
- Adm J. Ellis, Jr.: That's a great point.
- Dr. David Wolf: Yes, those are the things that our proposed approach is designed to capture.
- Dr. Mary Lynne Dittmar: Just to build on what everybody has said, I would like to emphasize the urgency in this. There is now a proliferation of discussion in space policy among different agencies, non-governmental organization, and nations with regard to norms. Therefore, we need the whole-of-government approach as suggested by Dr. Wolf.
- Adm J. Ellis, Jr.: Yes, there is a sense of urgency here. David, the need to redress the differences on process is something your subcommittee may want to think about.

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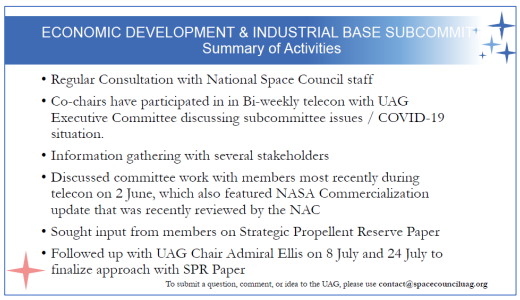
Economic Development & Industrial Base Subcommittee Report
Dr. Mary Lynne Dittmar & Mr. Eric Stallmer, Subcommittee Co-Chairs

Dr. Mary Lynne Dittmar noted that Mr. Eric Stallmer would be presenting the first part of the briefing.

Charts 1-2:

Mr. Eric Stallmer thanked the DFO, Mr. Nate McIntyre, for his support. This subcommittee has two new members, Ms. Eileen Drake and Lt. Gov. Jeanette Nuñez.

Charts 3-4:



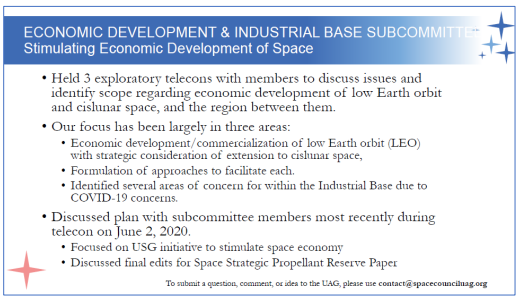
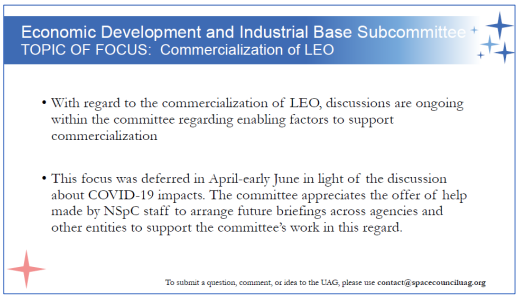


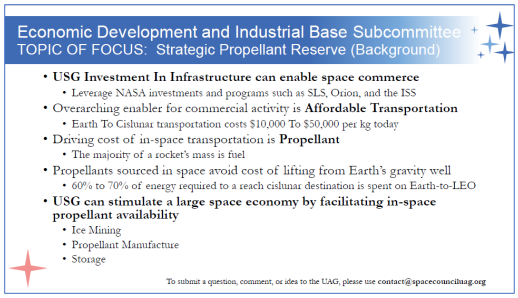
Chart 3 summarizes our activities since the last UAG meeting. A lot of our subcommittee work has been regular consultation with NSpC staff, which has been very helpful to our efforts (Chart 3). As co-chairs, we have been very active participating in the UAG Executive Committee (EXCOM) biweekly virtual meetings, that have really helped us discuss some of the issues the subcommittees have gone through in handling the COVID-19 situation. During this time, we've had several information gatherings with a variety of stakeholders. On June 2 we had a subcommittee meeting which featured a NASA Commercialization update that was recently reviewed by the NAC. We have also been working with our subcommittee members and Adm J. Ellis, Jr., to finalize our paper on a Strategic Propellent Reserve. As shown on chart 4, we've had three exploratory telecons with our members, basically to discuss how to identify and scope the economic development in Low Earth Orbit (LEO), Cislunar space, and the region in between. Our focus on those calls has been primarily these three issues: (1) economic development/commercialization of LEO; (2) formulation of approaches to facilitate each; and (3) identifying several areas of concern for within the Industrial Base due to COVID-19. A lot of this was discussed at our June 2 virtual meeting, where a lot of the focus we had, outside of the Space Strategic Propellant Reserve Paper, was focused on what were the best ways for the USG to stimulate the space economy, looking long term but also very much in the near term given the crisis due to COVID-19.

Chart 5:



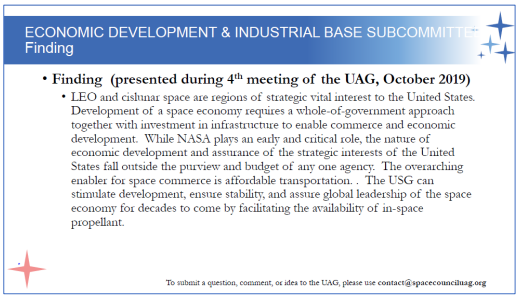
With regard to LEO commercialization, discussions are ongoing with the subcommittee, and how we are going to support that (Chart 5). Some of the discussion we had on Cislunar activities was deferred because of the discussion we've been having on how to best facility stimulation of the space economy in these times (COVID-19 impacts). We also appreciate all the help from NSpC staff to arrange future briefings across agencies and other entities to help create a larger LEO economy. With that I'm going to turn this over to Mary Lynne, who will discuss more the Strategic Space Propellant Reserve paper.

