

033117 Air Force Association Mitchell Institute for Aerospace Studies Friday Space Group Seminar on “Space Power to the Warfighter” with Scott Pace, Director of the George Washington University Space Policy Institute; Jamie Morin, Vice president of the Sun System Operations at Aerospace Corporation; General Roger Teague, Director of Space Programs in the Office of the Assistant Secretary of the Air Force for Acquisition; and Steve Isakowitz, President and CEO of Aerospace Corporation, on “U.S. Space Policy.” (For additional information on The Friday Space Group Seminar series contact Peter Huessy at [phuessy@afa.org](mailto:phuessy@afa.org))

MR. PETER HUESSY: Good morning, ladies and gentlemen. Good morning, ladies and gentlemen. On behalf of the Air Force Association and the Mitchell Institute for Aerospace Studies, my name is Peter Huessy, and I want to welcome you to this, our second, in our series of “Space Power to the Warfighter” seminars that we are going to be doing in 2017.

Just a reminder, on April 14<sup>th</sup> we have a breakfast with General Buck. On April 20<sup>th</sup> my nuclear series on “Missile Defense and Nuclear Deterrence” begins with Steve Blank and Mark Schneider, who are going to tell us the wonderful things going on in Russia with respect to strategic -n and strategic nuclear weapons policy. Then in May, of course, we will hear from Roger Teague, who is also one of our guest speakers here today. He will be speaking in May at our next breakfast on space.

It’s my pleasure on behalf of the Mitchell Institute, Dave Deptula, who is our director, and also our staff, to introduce Steve Isakowitz, who is the CEO of the Aerospace Corporation. He’s a leader in the space community. He comes at it from a variety of interesting perspectives, both inside and outside of government. He was trained as an engineer, a bachelor’s and master’s degree from MIT.

He oversaw the science and technology budget at OMB, including NASA and NOAA, then went to NASA headquarters in charge of exploration programs, then chief financial officer in the department of Energy, then went on to Virgin Galactic for a number of years first as chief technology officer and then as its president. He has a combination of being an engineer, with experience as a financial office, policy, and executive both in government and the private sector. So I thought it was particularly appropriate to ask him to moderate today’s event on space policy.

We have the good fortune of having him here as president and CEO of Aerospace. As his seventh CEO, I’ve been told he wears a badge with the number 007 on it.

(Laughter).

With that, would you please welcome the CEO and President of the Aerospace Corporation Mr. Steve Isakowitz?

(Applause)

MR. STEVE ISAKOWITZ: Good morning, everybody. Can you hear me okay? Good morning, everybody. Can you hear me all the way in the back, in the bleacher seats there? Thumbs up, alright.

Peter, thank you very much. I want to thank the Mitchell Institute for the opportunity to come here and to talk about the hottest topics in space policy with really a premier panel that I'll be introducing in a moment. As you know, I just joined the Aerospace Corporation as the president and CEO, and I am often asked when I meet people for the first time why did you decide to join the Aerospace Corporation having come from what was a fun and interesting start up company?

For me, the reason is pretty simple, and I think it's really the theme of this morning's discussion. Honesty, in my career in space, I think there is no more an exciting time in what's happening in space as is happening today. I think it's really exciting because I don't think there has been a time when we literally find all three major sectors going through some major transformational changes.

For example, in national security space, space has always been assumed to be a place where we can peacefully operate in the sanctuary of space and the biggest threat we'd have is a piece of orbital debris that we need to get out of the way from. That's no longer the case. We now have threats. We now have adversaries. We now have many new nations that are developing capabilities to do things in space.

It is forcing us to rethink the architecture of what we do in space to make sure it's resilient, responsive, not just with our legacy systems that we fly today. but how do we think about the new systems that come onboard? Civil space: Neil Armstrong said, "One small step for man, one giant leap for mankind." Since he set the giant leap for mankind, I actually think we're now at that second point for a giant leap for mankind.

So on civil space the hot debate is the Moon to Mars. Where is human exploration going, what's the opportunities to leverage what's happening in commercial and the international sector as NASA thinks it through? We also have the FAA and NOAA thinking about how to play their roles, in a very important way, as we go forward in space.

And then, of course, there's the commercial sector. We have the traditional commercial players that are also sort of upping game in terms of expanding the markets and meeting the needs here on Earth. But we also have these new entrants, that are developing new capabilities to make us rethink commercial launch, rethink what's happening in space, and the cost points have gotten to an interesting place where young students out of universities now can actually launch their little cubists up and demonstrate new capabilities and get financing out of Silicon Valley and elsewhere.

So with all those three things going on, what to me is exciting at the Aerospace Corporation is, Aerospace is an FFRDC, a nonprofit, entrusted partner of the government,

independent. We have a unique opportunity to be at sort of the leading edge of those discussions, and what I often term is, helping to shape the future. I think as we look at programs, as everyone in this room knows, a lot of emphasis goes on to the day of launch and when those satellites go into orbit. But we all know that usually the success of those programs, the seeds of the success of those programs, are embedded in what happens up front in the earliest days, often in the policy and the requirements and the architectures.

