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The Barriers to Successful Government-Commercial Relations

A Virtual Think Tank (ViTTa)® Report
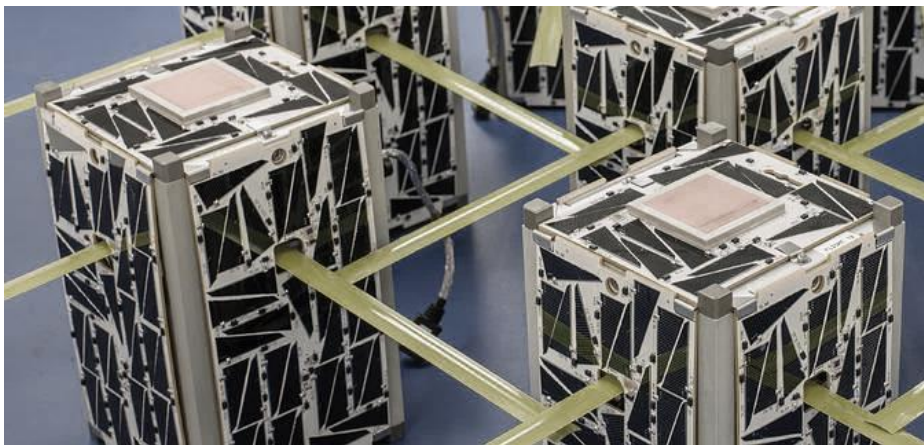
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What is ViTTa®?

NSI's **Virtual Think Tank (ViTTa®)** provides rapid response to critical information needs by pulsing our global network of subject matter experts (SMEs) to generate a wide range of expert insight. For this SMA Contested Space Operations project, ViTTa was used to address 23 unclassified questions submitted by the Joint Staff and US Air Force project sponsors. The ViTTa team received written and verbal input from over 111 experts from National Security Space, as well as civil, commercial, legal, think tank, and academic communities working space and space policy. Each Space ViTTa report contains two sections: 1) a summary response to the question asked and 2) the full written and/or transcribed interview input received from each expert contributor organized alphabetically. Biographies for all expert contributors have been collated in a companion document.

Question of Focus

[Q9] What are the biggest hindrances to a successful relationship between the private and government space sectors? How can these be minimized?
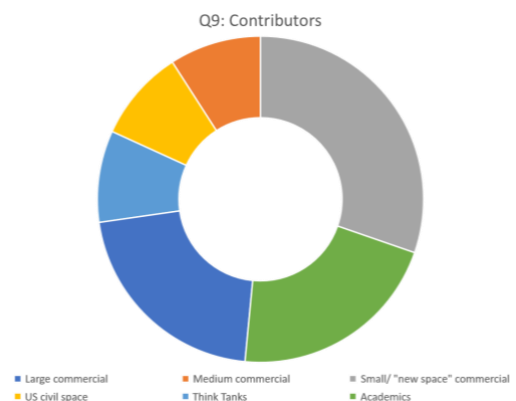
Expert Contributors

Adranos Energetics; **Brett Alexander** (Blue Origin); **Anonymous Commercial Executives**; **Anonymous Launch Executive**; **Major General (USAF ret.) James Armor**[2] (Orbital ATK); **Marc Berkowitz** (Lockheed Martin); **Bryce Space and Technology**; **Robert D. Cabana** (NASA-Kennedy Space Center); **Caelus Partners, LLC**; **Elliot Carol**[3] (Ripple Aerospace, Norway); **Chandah Space Technologies**; **Matthew Chwastek** (Orbital Insight); **Dr. Damon Coletta and Lieutenant Colonel (USAF ret.) Deron Jackson** (United States Air Force Academy); **Faulconer Consulting Group**; **Gilmour Space Technologies,** Australia; **Michael Gold** (Space Systems Loral); **Joshua Hampson** (Niskanen Center); **Harris Corporation, LLC**; **Dr. Jason Held** (Saber Astronautics, Australia); **Theresa Hitchens** (Center for International and Security Studies at Maryland, University of Maryland); **Dr. T.S. Kelso** (Analytical Graphics, Inc.); **Sergeant First Class Jerritt A. Lynn** (United States Army Civil Affairs); **Dr. George C. Nield** (Federal Aviation Administration); **Jim Norman** (NASA Headquarters); **Dr. Luca Rossettini** (D-Orbit, Italy); **Victoria Samson** (Secure World Foundation); **Spire Global, Inc.**; **Dr. Patrick A. Stadter** (Johns Hopkins University Applied Physics Laboratory); **Stratolaunch Systems Corporation**; **Dr. Mark J. Sundahl** (Cleveland-Marshall College of Law); **John Thornton** (Astrobotic Technology); **ViaSat, Inc**.; **Dr. Frans von der Dunk** (University of Nebraska College of Law); **Charity Weeden** (Satellite Industry Association, Canada); **Dr. Edythe Weeks** (Webster University); **Deborah Westphal** (Toffler Associates)