Charts 6-7:



With regard to economic development of the LEO, we thought originally just about LEO but quickly expanded this to think about LEO to Lunar Space, and we had some discussion about the need to have a "corridor" for economic development (Chart 6). The U.S. Space Force has been engaged in that, along with other groups outside the UAG that are also interested in this discussion. The idea was brought forward originally by Tory Bruno to think about having a Strategic Space Propellant Reserve. Eventually we made a recommendation at the UAG 4th meeting in October, 2019, to develop a White Paper with the purpose to map out some of the factors that would need to be considered in further studies to think about the viability of building such reserve. This recommendation was accepted by the UAG at that meeting and subsequently by the NSpC. Chart 7 summarizes the background for developing this recommendation. There is broad consensus that government investment in infrastructure can enable space commerce. One overarching enabler for commercial activity is affordable transportation, and a large cost driver for that is propellant. Propellants sourced in space avoid cost of lifting from Earth's gravity well. The idea is that the U.S. Government (USG) can facilitate a large space economy by helping in-space propellant availability.

Charts 8-9:



What we looked at was the model we already have on Earth, the Strategic Petroleum Reserve (Chart 8). That model exists not only to facilitate transportation, and many other things that are driven by the oil-based economy, but also to provide security for the U.S. Chart 8 also shows some of the other strategic reserves the U.S. engages in to prepare for a variety of contingencies. The idea was that the USG can establish a requirement to create and maintain a Strategic Reserve of Propellant sourced in space. Chart 9 shows the finding presented during 4th meeting of the UAG, "LEO and cislunar space are regions of strategic vital interest to the United States. Development of a space economy requires a whole of government approach together with investment in infrastructure to enable commerce and economic development. While NASA plays an early and critical role, the nature of economic development and assurance of the strategic interests of the United States fall outside the purview and budget of any one agency. The overarching enabler for space commerce is affordable transportation. The USG can stimulate development, ensure stability, and assure global leadership of the space economy for decades to come by facilitating the availability of in space propellant."

Charts 10-11:

As mentioned earlier, the UAG approved and forwarded a recommendation to the NSpC that the UAG develop a White Paper. In the process of developing the White Paper, we developed additional findings that have come out of the work itself on the White Paper (Chart 10). The finding is that the development of an in space strategic propellant reserve would enable three key outcomes: (1) it would stimulate economic development by reducing uncertainty regarding availability of propellant, enhancing confidence for governments and private interests alike; (2) it would buffer U.S. future in space economic interests from temporary interruptions in supply; and (3) it would also provide a significant means to help stabilize a future space commodities exchange, in which forward purchases (futures) of commodities such as water, oxygen, hydrogen, metals, and propellant, could be traded. Regarding this last one, last year there was a publication that highlighted China's aspirations in space (all UAG members should have received a copy of this paper), and one of the things that was very clear was that China and other nations are interested in the entire issues of commodities development and interchange in space, as well as the development of the infrastructure associated with a strategic reserve in space. These are both long-lead time events, but the technology is developing quickly and outpacing the policy. We need to think of our posture vis-à-vis with China, as well as other nations including allies, and send a message that the U.S. is seriously vested in opening up this corridor for friendly collaboration (and friendly competition), and that in order to do that we are trying to find ways to back the security of this from an economic point of view. The space commodities idea has been in development, on and off, for over ten years, but in essence it is just an extension into space of the capital market notion we have on Earth. The earlier we can send a signal to investors that we are willing to secure this environment, the better. What we are looking for is to get consensus from the UAG that the paper should be advanced to the NSpC, which will close the loop on the

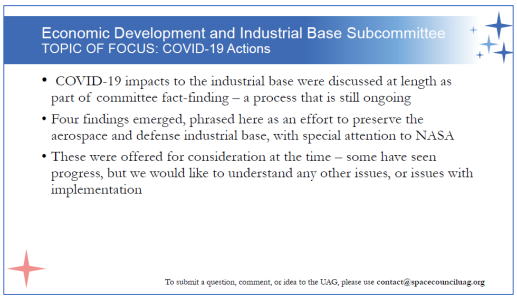
recommendation we made before [at the 4th UAG meeting] that a paper be developed and forwarded back to the NSpC. However, we don't want to request such approval before you've had an opportunity to comment. We are also open to making changes to the paper before we move forward, and I will stop there.

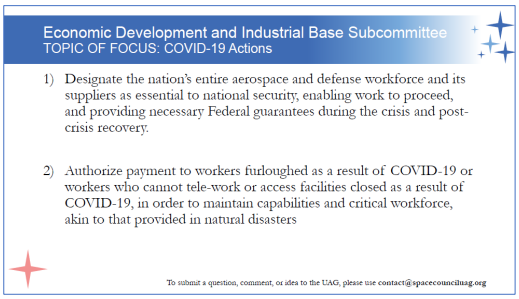
Discussion on the Recommendations:

- Adm J. Ellis, Jr.: As a matter of process, we'll have a period of one week during which written comments will be accepted for the White Paper, and then we'll go through approval. Are there any additional comments?
- Lt Gov Jeanette Nuñez: I wanted to ask, as we think about of importance of pursuing this initiative to encourage space commerce, what do you envision as the role of U.S. states in the development of this strategic space propellant reserve and how can we strengthen the role of states?
- Dr. Mary Lynne Dittmar: I hadn't thought about the role of states. States do contribute significantly on the development of commerce and the industry housed in those states. States would be benefitted by the development required to put this infrastructure in place.
- Mr. Eric Stallmer: A lot of work will be done, especially in Florida. Space Florida has been very active from an economic development perspective. I assume we'll be hearing from them, as well as other states that wish to be part. We'll look at what is happening at the state level.
- Adm J. Ellis, Jr.: Obviously there are significant infrastructure and support elements, just as with other strategic reserves. Mary Lynne, what do you need by way of a vote?
- Dr. Mary Lynne Dittmar: If we allow for a week for people to make comments, we'd want some time after that to resolve the comments and have a paper we can forward.
- Congressman John Culbertson: This is a brilliant recommendation. I suggest you link it with the establishment of permanent lunar presence, since water can be extracted from at the lunar south pole.
- Dr. Mary Lynne Dittmar: The scope of paper is to define parameter that would need to be undertaken by a subsequent study. The paper includes a list of considerations for that study, and that's where we could add a note specific to location.
- Adm J. Ellis, Jr.: Mary Lynne, before we move on, do you need a vote on your restated findings from our last session, or are you satisfied that you have the authority to move forward?
- Dr. Mary Lynne Dittmar: I'm satisfied that we can allow one week for comments and, if there is anything we need addressed, we'll get back to UAG members making the comments.
- Adm J. Ellis, Jr.: Concur.