And that's one of the things I'm actually looking forward to in working for the Aerospace Corporation. We're going to be upping our game in terms of helping to work through those opportunities to shape the future. In fact, one of the panelists today that probably wasn't on your list because I just hired him, is Dr. Jamie Morin, and I'll introduce him in a moment, but he'll be heading up our Center for Space Policy and Strategy. Part of that is to make sure that we play an important role with all the other key players that are out here.

Before I introduce the panel, I want to just finish with a story. Thirty years ago I was an aerospace engineer at MIT. I remember I was thinking to myself, where am I going to go in the industry? I happened to come across an article where McDonnell Douglas was doing research on electrophoresis, the idea of doing something commercial in orbit that has applications on Earth. I thought to myself, wow, that's kind of novel, having the commercial sector introduce sort of different business models that are out there that's very different than the Apollo paradigm.

So I was curious and I started to look into it. I found there were other companies. There were three really smart guys from Harvard who had a business plan to try to make an upper stage deploy on the Space Shuttle. Today, of course, that's known as the Orbital ATK.

Plus a couple of other companies were working with NASA on how to take the Space Station, which at that point was in design, and try to see how we could do more commercial activity on the Space Station. One of those companies actually happens to be Booz Allen. That's where I went for my first step in my career. When I got there my very first assignment was to work on a proposal on something called the Space Transportation System. Some of you in the room are going hmm.

The Space Transportation System -- there was a policy made that all U.S. satellites were going to fly on one launch vehicle known as the Space Shuttle. It was based on policy that says we can improve the economics. We can make access to space really low cost if we take all three sectors: national security, civil, and commercial, and fly it on the Space Transportation System. NASA was trying to get ahead of the game and looked at what the Europeans were doing, and saw they took the Arian, and through Arian SPOT, had a marketing organization to go out and the commercial lease. So they wanted to have a U.S. equivalent of a marketing organization. When I joined Booz Allen, that's what I worked on, a proposal to actually help market the Space Shuttle.

All that changed in one day, in January of 1986 with the Challenge accident,

when suddenly the U.S. government realized they made a terrible policy decision putting all their eggs in one basket. It took years for this country, and billions of dollars, to recover from that policy decision. To me, that's sort of a great text book example of why it's so important that as we set the policy and the roadmap for the things we do, that we really think hard about what goes into it, what are the risks that are involved?

We live in a time where I think there's a lot of exciting opportunities in front of us: public-private partnerships. And those are sometime the very same words we talked about in the '80s when we had the policy that we had in place. So how do we learn from these things to get it right this time?

Another interesting thing is I remember when I first showed up at Booz Allen they showed me where my new office was. I went in there and they said I want to introduce you to your office mate, he's a guy from Rockwell International. Rockwell was the builder of the Space Shuttle. You and him are going to work together in helping us put together that proposal. By the way, that guy's name is Scott Pace.

(Laughter).

But it also points out it's a small village here, with regards to the space industry, which I think all you guys can attest to. So let me introduce today's panel members. I'm delighted to have all three.

Major General Roger Teague is the Director of Space Programs in the Office of the Assistant Secretary for Acquisition for the U.S. Air Force. He directs the development and purchasing of space programs for Air Force major commands, product centers, and laboratories dealing with acquisition programs. His over three decades career in the Air Force is quite impressive. Of note, he served as Vice Commander, Space and Missile Systems Center, and was the Director of Strategic Plans, Programs and Analysis at Air Force Space Command.

General Teague, would you mind joining us up here?

(Applause).

Dr. Scott Pace is a Professor and Director of the Space Policy Institute at George Washington University's Elliott School of International Affairs. Dr. Pace serves as the Vice Chair of the NOAA Advisory Committee on Commercial and Remote Sensing. He served as the Associate Administrator for Program Analysis and Evaluation at NASA. Prior to NASA, he was the Assistant Director for Space and Aeronautics in the White House Office of Science and Technology Policy.

Scott, would you mind coming up here?

(Applause).

Dr. Jamie Morin is the Vice President of the Sun Systems Operations at the Aerospace Corporation. In this role he also serves as the Executive Director of our Center for Space Policy and Strategy. He recently served as the Director of Cost Assessment and Program Evaluation, known as the CAPE, for the Department of Defense, where he led the organization responsible for analyzing and evaluating the department's plans, programs and budgets in relation to U.S. defense objectives, threats, estimated costs and resource constraints.

I would also add that this is technically Jamie's first day at the Aerospace Corporation.

(Laughter/Applause).

This is not going to be the new way we do orientation at the Aerospace Corporation, in front of a live audience of media and 150 of your friends. With that, why don't you all have a seat and I want to give you each an opportunity to provide opening comments. I was told ahead of time that Scott and Jamie want me to call them Scott and Jamie. But General Teague, I'm sorry, I have to call you General Teague.

(Laughter).