Summary Response

The 33 individuals or teams that provided input represent large, medium, and small/start-up space companies;[4] USG civil space agencies; academia; think tanks; and professional organizations. Four of these are non-US voices (Australia, Canada, Italy, and Norway.)

The consensus view among the expert contributors to this report is that a successful and sustained government-commercial relationship in the space domain is as essential for achieving US national security goals as it is for achieving commercial profits.[5] At present, however, contributors see the ways in which US civil and National Security Space (NSS) operate as barring the attributes that make for an attractive

Q9: Contributors

Legend: Large commercial | Medium commercial | Small/ "new space" commercial | US civil space | Think Tanks | Academics

business environment, including: a) clear requirements and data exchange between government and commercial partners, b) persistent and predictable funding and cash flow, c) non-onerous and

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[2] The subject matter expert's personal views, and not those of his organization, are represented in his contributions to this work.
[3] Ibid.
[4] In this report, large companies are roughly categorized as those with more than 300 employees, medium as more than 50 employees, and small/start-up as up to 50 employees.
[5] See also the contribution by Coletta and Jackson for an instructive discussion on this point.

consistently implemented export controls, and d) synchronization of internal government agendas and decision making with regard to space.

The following sections discuss four themes related to US public and private space sector relations (i.e., US civil and National Security Space and the commercial sector) that emerge in the input provided by the expert contributors. While one of the themes focuses on positive aspects of the relationship, the other three themes focus on types of barriers—namely, red tape, culture, and organization of the bureaucracy. The frequency of mentions for each of these themes, as well as for specific examples of each given by the contributors, is summarized in the Figure below. These themes are discussed in greater detail below. It should be noted that, unless specified, there was no association between an expert's views and his or her professional affiliation. The barriers and mitigation options discussed here were identified as much by NSS and US civil space voices as by commercial and scholarly ones.

Figure: Summary of Contributor-Generated Themes for US Public and Private Space Sector Relations

Q9: Contributor Response Summary
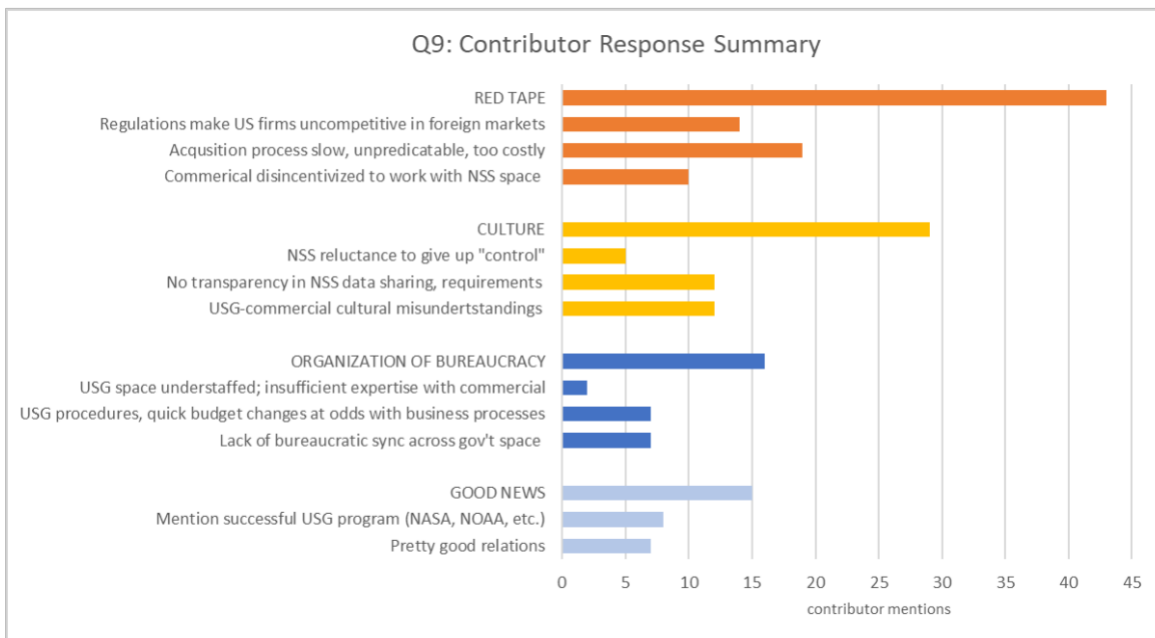
First, the Good News…