Mr. Eric Stallmer briefed the last three slides (Charts 12-14).

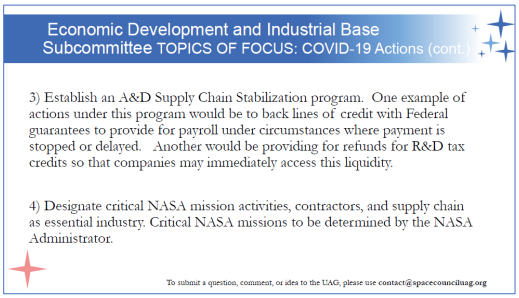
Charts 12-13:





As mentioned earlier, we also looked at the impact of COVID-19 on the industrial base. We have four findings (not recommendations), including areas of concern we heard from the subcommittee and also other bodies that Mary Lynne and I represent (Chart 12). These concerns were raised in the March-April timeframe, as COVID-19 was surging. Some of these have come to fruition, and the others are areas we need to look as the COVID-19 pandemic continues. The next two charts (Charts 13-14) describe our four findings. Our first and second findings address the issues of designating the nation's aerospace and defense workforce as essential to national security, and authorize payments workers furloughed (Chart 13).

Charts 14:



The third and fourth findings include Federal guarantees for payroll for aerospace and defense, and for the NASA Administrator to designate critical NASA activities, contractors, and supply chain as essential industry (Chart 14). We've been working these with our subcommittee and also other trade associations that we meet with routinely.

Q&A:

- Dr. Mary Lynne Dittmar: These are issues that are going to be with us for a while.
- Adm J. Ellis, Jr.: To be clear, you don't need approval, or a vote on these, since they're part of an active discussion and, as Eric noted, some have been addressed to some degree by current and future policies?
- Dr. Mary Lynne Dittmar: Correct. We just wanted to bring everybody up to speed on the fact that the conversations are ongoing.
- Adm J. Ellis, Jr.: For the UAG's information, because we did not have a chance to meet prior to the virtual meeting of the NSpC, we went ahead and put these four findings in the verbal report that I made to the NSpC so they would be aware of these concerns.

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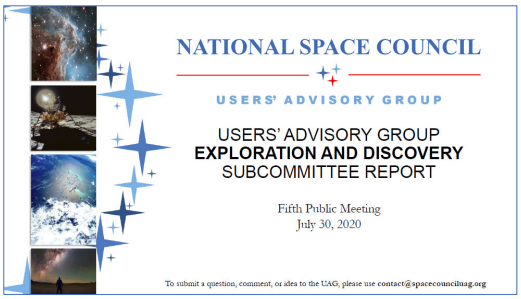
Exploration and Discovery Subcommittee Report

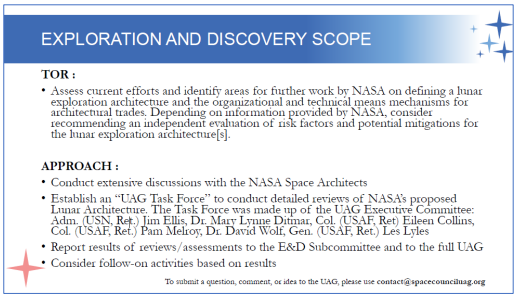
Gen Lester Lyles (USAF, Ret.), Subcommittee Chair

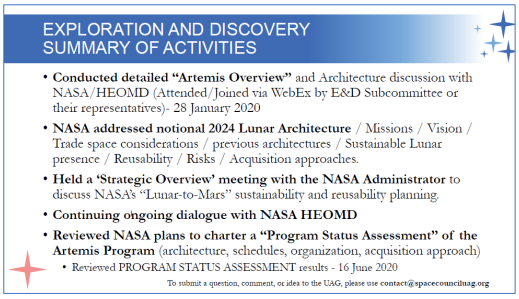
Charts 1-2:



Let me welcome the new members to the UAG, Hon. John Culberson, Eileen Drake, Dr. Bruce Jakosky, and James D. Taiclet, and also David Calhoun (CEO, Boeing) who is replacing another member from Boeing.