GEN. ROGER TEAGUE: Steve, good morning. Good morning, ladies and gentlemen. Steve, thank you so much.

It's great to be with you all. Happy Thursday. It's great to be out and doing our Space Power event and share a few thoughts concerning this. I think this is a very, very important topic, and Steve, kudos to you and the Aerospace team for pulling this together.

Everything we do in national security space is paced by politics. Whether we're acquiring, operating or sustaining space systems, the importance of policy and the implications thereof really shape how we conduct our business. So this topic is so appropriate for all the reasons that Steve eloquently laid out before you.

I agree with him. This is an extremely exciting time to be in the space business. It's all the more important that we continue to provide focus on our proper policies, as well as shaping the international environment, our commercial environment, all the players that are going to be, as we see an increasingly competitive and contested and congested space environment, policy is going to drive that; how we think about our future operations, how we acquire things. From an acquisition perspective I can just tell you that we are very much aware of the need to be able to field and sustain capability in new and different ways, and continue to provide proper focus on acquiring and delivering our space systems and capabilities on time. Certainly it's important to continue discussions on that, but as we look at continuing to reform our acquisition processes, reduce our bureaucratic layers if you will, and be able to field and sustain them in new and different ways, and pursue different kinds of partnerships with industry, I think that's going to go a

long ways towards continuing to be able to achieve our goals in delivering capability more rapidly.

So again, Steve, thank you so much for the kind offer to be here today. I look forward to the discussion.

MR. ISAKOWITZ: Thank you, General Teague.

Scott.

MR. SCOTT PACE: Thank you very much, Steve, for inviting me to be a part of this. The story about the Shuttle marketing contract, I think, is really an instructive one at several levels. At that time, I could show you 24 points per year, and what all the payloads were that went in there. I was beaten up by my management for not showing 40 points per year because we wanted to see a fifth orbiter, and we actually were offering the government a good price.

What was striking to me about it and why I later went back to do a degree in public policy, is I realized a lot of these issues that I really cared about in space were not really primarily technical issues, and the weren't even really economic issues, they were primarily policy questions. Why are we doing this? What's the major purpose that drives us here?

In the case of the Shuttle situation what had happened is, as my colleague John Wason (ph) described, it really was a policy failure. We went into the Shuttle program, which is a magnificent vehicle and achieved a lot -- I am not criticizing the Shuttle by any means in this way -- but we went ahead with this program without a clear issue of where were we going to. We didn't want to stop human space flight. We wanted to do something next. We wanted to experiment with re-usability.

We were excited about commercial possibilities. We were excited about international participation. But we asked the question about why were we going ahead in a very, very narrow way?

Some of you know the history of the Shuttle. It got into an economic analysis on cost-benefit. It had large fixed costs. You had to fly a lot to amortize those fixed costs.

We all know where that leads, to a policy of putting everything on the vehicle because the question was driven by cost-effectiveness analyses at a very narrow level between OMB and with NASA. They asked the wrong question. The consequence of asking the wrong questions was, I think, very, very heavy and very costly for the United States. So it's not only what's the right policy, what's the right questions you should be asking in deciding among these different policies?

Going forward today, one of the things I would say about what's different today than in the past is in the Cold War period leadership was about doing things that no one

else could do. Look at me, look how cool I am, I can do this and nobody else can. But in today's environment where you have many more state and non-state actors who are active in space, the measure of leadership is not what you can do by yourself, but what you can get others to do with you. What other partnerships can you get for them to come with you: commercial partnerships, international partnerships, scientific community partnerships; partnerships between the civil, commercial and national security communities, so that they're all hauling in the same direction?

The Chinese have a wonderful phrase, "comprehensive national strength." I think for a long time, and still, we treat space in its own little separate silos. So diplomacy is over here, civil space exploration is over here, and the national security, acquisition (thrash ?) is over here. We don't really think about that in some sort of a general direction about what are we trying to reinforce with each other, what is leadership in the post-Cold War environment going to be?

People have written about this stuff a lot. I would commend to you some of the old National Space Council reports that friends of mine are sending around on attachments. They're going like, hmm, this is repeating itself, we've seen this before, the reorganization memos on national security space between NRO and DOD and so forth. We've been rather preoccupied, rightly so, for the last several years since 9/11. But the threats from Russian and Chinese counter-space capabilities to space sanctuary, as Steve mentioned, are back and more to the forefront.

So issues of national security space, I think, are going to be really crucial going forward, more crucial probably than this or that science program at NASA, which I dearly love. The question will be, how does NASA, the commercial community, and so forth, work together in that new environment? Asking the right questions is going to be a crucial part of that, and I hope that Steve's organization will be a leader in doing so. Thank you.

(Applause).

MR. ISAKOWITZ: Thank you, Scott. Finally, Jamie.

MR. JAMIE MORIN: Should I mention that I paid for the coffee?

(Laughter).

I'm conscious that in the future where I might appear on stage with former office mates might not be as pleasant a future for me.

(Laughter).