Although the question of focus prompted experts to address hindrances, nearly a third (30%) of the contributors feel that relations between US public and private space sectors are fairly good. In fact, even among contributors who see significant barriers, several identify specific organizations and programs as exemplars of ways to make USG space a more attractive and accessible business environment.[6] NASA is the governmental organization that is most frequently cited as having made progress in cutting red tape and developing innovative ways to work with commercial actors. The FAA Office of Commercial Space Transportation is the second most cited, followed by NOAA and then finally, some programs at NGA.[7]

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[6] In contrast, the DoD was singled out by a number of contributors as being particularly difficult to deal with.

[7] Contrary to what we might expect, these responses came from the full range of contributors (i.e., large, medium, and small/start-up space industry enterprises, as well as US civil space, academics, and think tanks).

The Barriers

The majority (70%) of expert contributors mentioned at least one of three types of important barriers that hinder relations between the commercial sector and US National Security Space. "Red Tape" refers to barriers imposed by USG regulatory and acquisition/contracting processes. "Culture" captures barriers that contributors suggest arise from the different goals, expectations, and cultures of the NSS and commercial space communities. Finally, "Organization of Bureaucracy" addresses impediments that result from the organization and structure of the US bureaucracy.

#1: Red Tape

What are described as opaque, convoluted, and slow US regulatory and acquisition/contracting processes are the hindrances that are most frequently mentioned by contributors.

Acquisition Contracting

In a sentiment echoed by other contributors, Major General (USAF ret.) James Armor of Orbital ATK suggests that problems with space acquisition do not just reside within bureaucratic machines, but often emerge at the outset from "a poor requirements process—[the NSS] can't decide what it wants." Dr. George C. Nield of the Federal Aviation Administration offers a reason for why this is so: "the nature of the DoD organizational structure, namely lots of people can say 'no,' but no one's empowered to say 'yes'."

What is the impact on the commercial sector? In short, the effect is increased costs of doing business with NSS. When acquisition and contracting processes are difficult to navigate, involve so many steps, and require extended periods to reach contract award, the transaction costs of working with the USG can become higher than the value of the work itself—a negative business case that is extremely difficult to defend to shareholders and investors. Lengthy periods of uncertainty involved in securing work with NSS also increase financial risk to companies who must spend up-front capital to pursue NSS work.[8] Smaller companies may experience additional barriers. Three contributions from small or start-up businesses find that current acquisition processes may benefit "entrenched interests" and make it difficult for smaller firms to compete with larger, better-known prime contractors.[9] Theresa Hitchens of the Center for International and Security Studies at Maryland sees the issue as reciprocal—that is, the "creakiness/complexity of the acquisition process at DoD and NASA" also makes it harder for the USG to find and work with smaller companies.

Regulation

While contributors were sympathetic to the necessity of government oversight of dual-use technologies with national security implications, many believe that this oversight is overly restrictive, unfair to US firms, and/or prone to what Joshua Hampson of the Niskanen Center tags as the "capriciousness and opaqueness" of decisions about export controls.[10] More than half of the expert responses mention inconsistently implemented, "burdensome" and/or "outdated" mandatory Federal Acquisition

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[8] For more on this point, see the responses from Alexander, Cabana, and Rossettini.

[9] For related commentary, see the contributions from Adranos Energetics, Thornton, and Carol.