Charts 3-4:

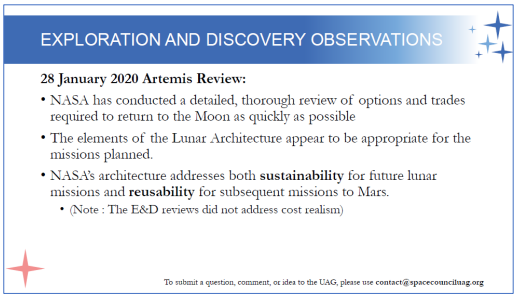


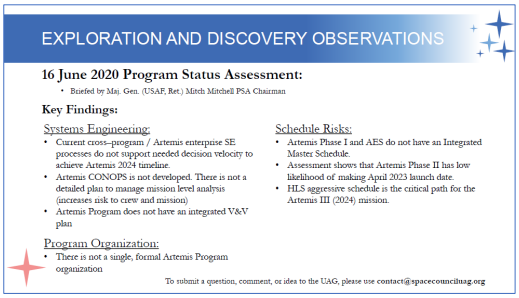


The subcommittee has focused on one major task we were asked by the NSpC, which is to look at and assess the Lunar Architecture for getting back to the surface of the Moon by 2024. Specifically, we were to assess current efforts, identify areas for further work by NASA in defining a lunar exploration architecture (Chart 3). The approach that we used was to conduct extensive discussions with the NASA space architects, and the human exploration operations and organization at NASA. We established an "UAG Task Force" to conduct detailed reviews of NASA's proposed Lunar Architecture. That Task Force was made up specifically of the UAG Executive Committee: Adm Jim Ellis Jr. (USN, Ret.), Dr. Mary Lynne Ditmar, Col Eileen Collins (USAF, Ret.), Col Pamela Melroy (USAF, Ret.), Dr. David Wolf, and me. Our activity was to review the architecture approach to address the questions specifically posed by the White House and the UAG in the past, and then to report the results back to both this subcommittee and the full UAG. This briefing is one part of that, and then we would consider any follow-on activities based on results.

Chart 4 is a summary of activities we are engaged in. We conducted a detailed "Artemis Overview," and architecture discussion with NASA. Earlier this year we held a meeting with NASA, which gave us various presentations. Those presentations included making sure we understood the mission that was being addressed, what NASA's mission was, what the trade space considerations were, previous architectures that they've examined to inform a sustainable lunar presence, and what are their goals, risks, and the acquisition approach they were planning to use. We also held a "Strategic Overview" meeting with the NASA Administrator to discuss NASA's "Lunar to Mars" sustainability and reusability planning. We knew it was not just going to the lunar surface, but also preparing for going to Mars, while also making sure there was a strong presence on the lunar surface. We had ongoing dialogues on a regular basis with NASA Human Exploration and Operations Mission Directorate (HEOMD) people, and then we were informed about how NASA planned to address an independent assessment of the program status of the Artemis Program to look at the architecture, schedules, organization, acquisition, and everything except cost. One of the things we wanted to make sure was who was going to be the lead for this. The lead for this assessment was Maj Gen Howard (Mitch) Mitchell (USAF, Ret.), supported by a large team of experts from NASA, the Air Force, academia, etc.

Charts 5-6:





Our observations from the January 28, 2020, Artemis Review are that: (1) NASA has conducted a detailed, thorough review of options and trades required to return to the Moon as quickly as possible; (2) we considered that the elements of the Lunar Architecture appeared to be appropriate for the missions planned; and (3) we came to the conclusion that both both sustainability for future lunar missions and reusability for subsequent missions to Mars were beign addressed (Chart 5). As noted earlier, this particular effort did not discuss cost. Our consensus was that NASA had answered throroughly the questions we had about trades and options.

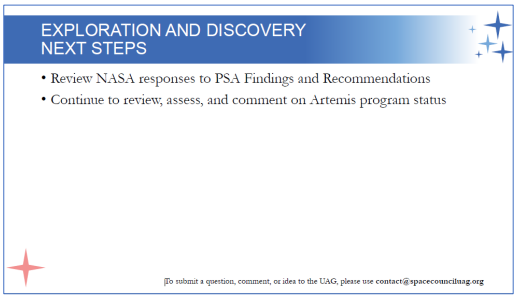
On June 16, 2020, we got a briefing from Maj Gen Mitch Mitchell (USAF, Ret.) on the NASA Progam Status Assessment, or PSA (Chart 6). The key findings from that assessment covered systems engineering, program organization, and schedule risk.

In the systems engineering areas, the key message were: (1) NASA needed to define a system engineering and integration approach to ensure that all the different elements involved in Artemis are linked together, and to ensure that key decisions should be done in the velocity needed to support the aggressive 2024 Artemis timeline; (2) A concept of operations (CONOPS) for NASA was not fully developed; and (3) There was need for a detailed verification and validation (V&V) plan to address mission level analysis, and that there was risk to crew and mission if that was aggresively addressed by the NASA team

In terms of program organization, they pointed out there was not a single formal Artemis Program organization. They recommended that there be a single organization to combine all the different elements. There were five major ones, divided into two major elements of associate administrators at NASA HQ. That has also been addressed by NASA, and the individual names to be program manager for bringing all this together an individual identified: Col Dave Madden (USAF, Ret.) with a great history in managing major programs at the Air Force, such as the Global Positioning System (GPS).

In the area of schedule, the assessment team said that Artemis Phase I, and the Advanced Exploration Systems (AES) were lacking an Integrated Master Schedule of how all those things fit together. And, their assessment at the time was that the Artemis Phase II program, specifically associated with launch activity, was at high risk for making the April 2023 launch date. NASA has obviously jumped on this, and are looking at options to address this and focus government and industry resources to support the activity and make sure the schedule can be met. Finally, the assessment team said that the Human Landing System (HLS) aggressive schedule was really the critical path for being able to accomplish the Artemis III 2024 mission to get back on the lunar surface. I'll mention that this particular assessment was done before the downselection for HLS. Subject to that, there have been different looks in terms of what the schedule options and the schedule risk are, and NASA is relooking at the ability to ensure that that this hole in the critical path is being addressed.