I'm delighted to be here with some now current colleagues. I was saying future colleagues until this morning. I appreciate the chance to see so many old friends in the audience here.

It is really a seminal moment for the U.S. national security, civil and commercial space that we're in today. Our space environment, as Scott really alluded to, is one where the interplay between the world of policy, the world of technology, science and engineering, the world of economics, is in a continual and tight feedback loop where what is possible is defined by an overlap between those three very different environments. All of those environments are perennially being complicated by the globalization of space and the rise of new players, both in the United States and around the world.

That interplay played out very neatly and directly and unpleasantly in the Shuttle program, where we did have extraordinary assumptions about the economics of the market that the Shuttle would serve. If there was to be any chance of achieving those economics we needed a very restrictive policy that drove us to a single solution. And among many other causes, we got to some specific choices about risk acceptance in space operations because we needed to make that prophesy of rapid launch a reality.

I'm obviously, among an expert audience, vastly over-simplifying some complex stuff here, but if we continually think about that interplay between the policy of what is technically feasible and what is economically feasible, I think we generate real insights about what strategic options are available to the United States, what strategic options are available to non-state players, and what strategic options are available to other state players. It's only by rigorously thinking about that, and doing it in a way that's deeply informed by insight into all of those areas, and based on data and analysis, that we can have the best shot at making smart decisions. It's because of the prospects of doing that well that I was so excited to hear from Steve about the opportunity to reinvigorate the center at Aerospace. I'm excited by the chance and look forward to hearing from a lot of folks in this room and to a really robust discussion today until we get it right.

(Applause).

MR. ISAKOWITZ: Thank you, Jamie. Let's get started. Scott, you mentioned the National Space Council. The National Space Council, we're hearing, is on the verge of being announced by this White House.

I've had the chance to work under different policies in Washington. I was there working with Mark Albright the last time we had a National Space Council. I worked with you when OSTP led those discussions. I worked with General Brad Bolton (ph) when the National Security Council led those discussions. Why don't you start off the discussion, and I'd be interested to hear your view in terms of how you think this National Space Council needs to operate to succeed, and what do you think are the first things it needs to do?

MR. PACE: It has, I think, some of the first elements of success, which is the personal interest of the vice president. That's the number one thing that you have to have. The second thing that I think you will have to see is, what is actually in the text of

the final executive order when it comes out? What's the relationship between the Space Council and the NSC? We have one over-worked NSC colonel right now who does space on that staff. I would like to add probably about four FTEs to him to help just keep up.

So I don't think that the Space Council needs to be a large staff. I think we had a fairly large staff in Bush 41. I don't think we need to be quite that large.

But you need an element that talks to the primary principles in Defense, Intel, NASA, and of course Commerce and Transportation. It has to be a principle solving organization. When you're in the White House, the last thing you should be doing is running operations. You shouldn't be telling NASA what to do. You shouldn't be telling DOD what to do.

What you should be working on is the seam-lines between those organizations, so you press the president's agenda down. You adjudicate issues that come up. I think if you look at space, as again a form of comprehensive national power, there are actually plenty of issues between the civil community, commercial community, between the diplomatic community and national security community, that probably can only be resolved at the White House.

So if the council forms that functions in tight integration with the NSC, I think it will have high value added. If it turns to be another group that tries to second guess, operations that start discussing what's the next POM size, then it's not going to be that useful because the bureaucracy will naturally push back against that, and it won't be using the White House to its highest and best value.

MR. ISAKOWITZ: Thanks, Scott. General Teague, from a national security standpoint, as you think about a National Space Council, what do you think will be the kinds of issues it's going to have to grapple with in your sector?

GEN. TEAGUE: A great question. I think first and most importantly the National Space Council, the thing that it most can provide, is leadership. We really need U.S. national leadership representation across the international body to be able to provide focus on a number of different areas. Within the areas that Scott just mentioned, you look at the requirements set, potential ITAR issues, being able to work responsible space kinds of issues across the domain, as well as with our international commercial civil partners. Those are very, very important aspects as we look to the future of what a Space Council might be able to provide. But first and foremost, I think, is leadership and having a strong voice at the table.

MR. ISAKOWITZ: Jamie, from your perspective, I'm sure you've been in many agency setting. What do you think?

MR. MORIN: Well, let me start with a plug, which is that Jim Baylor (ph) wrote a good background paper on this late last year, which is worth looking up. I had the

opportunity to chair the Air Force Space Board and be a member of the Defense Space Council for about four years, and to be active in a whole host of interagency discussions on space, on resource levels, and on goals and objectives. My biggest takeaway from that is that it's really important in space to recognize that all of the institutions that we think of as the major players in space are themselves made up of a succession of other sub-institutions, all of which have their own agendas.

The iterative process of working out an Air Force position in space, followed by a Department of Defense position in space, followed by an interagency position in space, and watching the way the different equities got balanced, was one of the most fascinating things I've been involved with for the last four or five years. If we could write that up, that would be an interesting study, but I don't think we can.