[10] The Bryce Space and Technology Team disagreed with this viewpoint. According to CEO Carissa Christensen: "Generally speaking, the regulatory environment around commercial human spaceflight has been favorable and the regulatory environment around commercial launch has been favorable. The regulatory environment that approves very small satellite systems and large constellations of very small satellites has also been favorable."

Regulation (FAR) requirements, International Traffics in Arms Regulation (ITAR), and other compliance requirements as major barriers to successful relations between public and private sector space.[11]

There are two inevitable results of restrictive export controls. First, activities such as moving space-related items from general export controls to ITAR put US companies at a disadvantage relative to foreign competitors, and create a situation that eventually will incentivize companies to leave the US for areas with more lenient controls.[12] Second, as Lieutenant Colonel (USAF ret.) Deron Jackson (United States Air Force Academy) argues, a restrictive environment invites competition from foreign governments eager to attract business away from the US.

#2: Cultural Differences

What experts saw as "cultural" barriers to government-commercial partnerships in the space domain were attitudes and behaviors rooted in the different agendas, priorities, motives, incentive structures, and varying speeds of operations of government and commercial space. Contributors described two specific sources of culture clashes: differences in expectations about the operational environment, and different concepts of information sharing and control.

Environment

One critical difference between government and commercial space, unsurprisingly, emanates from the varying operational environments in which each side finds itself. In one example, Hampson observes that the private- and public-sector funding environments "do not neatly overlap." He points out that even small changes in program funding can strain relations between the government and the private sector. Pressure on businesses to produce revenue—or at least the real possibility of it—to investors and directors as quickly as possible can be stymied by the deliberate pace of the NSS funding processes and decision cycles. In addition, government planning on the single fiscal year is simply out of alignment with commercial investment planning which, by necessity, requires longer lead times (e.g., for staffing-up, engaging capital investment, etc.) than does government planning. This mismatch can be lethal to all but the largest and most mature firms. For smaller, or "new space" innovators, this discrepancy can "de-incentivize entering the market or working with the US government" (Hampson).[13] Dr. Luca Rossettini (D-Orbit, Italy)[14] concurs that misunderstanding of commercial funding requirements is a major reason that companies often do not even consider the USG in their business planning. Simply put, the NSS business environment is too slow and thus too risky for the "aggressive go-to-market" strategies that drive many of these privately-funded enterprises.

Information Sharing and Control

A number of experts remarked on barriers generated by government versus commercial expectations regarding the control of all facets of space capabilities, systems, and development. An area in which the government culture of "control" appears particularly harmful is the control of information. This includes what experts identified as the tendency of NSS organizations to expect unidirectional information flows from commercial to government but not the other way around. Dr. Damon Coletta and Lieutenant Colonel (USAF ret.) Jackson (United States Air Force Academy) and Victoria Samson (Secure World Foundation) are critical of the government's lack of transparency and tendency for "over-classification"

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[11] See the input from Adranos Energetics on the small satellite community efforts at self-regulation.

[12] For related discussions, see responses from Lynn, Norman, Gold, and Hampson.

[13] For more on this line of argument, see the input from Nield; Rossettini; Spire Global, Inc.; Stadter; and an Anonymous Launch Executive.

[14] See also input from Adranos Energetics for a similar argument, and Harris Corporation, LLC on the business risks associated with investing in potential regulated dual-use technologies.

of space-related information. As an example of the former, Dr. T.S. Kelso of Analytical Graphics, Inc. recounts his experience with tracking data disseminated by the Joint Space Operations Center (JSPOC) to commercial space; he notes that this data often is delayed, of questionable veracity, and/or incomplete. He says, "we constantly run into this kind of situation where the government is trying to protect processes or capabilities or systems or whatever it happens to be…but at the same time, we are putting hundreds of satellites that DoD relies on for things like communications at risk because we could think we understand the situation and actually maneuver into a collision rather than avoid one." In a similar vein, the ViaSat, Inc. team comments on a recent statement by the Secretary of the Air Force on barring proprietary interfaces with government systems. They argue that declarations such as these illustrate a key government misunderstanding of the commercial sector, and should be the foci of efforts to find mutually beneficial common ground.