Chart 7:



Where we go from here for our subcommittee? The obvious thing is to review NASA's responses and actions to PSA findings and recommendations, and we intend to address those in the next few weeks with on-going meetings. Ms. Kathy Lueders has been brought in to HEOMD to take over this particular effort, and is putting together her team to take action on the findings and recommendations in the PSA. It is my intent for the subcommittee to follow-up over the next couple of months on what NASA is doing and to reassess whether there are any gaps. Finally, and not shown on this chart, one of the things that is sort of obvious for this particular subcommittee, is that we have been so focused on the exploration architecture that the "Discovery" portion of our subcommittees name has taken second place. As we go forward, we have an opportunity to understand what is going on in the area of discovery, including science. We need to understand what the status is in this area. More will come from the Exploration and Discovery Subcommittee, with primary focus on the architecture things that have been addressed, and look at the things in Discovery that we haven't had a chance to address.

Q&A:

- Adm J. Ellis, Jr.: The addition of Dr. Jakosky to this subcommittee is going to be of big help.
- Dr. Bruce Jakosky: The comment about "Discovery" and science is an important one. From where I sit in the science community, there appears to be very little effort in the Artemis program to integrate science. The concern I have is that if it is not integrated from the beginning, it's going to be a last-minute add-on and is going to suffer. I'd like to see some discussion on encouraging NASA to integrate science into the program at the earliest possible stage.
- Gen Lester Lyles: I agree with you wholeheartedly. I'm also am Chairman of the NASA Advisory Council (NAC). A couple of years ago we came up with that same recommendation that science be integrated early on with the activities going on with the architecture and human exploration and operations (HEO). We've had a series of meetings, and particularly with our science committee in the NAC, combined with the HEO committee, to address that question. For this subcommittee, I plan to early on review the things we have proposed through the NAC that addresses your question.

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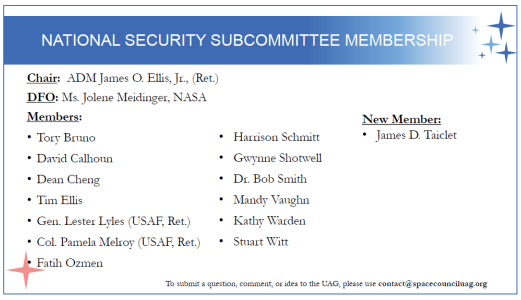
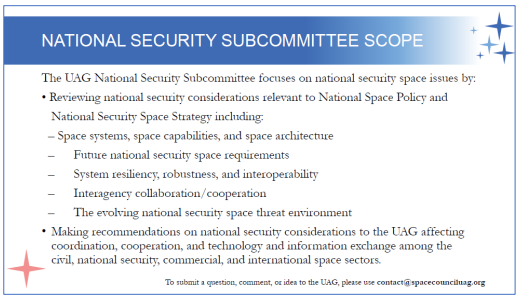
<u>National Security Subcommittee Report</u>
Admiral James Ellis, Jr. (USN, Ret.), Subcommittee Chair

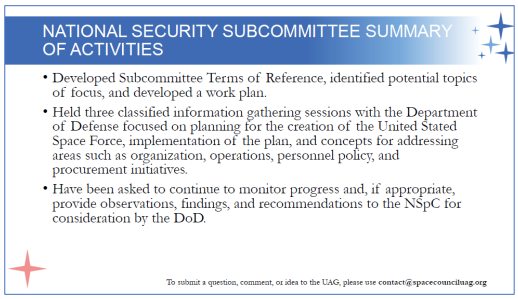
Charts 1-2:



As you might expect with the "National Security" title, our membership requires folks with the appropriate level of security clearances. I want to welcome our new subcommittee member, Mr. Jim Taiclet, and I also want to acknowledge the great support from Ms. Jolene Meidinger (NASA) as our DFO. She's done a great work in coordinating the classified briefings we've had, the SCIF (Sensitive Compartmented Information Facility) access, and the like.

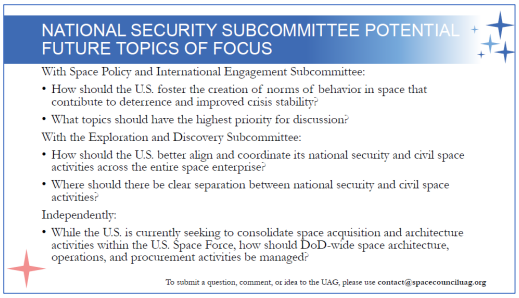
Charts 3-4:





As you can see in Chart 3, there really isn't much in the National Security area that we can't touch on. In addition, we also support the other subcommittees who may need classified access for insights to their work. We too have been busy, but have been impacted more by COVID-19 due to the inability to gather in secure facilities to do our work. We've had three classified information gathering sessions with DoD, initially focused on the U.S. Space Force, its creation, plan for its implementation, implementation of that plan, and then to develop concepts for organizing areas such as operations, personnel policy, and procurement initiatives (Chart 4). The last two of those took place on January 29 and March 2, 2020, and involved DoD representatives, as well as Air Force and Space Force leadership. That effort is going to continue to monitor their progress on establishing this service, and if appropriate provide observations, findings, and recommendations to the NSpC for consideration by the DoD. One of the things we are going to undertake is to review the classified portion of the Space Strategy, released on June 17, 2020, as soon as we can gather in Washington D.C.

Chart 5:



We do work with the other subcommittees (Chart 5). We are working with the Space Policy and International Engagement Subcommittee, under Dr. Wolf. We'll be considering whether we should explore whether the U.S should foster the creation of norms of behavior, and in order to do that effectively we need some understanding of whether those norms have been violated, which sometimes requires classified access. With the Exploration and Discovery Subcommittee we are talking about coordinating national security with civil space activities across the entire space enterprise, and this may also require classified access to identify where that separation ought to be. We are also independently, while the U.S. is currently seeking to consolidate space acquisition and architecture activities within the U.S. Space Force, looking at how should DoD-wide space architecture, operations, and procurement activities be managed.