We've got to be conscious of that, right? The positions that are arrived at at each level are a balancing of complex equities. The risk, as you move to a centralized, single point of coordination for space policy is that by the time you elevate it to the Executive Office of the President, perhaps the vice president of the United States level, you may have squeezed out so many of those balancing acts that you've oversimplified problems and you get blanket policies that are perhaps sub-optimal.

But all of that is in the implementation. That's in the culture of the organization and the implementation of a process (and the makeup?). So we just need to be very conscious as we go down this route, how to set the right tone and tenor for a body that helps to really crystalize those choices. What would it mean if NASA and DOD strove for much more commonality of launch? There's real tradeoffs and we've got to understand them in-depth, not just lay out a blanket decision that ignores the nuances of the situation.

MR. ISAKOWITZ: Thanks, Jamie. Let me pick up on the point you just made on launch. As I made in my opening comments, we've learned a lot from the Space Shuttle program. We've retired the Space Shuttle. We now have the Delta and Atlas, the work horses for the U.S.

In the next few years, we're going to be flying all new rockets that are out there. What do you view as sort of the implications of these new rockets? What are the big policy issues you think need to be addressed to make sure we successfully make that transition, and have we learned anything from history in terms of getting it right?

MR. PACE: I think one of the things we have to look at is that space launch doesn't follow I think people's intuitive idea of the way markets work. Most people think as you drive prices down demand increases, there's elasticity, all that kind of good stuff. You've come out of a company that was doing the space tourism business. I think if we go and look at some of the past analyses that have been done, which I think are bearing out, basically demand for launch is not elastic.

As you get lower and lower prices, all you're doing is getting less revenues.

You're reallocating market share. So I think, for example, Space-X has done a tremendous job of taking market share away from the Proton, taking it away from Ariane, but it hasn't really sparked new demand. It has been a reallocation of that market. I think you have to have dramatically lower levels of prices before you trigger the next large pulse, which I think will probably be space tourism, if they can hit the price point, if they can hit the safety points, that are there.

So the question for space launch is, what's the policy -- barring that, before you get to space tourism -- what are you trying to accomplish? Are you deploying major strategic defenses? Are you doing an international return to the moon?

If you're not doing any of those other major new things, then incremental improvements are about all that probably will make economic sense. There's some really exciting ones. There's incremental improvements that are happening in reusability. There's incremental improvements that are happening in the sub-orbital world that again, probably will be major, major game changers. But it's not going to be a dramatic phase shift until I think you get prices much, much, much lower.

So policy in the near term will drive what this market is. When people talk about it as a market I think it's often a misnomer. This really is a national strategic industrial capability, the way we would think of naval shipbuilding as a strategic capability. It may do some commercial work on the side, but it's primarily driven by national strategic needs rather than the market.

MR. ISAKOWITZ: General Teague, I'd be interested in your comment. You're living this every day, whether it's RD-180 or trying to figure out how to certify these new entrants. So I'd be interested in your take, but also let me add to that.

One of the things that's unique to the government is the desire for a heavy lift launch vehicle. We have a number of companies that are trying to develop it. We have NASA who is developing the Space Launch System. How do you see that playing out?

GEN. TEAGUE: Well, I agree with Scott's point. There's going to be a natural tension. There always has been and there will be a tension between trying to achieve the price points for affordable launch to be able to bring in a whole new set of entrants. It's all about affordable launch, right? That's ultimately what drove us in the mid-90s towards the current EELV program. As we bring in new entrants and evolve to our next generation launch system, that tension is still going to be there with regard to being able to launch space tourism in a responsible way.

But you complement that -- or the opposite effect of that -- is the need to maintain mission assurance. For national security space, and certainly for space tourism, you can't sacrifice those. There's some boundaries there as you look to launch humans in spaceflight from a civil perspective or a commercial perspective in a tourism and/or national security space, trying to achieve the price points that are going to make it a more successful road to market, that tension will continue to be there.

Long term, I think from a heavy lift capability, our requirements are well known from a national security space perspective. They're well documented. We have a pretty good forecast. Although, while we're trying to grow the smaller class satellites and be able to provide more capability on-orbit, or more rapid launch reconstitution kind of basis, again that tension is still going to be there shaping that market because ultimately it is going to be about mission assurance in the long term.

MR. ISAKOWITZ: Jamie, I'd be interested in sort of your perspective as well in terms of how you see DOD views space launch. Let me just throw in even just for the new administration. There's a lot of talk about major investments in infrastructure. Should space be included as part of that discussion?

MR. MORIN: I think there's no question that space infrastructure is going to be a part of the nation's competitive position going into the next few decades. So if the administration is serious about catalyzing major investments in infrastructure, the space launch and space command and control type infrastructures are all areas that will need to be looked at for investment. I think those are important.

Before the breakfast started Scott and I were talking. He posed a question, a really good one, which is, if you could know the answer to only one question about space, what would the question be? For me, the answer to my question was, what will be the total U.S. launch demand for the next decade or so?