Nield describes the USG as committed to a "deeply ingrained habit of doing things the way we've always done them." A number of experts identify the ironic result: The standard steps taken by the government to protect NSS systems could generate *increased* risk to those assets; an effect that these experts expect will only worsen as the space environment becomes more crowded. Contributors argue that ultimately, the key difficulty to overcome in the name of partnership is the reluctance of the NSS community to amend its standard procedures for fear of yielding control to other elements of the USG or the commercial sector.

Dr. Edythe Weeks of Webster University offers a slightly different view of the impact of culture clashes between public and private sector space. Rather than taking sides—or assigning the government most of the blame—Dr. Weeks characterizes the (ultimately self-defeating) conflict between the "myths" of commercial versus government space as one over "who knows the best way." Commercial space, she argues, believes that it can produce space capabilities smaller, better, and faster than can government space. Given this ethic, it is not surprising to uncover commercial sector frustrations with a government space enterprise that it perceives as following a slower, less effective path. This commercial-government 'mythology,' encourages commercial space and the US public to "forget" the significant role played by the government in setting the legal conditions, funding innovative research and development, and purchasing services that underwrite commercial space. The mythology also diverts Congressional attention from the critical role of US government space, with the ironic effect of reducing budget appropriations for public sector space programs. This creates a negative cycle which lies at the heart of much of the budget uncertainty about which commercial actors complain.

#3: Bureaucratic Organization and Structure

The final category of hindrances mentioned by contributors has more to do with the practices and structure of the federal government than with the DoD or the NSS, specifically. Key issues mentioned by the expert contributors were the insufficient staffing and underfunding of US government space as a whole, as well as the legal requirements and other elements of the NSS acquisition process that are outside direct DoD input or control. Examples of the latter include the particularities of Congressional processes that can cause unanticipated roadblocks in program funding; or White House policy and priority changes that can change significantly from one election to the other. Robert Cabana of the NASA-Kennedy Space Center cites deficient policy synchronization among USG space agencies as adding to the confusion felt by firms that may want to do business with the USG. Hitchens in turn identifies the "lack of a clear policy on export controls [as] slowing the licensing process" for commercial space. Finally, Faulconer Consulting Group[15] argues that many of the issues are the result of not having clearly established the government's role relative to commercial space, asking, "Is the US Government client,

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[15] See also the input from C. Weeden.

manufacturer, or regulator?" They further point out the source of conflict: As one of the largest potential investors in the space sector, work done by government agencies is often in direct competition with "what the commercial providers can provide," while at other times, the government is "purely the customer purchasing commercial services."

Actions to Minimize Hindrances

If it is agreed that fostering a healthy, globally competitive commercial space sector is *not* at odds with US national security requirements but is itself a key requirement, then middle ground solutions must be found. To do so effectively requires taking an accounting of where the points of tension are. As such, tensions between commercial and government requirements, together with some steps for mitigating each, are summarized in the table below.

Table: Tensions Between Commercial
and USG Requirements and Potential Mitigation Points

Finding the Middle Ground

Commercial Needs	Recommended USG Actions to Improve Relations with Commercial Space	Government Requirements
Financial predictability for rapid revenue, business case	Provide quick notification of funding, write contracts in ways to make industry resilient to funding, policy, priority changes	Legal procurement processes and FY budget cycles; Congressional, executive oversight and priorities
Clear info about government requirements; IP protection	Reconsider which information is truly sensitive, in need of protection vs. SOP	Classification, security to protect sensitive capabilities, systems and vulnerabilities
Need for market share, expansion, global competitiveness	Reconsider which products are truly sensitive; no blanket restrictions; relax export restrictions, allow appeals	Need to limit availability of sensitive technology components
Lead time to plan and staff up for revenue, accommodate multi-yr investment planning	Reduce red tape; streamline processes; use multiple types of funding vehicles for quick turnaround and decisions on funding	Deliberate, careful stewardship of public funds, legal procurement processes
Healthy growth, profits	Foster dialog to clarify commercial and government incentives and priorities	Need for low-cost, reliable technology suppliers and services

Reducing (the Impact of) Red Tape & Encouraging Bureaucratic Change

Contributors mentioned the need to "streamline," "update," and "reform" both acquisition and regulatory practices by taking steps to make them more transparent, lowering transaction costs to businesses associated with lengthy proposal writing and processing times, and facilitating access to businesses beyond the "old space" firms with which the NSS community currently partners. The majority of recommendations involved expanding the sizes and types of solicitations and funding vehicles

available for space acquisition (e.g., increased use of Broad Agency Announcements [BAAs]; Small Business Innovation Research awards [SBIRs]; fixed-price contracts, competitions, demonstrations, and prizes; and space act agreements) to allow the government to leverage private sector investment and capabilities while reducing bureaucratic costs.[16] Marc Berkowitz of Lockheed Martin offers several suggestions to facilitate progress, including increasing funding for federal regulatory agencies so that they might be fully-staffed, offering workers incentives for good performance, and modifying personnel policies to attract the best talent to the USG.