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Public Comment

James J. Miller: I have been monitoring the input on our e-mail address (contact@spacecounciluag.org). We do have one person that is prepared to make a statement. [Note: See Appendix D for the full statement]

- Dr. George Nield (Chairman, Global Spaceport Alliance): I wanted to offer a brief comment on the importance of spaceports to our nation's space activities these days. There are a lot of challenges and opportunities associated with them. On the opportunities side we see the chance there could be some real benefit to either formally or informally pulling together a national spaceport network, consisting of not only commercial spaceports, but also government launch and landing sites, and private launch and landing sites, and working together for the good of the country. On challenges side, one of the issues is that the Federal Government has traditionally provided substantial funding to develop, repair, or upgrade all forms of transportation infrastructure, including roads, bridge, interstate highways, railroads, seaports, and airports (to the tune of $3.5 Billion every year from the FAA), but incredibly given the importance of space to our nation today, there is not currently any opportunity for the Federal Government to assist financial with space-related infrastructure, specifically airports. This is something the government and UAG should consider in the future. The Global Spaceport Alliance has pulled together a document, "National Spaceport Network Development Plan," which compiles a number of recommendations, including options to support spaceport infrastructure funding. That is available to the UAG and other interested parties, and we'd be happy to interact with the group or with individuals offline to discuss that and answer any questions. My e-mail address is george.nield@commercialspacetechnologies.com and I would be honored to assist the UAG in future if there is any interest in this area.
- Adm J. Ellis, Jr.: Thanks George, those are important points. One of our focus areas is the important of resilience in our space architecture. We often describe the satellite constellations as critical infrastructure, and we also need to think about the critical infrastructure on the ground as well. We welcome the paper, and thanks for your comments.

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Next Steps and Closing Remarks
Adm J. Ellis, Jr. (USN, Ret.), Chair, UAG

As we come to close here, I apologize for the length of the session. We had lots to cover and we wanted to get caught up again with all of you. We'll consider how to put these meetings into bite-sized chunks going forward. We appreciate your patience, and certainly value your participation today. The briefings will be posted for viewing at: https://www.nasa.gov/content/national-space-council-users-advisory-group, and we will move forward with the two recommendations that have been approved. JJ, are there any other actions?

- James J. Miller: I just wanted to say thank you to all the DFOs on behalf of the full UAG to Ms. Rebecca Zia from Artic Slope Technical Services and Ms. Alexandra Doten from Overlook Systems Technologies, Inc. for their phenomenal logistical support. Thank you for helping us make the meeting successful.
- Adm J. Ellis, Jr.: In closing, on behalf of the UAG I want to thank all of you, members, staff, and in particular the public for your participation in this session. Though these are difficult times for our nation, the UAG still stands for any assistance the NSpC requires. There's no doubt the last few years have brought new energy and vitality to the space community, but it is also clear that as a nation we are now confronting some unprecedented challenges both in space and in any other sector of our economy and society. We appreciate the focus the NSpC brought to our role in space, and we continue to innovatively support these efforts in making difficult choices in defining the future of the nation in the space enterprise. Again, thank you all for your patience and participation. We are adjourned.

The meeting was adjourned at 1:07 PM.

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Appendix A: Agenda

10:00-10:05	**CALL TO ORDER** *James Joseph "JJ" Miller –UAG Executive Secretary*
10:05-11:00	**HISTORICALLY BLACK COLLEGES AND UNIVERSITIES: AMERICA'S INNOVATIVE ASSET** *Dr. Victor McCrary – Vice Chair, National Science Board and Vice President for Research, University of the District of Columbia*
11:00-11:05	**UAG SUMMARY OF MEETING GOALS** *Admiral James Ellis, Jr., USN, Retired –UAG Chair*
11:05-11:25	**OUTREACH & EDUCATION SUBCOMMITTEE REPORT** ***Including Findings and Recommendations** *Colonel Eileen Collins, USAF, Retired –Subcommittee Chair*
11:25-11:45	**TECHNOLOGY & INNOVATION SUBCOMMITTEE REPORT** ***Including Recommendations on Space Data Solutions & Standards** *Colonel Pamela Melroy, USAF, Retired –Subcommittee Chair*
11:45-12:05	**SPACE POLICY & INTERNATIONAL ENGAGEMENT SUBCOMMITTEE REPORT** ***Discussion on Norms of Behavior in Space** *Dr. David Wolf –Subcommittee Chair*
12:05-12:25	**ECONOMIC DEVELOPMENT & INDUSTRIAL BASE SUBCOMMITTEE REPORT** ***Including Strategic Propellant Reserve White Paper** *Dr. Mary Lynne Dittmar and Eric Stallmer –Subcommittee Co-Chairs*
12:25-12:35	**EXPLORATION & DISCOVERY SUBCOMMITTEE REPORT** *General Lester Lyles, USAF, Retired –Subcommittee Chair*
12:35-12:45	**NATIONAL SECURITY SUBCOMMITTEE** *Admiral James Ellis, Jr., USN, Retired –UAG Chair*
12:45-12:55	**PUBLIC COMMENT**
12:55-13:00	**NEXT STEPS & CLOSING REMARKS** *Admiral James Ellis, Jr., USN, Retired –UAG Chair*
13:00	***ADJOURN***

Appendix B: Membership

Admiral James Ellis, Jr.
USN, Retired
Users' Advisory Group Chairman

Dr. Buzz Aldrin
USAF Retired Former NASA Astronaut

Mr. Salvatore T. "Tory" Bruno
President and CEO, United Launch Alliance

Mr. David L. Calhoun
President and CEO, The Boeing Company

Mr. Dean Cheng
Senior Research Fellow, Heritage Foundation

Colonel Eileen Collins
USAF, Retired
Former NASA Astronaut

The Honorable John Culberson
Former United States Congressman and Former Texas State Representative