Figuring out not just what you need in the heavy area, what do you need in the military area, but what you need in the commercial area, and how much business space can American launch companies take from international competitors, if the answer is in one magnitude you come to a completely different industry structure than if it's in another magnitude. The fixed costs and rate effects are very, very large in space launch. So for me, that's a question the answer to which I do not know.

But I think we can start to understand it in terms of kind of a probability fan, especially once we get a few of these key strategy and approach choices down. So, General Teague, I look forward to you solving that, and I know there's a lot of people here waiting.

(Laughter).

GEN. TEAGUE: I'll get right no that.

MR. ISAKOWITZ: Thanks. Scott.

MR. PACE: First, this is an actual cultural gap kind of thing because when I was at Rockwell I had these kind of conversations with the guys at Aerospace, because we were talking about the next fleet of commercial vehicles and expendable vehicles and Shuttle vehicles, and of course what combinations made sense.

MR. ISAKOWITZ: As you know, I've been deeply inculcated into the aerospace culture in the last four to seven minutes.

MR. PACE: We can talk about some of your precedents.

(Laughter).

And they were great analysts, but we came from different directions. So the Aerospace guys would ask me about, what are the requirements for being out there? Coming from industry, I was like no, that's not really the way it presents, because I was doing market projections and market assessments and I was looking at price points, I was looking at other competing technologies that would go different directions.

So some of the analysts would understand what I was saying about what market trends were and price points and things like that, and others thought that I actually knew the answer for the requirements and I just wasn't going to tell them. I tried to tell them the difference. From the intelligence community you make a distinction between secrets and mysteries. They thought I had an answer to a secret, and really it was more of a mystery.

I think one of the things that is going to drive some of this launch discussion, what the outcome will be, will be not just government policy decisions which will come on this side, but will be things like outcomes of mega-constellations versus high throughput satellites. So the nature of the future global broadband community, connectivity from orbit, if it goes one way it's still big GEO satellites with lots of GEO backhaul. If it goes another way and ground infrastructure costs drop, some of these small light sat launchers may survive, but they may not. So that's not a launch policy discussion, that's an outcome of a complex market competition that we won't really know for a while.

MR. ISAKOWITZ: But you did promise me an answer.

MR. PACE: We can give you an answer. I'm from industry. I can always give you an answer if you want.

(Laughter).

MR. ISAKOWITZ: Let's talk commercial for a little bit, because you brought that up, Scott. Again, in this administration there has been a lot of discussion of public-private partnerships. Just the other day they announced an Innovation Office set up by Jared Kushner in terms of wanting to do more with regards to innovation linked to the private sector. And there's a lot happening in space these days.

We've had a lot of the kind of exciting talk that we see today. We had that occurring in the 1990s. So what's different and what do we learn from the '90s to make

sure we get it right this time?

MR. PACE: I tell my students that this is about the fourth generation of excitement in commercial space that I've been through. The general outcome is most all of them die. One or two of them in a sector survive.

What's different today is that the companies are better financed. There's levels of prior investment, which as quantitative easing goes down easy money is drying up and becoming harder. Some people are having trouble getting phase A money or first round money. But there is more money, people are more experienced, the business plans are better, there's more information technology markets that are driving a lot of these things that are bringing new demand to the market.

I think particularly location-based services, the Googles and Facebooks have brought new demand to the market. So market management is different, they're more sophisticated, all that is good. What I think we should still be cautious about in talking about public-private partnerships, which is really more of almost a European phrase that doesn't really translate well in the U.S., is what makes a good deal?

In some cases where there is non-government demand that we can share, like launching GEO satellites and then also sending cargo to the Space Station, public-private partnerships make a ton of sense because I can spread the fixed cost. In areas where the government is the primary if not sole buyer, then public-private partnerships to me make no sense. If the government is putting a lot of money into something, 90 percent or more, than as an investor I would expect the government to own basically the intellectual property. If the government is not putting in the majority of the funding, then we can negotiate what the IP is like.

So not all public-private partnerships are alike. It depends on the demand, it depends on the other parts of the market, and it depends on what deals you're going to drive.

MR. ISAKOWITZ: General Teague, I'm sure you're facing this also. What are your thoughts from an acquisition standpoint?

GEN. TEAGUE: I think it's really where the government is going. In the future, as we look to try to tap into public-private partnerships in a new way of doing business, tap into commercial capabilities, I do think that that's different in that for years in the past we've always tried to have our own dedicated systems and dedicated satellites at dedicated government-owned kinds of systems. For the first time, across every mission area, as we release solicitations and requests for information, things like that, across every major space mission area, there's a robust response from industry with all kinds of services and capabilities that we now need to, in turn, figure out what those intellectual property rights ought to be.

Again, this is all about resiliency, right? As I look to the future of national

security space and being able to provide different ways of accomplishing our mission should we ever lose any of our dedicated assets for whatever reason, it's all about having those alternative paths and capabilities. So you're really looking at the requirement through a much different lens now, and then being able to tap into that capability as it's presented. So we believe that there's a robust market in the future for these kinds of partnerships.