Dr. Mary Lynne Dittmar
President and CEO, Coalition for Deep Space Exploration
President and CEO, Dittmar Associates

Ms. Eileen Drake
CEO and President, Aerojet Rocketdyne Holdings, Inc

Mr. Tim Ellis
Cofounder and CEO, Relativity Space

Mr. Homer Hickam, Jr.
Board Chair, U. S. Space and Rocket Center

The Honorable Kay Ivey
Governor of Alabama

Dr. Bruce Jakosky
MAVEN Principal Investigator
Professor of Atmosphere and Space Physics, University of Colorado

Mr. Fred Klipsch
Marian University

General Lester Lyles
USAF, Retired
Chairman, NASA Advisory Council

Colonel Pamela Melroy
USAF, Retired Former NASA Astronaut

Lieutenant Governor Jeanette M. Nuñez
Chairman of the Board, Space Florida

Mr. Fatih Ozmen
CEO and Owner, Sierra Nevada Corporation

The Honorable Harrison H. Schmitt
Former NASA Astronaut
Former United States Senator, New Mexico

Ms. Gwynne Shotwell
President and COO, SpaceX

Dr. Robert H. Smith
CEO, Blue Origin

Mr. Eric W. Stallmer
President, Commercial Spaceflight Federation

Mr. James D. Taiclet, Jr.
President and Chief Executive Officer, Lockheed Martin Corporation

Ms. Pamela Vaughan
STEM Integration Specialist, Arkansas Department of Education

Ms. Mandy F. Vaughn
President, VOX Space

Ms. Kathy Warden
Chairman, CEO, and President, Northrop Grumman Corporation

Mr. Stuart O. Witt
Founder and Owner, S.O. Witt & Associates, LLC
Former General Manager and CEO, Mojave Air and Space Port

Dr. David Wolf
Former NASA Astronaut
Professor of Aerospace Engineering, Purdue University

Appendix C: Attendance

Members:
- Adm. James Ellis, Jr.
- Dean Cheng
- Col. Eileen Collins
- The Hon. John Culberson
- Dr. Mary Lynne Dittmar
- Eileen Drake
- Tim Ellis
- Homer Hickam, Jr.
- Dr. Bruce Jakosky
- Mr. Fred Klipsch
- Gen. Les Lyles
- Col. Pam Melroy
- Lt. Gov. Jeanette Nuñez
- Fatih Ozmen
- The Hon. Harrison Schmitt
- Dr. Bob Smith
- Eric Stallmer
- James D. Taiclet
- Mandy Vaughan
- Pam Vaughn
- Stuart Witt
- Dr. David Wolf

Speaker:
- Dr. Vic McCrary

Staff:
- Barbara Adde
- Amanda Allen
- Dr. Ben Ashman
- Alexandra Doten
- Nate McIntyre
- Jolene Meidinger
- JJ Miller
- Dr. A.J. Oria
- Sarah Salem
- Taylor Weeks
- Rebecca Zia
- Lesha Zvosec

UAG Members Not Recorded:
- Dr. Buzz Aldrin
- Tory Bruno
  - Represented by Andy Bunker
- David Calhoun
  - Represented by Tom Culligan
- The Hon. Kay Ivey
- Gwynne Shotwell
  - Represented by Mike Lapidus and Caryn Schenewerk
- Kathy Warden
  - Represented by Marty Frederick

Guests:

- Alan Feinberg
- Alexander Burg
- Alvin Drew
- Andrew Adams
- Andy Bunker
- Ann Zulkosky
- Angela Peura
- Angeliki Kapoglou
- B Harvey
- Barbara Zelon
- Beau Backus
- Bette Siegel
- Ben Corbin
- Bhavya Lal
- Brett Alexander
- Caryn Schenewerk
- Carol Hamilton
- Carolyn Pace
- Chad Hill
- Chris Cannizzaro
- Chris Hofer
- Chris Kunstadter
- Christopher Blair
- Cindy Martin-Brennan
- Dale Ketcham
- Dallas Bienhoff
- Dana En
- Darcy Elbum
- Dave Howard
- Dave Huntsman
- DeAnn Reilly
- Edward Stanton, Jr.
- Emil Cherian
- Eric Toemmes
- Erin Kennedy
- Frank Bauer
- Gene Mikulka
- George Nield
- Grant Anderson
- Hanh
- Holly Tucker
- James Chilton
- James Lochner
- Jed Dennis
- Jeff Auerbach
- Jeff Foust
- Jeff Trauberman
- Jerry Krassner
- Jessy Kate Schingler
- Jillianne Pierce
- Jim Muncy
- JMS
- John Anton
- John Barry
- John Schumacher
- John Wagner
- Jules McNeff
- K. Leszczak
- Kacey Templin
- Katie Frakes
- Katsutoshi Ishisoko
- Kathleen Boggs
- Kelly Ann McCarty
- Kenneth Chang
- Ken Panos
- Kota Umeda
- Laura Forczyk
- Marcia Smith
- Mario Tantardini
- Mark Mozena
- Martin Faga
- Marty Frederick
- Mary Engola
- Meredith McKay
- Michael Lapidus
- Michelle Cantrell
- Mike Manor
- Pat Diamond
- Patricia (Diane) Rausch
- Paul Kim
- Pete McCallum
- Peter A Garretson
- PK
- Randy Gigante
- Ravi Chaudhary
- Refaad Rashad
- Richard Rogers
- Rick Kendust
- Ronald Keen
- Sara Bayer
- Scott Smas
- Stephanie Wan
- Steve
- Steve Moran
- Theodore Kronmiller
- Thomas Plumb
- Walt Faulconer
- Wayne Hale