MR. ISAKOWITZ: One of the things noted certainly from the commercial sector is an ability to adopt new technologies, to get things fielded very quickly, to take risk. When we think about what the government needs to do to be more like that, there's a lot of discussion today on rapid acquisition, on perhaps even re-organizing national security space. So, Jamie, I'd be interested from your perspective, where do you see those issues going as it plays out, particularly as these are the kinds of tough questions that Congress is asking?

MR. MORIN: Right. I think the key is to think about space as a series of mission areas, not just as a single domain. There are clearly mission areas where either in national security space or in civil space, our openness to approaches that expand the list of risks is going to be limited. Missile warning is a business where we have a very high standard for success, and you can go through the list and find some others there. I expect some of those more conservative areas to be laggards, and the key is going to be to find the mission areas where we can pioneer more rapid capability fielding and prove out the organizational approach, because right now we have organizational challenges, technical challenges, and economic challenges in order to rapidly field capability.

We all want to be able to do it, but if you're balancing risks in all of those areas, it's going to be a tough value proposition to put in front of national level decision-makers. On the other hand, if you've demonstrated organizationally first that you can successfully field capability in these ways, then there's going to be much more receptivity. So I think it's like many things in government, it's a crawl, walk, run kind of approach, even when we're talking about rapid crawling, rapid walking, and then rapid running.

(Laughter).

MR. ISAKOWITZ: Does anyone else want to add? Alright, let's open it up to the audience now. What questions do you have on some of the things you've heard about today? Who's the first brave soul?

MR. : I don't know if you'll be able to hear me in the back of the room here.

MR. ISAKOWITZ: We're all trying to get off the spot here.

(Laughter).

MR. : Thank you, Steve, I appreciate it. The conversation that was just going on

strikes me that in the past where we've seen successful new commercial space areas, like think of the commercial imagery area, is when the government has been willing to sort of let go of part of the market space and allowed it to be privatized. There's a couple of examples that you might think of that have potential in that area. For example, PNT could potentially go that way, although I don't see any signs that DOD is willing to sort of let go, if you will, of the GPS mission.

Perhaps, the weather mission? Right now NOAA provides free data to the world, just like PNT-GPS provides free data to the world. Is there any opportunity for the government to essentially let go of missions in order to enable kind of the emergence of commercial sectors?

MR. ISAKOWITZ: Scott.

MR. PACE: I would say in both of those areas the answer is no. The reason is because both those areas of public safety and national security are so central. I was at Commerce in Bush 41 and I remember Senator Fritz Hollings calling up my boss, at that time the deputy secretary of Commerce, over problems in the GOESS program.

I was standing a ways from the desk and I could hear the Senator screaming at him. Okay, what would happen if he killed anymore constituents in his district due to failure of the weather satellite program? So there is a fine sense of things that are really important.

It's the same thing with GPS. GPS is an incredible strategic advantage for the country, but it is also a vulnerability that I don't think we would really trust anybody else's fingers to be in control of that. So public safety and national security are kind of the exceptions.

The gray area I think you pointed out in remote sensing is the area we are, I think, having the most debate on right now. What's happened is the private sector has merged faster and further ahead of where government is at. We're doing licensing decisions now. I'm doing this wearing my new advisory hat.

The central problem -- the licensing process has broken down. I mean, I helped write it in '92. Okay, it is out of date. It is not respective of where the market is now. The reason is because the private sector is innovating faster than the government understands.

So it's not a matter of the private sector's I want to do this, and the government goes I've been doing that. I don't know if I want you to do that. The private sector is coming forward and saying I want to do this, and the government is like holy crap, you can do that? Hmm, let me think about that.

So getting the government to catch up for speed of acquisition, to catch up to how rapidly the market is moving in some areas, I wouldn't look at giving up areas like

weather or PNT, which are actually fairly well defined. I want the government to be faster at acquisition in responding to what is already happening in certain areas, particularly in comm, particularly in remote sensing.

GEN. TEAGUE: If I could, I would just add, to answer your question, Eric, is really what kind of complementary capabilities across every mission area can we better incorporate to drive resilience into the equation across, again, all of our different mission areas? I think a key component of achieving that goal is going to be having to adopt some type of minimum certification or threshold standards or contributions. That's going to be something that we're going to have to look at carefully across each of our mission areas, but there is opportunity, again, and we are actively seeking participation through both commercial, international, and civil sources.

MR. ISAKOWITZ: Great. Over there.

MR. : Yes, the question is for you, Mr. MR. ISAKOWITZ:. Given your last years, I think, working in the commercial space sector, I'm just wondering how that experience affects the way you see your job now at Aerospace Corporation? In particular, will you be trying to help the acquisition community find relationships with solid commercial companies? Or, will you be trying to train Air Force acquisition to do tricks like you learned when you were in the commercial world?

MR. ISAKOWITZ: I'm not sure it's fair to ask the moderator a question, but --

(Laughter).