Appendix D: Statement by Dr. George C. Nield, Chairman of the Global Spaceport Alliance

GLOBAL SPACEPORT ALLIANCE

Statement by Dr. George C. Nield,
Chairman of the Global Spaceport Alliance,
for Submittal at the July 30, 2020 Meeting of the
National Space Council Users' Advisory Group

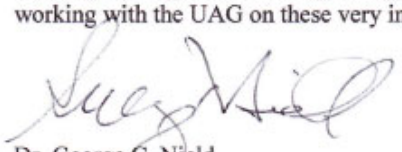
Mr. Chairman, and members of the National Space Council Users' Advisory Group (UAG), thank you for allowing me to submit this comment today. My name is Dr. George C. Nield, and I currently serve as the Chairman of the Global Spaceport Alliance. The GSA was formed in 2015 with the goal of creating a global network of spaceports that will allow increased access to space, and that can serve as focal points and technology hubs in growing the space economy. The group currently has 20 Member Spaceports, from 5 different countries all over the world. We hold an annual Spaceport Summit in Houston in conjunction with the SpaceCom Conference, and we are actively involved in partnering with stakeholders at NASA, the Department of Commerce, and the FAA, and with industry and academia.

This is a very exciting time for commercial space, especially for those of us interested in spaceports. As you may know, the FAA Reauthorization Act of 2018 contained several spaceport-related provisions. In addition to mandating the establishment of the Office of Spaceports within the FAA, the Act called for the preparation of two reports to Congress: one by the Secretary of Transportation on National Spaceport Policy, and one by the GAO on potential options for funding spaceport infrastructure. Both reports were to be submitted to Congress within 1 year, which means they were due last October. Unfortunately, as a result of the lengthy review process, I don't believe that either report has so far been delivered. However, because both topics are so important, it is crucial that we continue our discussion of those issues.

That brings me to the primary reason for my comment today. I wanted to let the UAG know that the Global Spaceport Alliance has just completed putting together a National Spaceport Network Development Plan for the FAA Office of Spaceports and other interested stakeholders. The document contains a proposal for a National Spaceport Policy; potential benefits associated with the development of a National Spaceport Network, consisting of current and prospective commercial spaceports, government-owned-and-operated launch and landing sites, and privately-owned-and-operated launch and landing sites; comments on the recent Range of the Future activities by the Department of Defense; options for providing spaceport infrastructure funding; ideas for spaceport-related programmatic initiatives; and a series of recommendations on needed changes to policies, laws, and regulations. Also included is a list of specific spaceport infrastructure projects and related cost estimates. We expect to update the document annually, or as conditions warrant. In some ways, it could be thought of as being the spaceport-equivalent to the National Plan of Integrated Airport Systems, or NPIAS, that is published biannually by the FAA Office of Airports.

If UAG members or other participants in the meeting today would like to find out more about the Global Spaceport Alliance or the National Spaceport Network Development Plan, please let me know, and I would be happy to provide a briefing at one of your future meetings, or to engage with you individually, both to answer your questions, and to discuss how we can make the document more useful as an information resource for the community. My email address is george.nield@commercialspacetechnologies.com.

Once again, I appreciate having the opportunity to provide this input today, and I look forward to working with the UAG on these very important issues.



Dr. George C. Nield
Chairman, Global Spaceport Alliance

Appendix E: Acronyms and Definitions

AANAPISI	Asian American and Native American Pacific Islander-Serving Institutions
AAS	American Astronautical Society
ABET	Accreditation Board for Engineering and Technology
AES	Advanced Exploration Systems
ASAP	NASA Aerospace Safety Advisory Panel
ASU	Arizona State University
CCSDS	Consultative Committee for Space Data Standards
CONOPS	Concept of Operations
COVID-19	Coronavirus Disease 2019
DARPA	Defense Advanced Research Projects Agency
DFO	Designated Federal Officer
DOC	Department of Commerce
DoD	Department of Defense
EO	Executive Order
EU	European Union
EXCOM	Executive Committee
FAA	Federal Aviation Administration
FACA	Federal Advisory Committee Act
FAMU	Florida Agricultural and Mechanical University
FY	Fiscal Year
GPS	Global Positioning System
GSFC	NASA Goddard Space Flight Center
HEOMD	NASA Human Exploration and Operations Mission Directorate
HBCU	Historically Black Colleges and Universities
HLS	Human Landing System
ICANN	Internet Corporation for Assigned Names and Numbers
LEO	Low Earth Orbit
MSI	Minority Serving Institution
MUREP	Minority University Research Experience Program
NAC	NASA Advisory Council
NAS	National Academy of Sciences
NASA	National Aeronautics and Space Administration
NATO	North Atlantic Treaty Organization
NGA	National Geospatial-Intelligence Agency
NRB	Norms of Responsible Behavior
NSB	National Science Bord
NSF	National Science Foundation
NSpC	National Space Council
PSA	Program Status Assessment
R&D	Research and Development
S&E	Science and Engineering
SCIF	Sensitive Compartmented Information Facility
SDA	Space Domain Awareness
SDO	Standard Developing Organization
SGE	Special Government Employees
SPD	Space Policy Directive
SSA	Space Situation Awareness
SSE	Space Security Exchange
STEM	Science, Technology, Engineering and Mathematics
STM	Space Traffic Management
STMD	NASA Space Technology Mission Directorate
STW	Skilled Technical Workforce
U.S.	United States

UAG	Users’ Advisory Group
UDC	University of the District of Columbia
UN	United Nations
USAF	U.S. Air Force
USG	U.S. Government
USN	U.S. Navy
USSPACECOM	United States Space Command
V&V	Verification & Validation
VP	Vice President
xEMU	Exploration Extravehicular Mobility Unit (i.e. spacesuit)