It's a good question. The last five years actually have been a great experience for me working in a start-up. And it was a great opportunity to see clearly the very different approach that the private sector plays.

In some ways, it seems new. I actually am sort of back to the future. I think there was a time in the '50s and '60s where as a nation we learned to buy things quickly.

We took risks. We were sort of slaves to the design review. We were very hardware intensive. We'd tried things, learned from them, fly again.

That's what I see really happening in the private sector now, that ability to move quickly and to be able to be sort of very focused on trying to get things on a timely basis; and the ability, frankly, to even back down on the requirements if it means that you could field it and get something that's good enough, get going, and learn from that and iterate on that. I think that government certainly can learn from that. I think at Aerospace Corporation I'm looking forward for us playing sort of a bigger role and working with our government customers out there to try to look at these new ways.

Just last week we hosted an accelerator event on campus where we invited 10 start-up companies to come on campus to talk about some of the things that they're trying

to do in space and aeronautics. We invited government customers there. We tried to make connections, start to sort of build bridges out there, as well as look at our own labs and look at partnerships across what other FFRDCs and national labs are doing. I do think it's really at a critical time for this nation that we leverage what we're doing across this nation, because if we don't I think clearly the international competition will.

Other questions? Let's go with Neil.

MR. : I want to go back to something that Jamie said earlier about the question to which you want to know the answer, and the answer to the question and all that. When we look at the launch issue, the Air Force has recently put out a draft RFP on the next phase of their acquisition program. It's got a mission model through 2027, the next decade. It's not only flat, it's a lot smaller than if you look at the last decade.

It was also posited that on the commercial side Space-X has done a good job of taking market share from other people, but not growing the market at all. So if the question is what does the next decade look like in terms of launch rates, I would say that's kind of not the question. The question is really, what's the decade after that and what is the potential game changer that says that world is different and how do we prepare for that world?

I think from an industry perspective we need to not be stuck in the past and in the current world we need to plan for that future somehow. I'd be interested in your thoughts.

MR. MORIN: I think you're exactly right. I was only concerned that the crystal ball that I was being offered might break if I asked for 20 years instead of 10.

(Laughter).

Apparently, I can't even get 10. But absolutely, the long-term investments that industry is making and the path for development of new capability is predominantly driven by years 11 through 25 or 30. That's critical. Our role, obviously, is predominantly helping government -- not only, but predominantly -- helping government understand the strategic decision framework which needs to be looking out that far but also has to be looking pretty rigorously in the more knowable near-term. So that's what drove me to the 10 year, but if I could have the 20 I'd take that in a minute, as a better approach.

And again, fundamentally you've seen the demand signal on the government side. I think there's more uncertainty, especially once we get to the end of this next coming decade, as to where the commercial is. Some of the models that are out there are going to be starting to scale if they come true by 10 years from today.

MR. ISAKOWITZ: Unfortunately, we're at the end of our time here. I'm sorry, we'll catch you afterwards. To wrap things up, one area that I did short thrift on was on

the civil side, so I'm just going to do a lightning round question, have a survey. I know I'm going to simplify this.

I'd like to see sort of a raise of hands between either those that say yes we should go to the moon and go there to stay and that should be our focus over the next 10 or 20 years; or those who say no, no, it's really all about Mars. We really ought to focus our efforts on getting to Mars.

So all those who that are Team Moon, raise your hand. Okay, and Team Mars. Alright. One vote per person, Ed.

(Laughter).

This is an area that's going to be of a lot of interest for the new administration to deal with. I want to thank Jamie, Scott and General Teague for really a very interesting discussion this morning.

(Applause).

MR. HUESSY: I want to thank our sponsors, particularly our guests here from the Norwegian embassy and from Brunei. Also I want to thank our supporters. Particularly there are two people at the Mitchell Institute that do an enormous amount of work on these breakfasts.

One is Nicky, who recently joined us; the other is Abby Gillett. They do a lot of the web site work, a lot of the invites. This takes a lot of effort and time and they do really an extraordinary amount of work.

And I want to thank our sponsors. Just remember, for those of you, the Bolton Room is right here, which is where our meeting is a little after nine o'clock. Please don't waylay our speakers too long. If you have a question, fine, but at 9:05 we'd like to get out of here.

Also, I understand some of you need to hurry to go over to Heather Wilson's confirmation hearing for the Secretary of the Air Force, which is at 9:30 a.m. this morning. Hopefully we'll have a Secretary of the Air Force soon to guide us.

I want to thank again the wonderful folks at the Aerospace Corporation who came to me with this idea. Those of you who have supported this, Scott, thank you so much. Jamie, I've known for many years. He was Mr. ICBM in Senator Conrad's office. General Teague, thank you for your help.

Steve, on behalf of the Mitchell Institute of Aerospace Studies of the Air Force Association, and on behalf of us, thank you very much for this. Welcome to you all. Thank you for coming. I'll see you on April 14<sup>th</sup> with General Buck.

(Applause).