While there is recognition that particular technologies invoke real national security concerns, contributors believe that updating obsolete legal requirements and export controls will encourage growth of US commercial space while still achieving national security goals. Like many of the contributors, Sergeant First Class Jerritt A. Lynn (United States Army Civil Affairs) sees a direct connection between export restrictions and satisfaction of US national security goals. However, his argument runs counter to much of current policy thinking. Namely, he argues that more restrictions can mean *less* security. He recommends avoiding "blanket regulations and categorization that generalize a market." Regulating space in this way will degrade the US leadership role in innovation of space technologies by incentivizing businesses to restrict research and development investment that would have occurred if companies had had access to larger (international) markets for their products. Hampson adds that "relatively simple reforms," such as increasing transparency into why a company's products have been restricted, establishing an appeal process, and allowing US companies to sell capabilities that are already available in the international market, can result in major improvements.

Minimizing Cultural Barriers

Addressing impediments wrought by cultural differences will likely require a shift in how the NSS community operates, as well as openness to fostering a beneficial business relationship—particularly with smaller, "new space" innovators. Contributors' recommendations for mitigating cultural differences are centered on increasing the transparency and the quality of NSS communications with the commercial sector, as well as on engaging in government-commercial dialogue to familiarize each side with the agendas and "business models" of the other. An added recommendation was offered both by Deborah Westphal (Toffler Associates) and by an Anonymous Launch Executive, who each suggested that cultural differences would be less critical if the NSS community clearly defined its lane as research and development on systems that have no commercial use (e.g., nuclear weapons) and allowed the commercial sector to take the lead in other areas.

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[16] See also the contributions from Gold, Nield, and Rossettini.

Subject Matter Expert Contributions

Adranos Energetics

Chris Stoker
Chief Executive Officer

Dr. Brandon Terry
Founder and Chief Technology Officer

11 August 2017

INTERVIEW TRANSCRIPT EXCERPT

Interviewer:	Right. I agree. I think this is an important point. So, would you say the current feeling right now within the small sat community is that they would be looking towards private industry to establish an institution to regulate or if it's completely reliant on the government initiative?
B. Terry:	I mean it's a tough situation because if the government takes it, if I am North Korea, if I want to put a satellite up there, am I going to care what the US says about where I should put my satellite and why? So that the hard thing with the government taking control of that situation is how they're going to be enforceable, if some of these smaller nations that don't like to play by the rules start turning things up. But I think in general, we've done a really good job at Geo-Sync, on keeping good responsibility there. I don't know if we just need to bring some of that more into LEO. But I know that is a concern in the community as we've been networking at these conferences.
C. Stoker:	There thing I'd like to add to that, the difference I do think is who's going to enforce it, private vs. government. I mean that's going to exist and we got to play ball. I guess I just partially disagree with Brandon and say the groups are more likely to play ball if they have sovereignty behind them. Maybe you convince me otherwise, but I've never actually thought about a private group trying to enforce any of these things because it would be highly reliant on the private group making funding contributions out of their own volition versus the power of taxation, funding this kind of effort to enforce and regulate. I don't know that I see a private group ever succeeding in enforcing anything. That's my opinion. …
Interviewer:	Right, okay. Now in your experience, is there a particular concern that a company like Adranos Energetics that could shift that dynamic? In other words, the innovation in the commercial sector that the US is currently boasting, is there something we can particularly verify that would not only stop that dynamic, or push it out to a different country, or is there a specific obstacle that comes to mind?
C. Stoker:	Well, the obstacle is where is your money going to come from so your company can grow? The most likely source for us is US space, but there might be a European group or country that's really interested in what we're doing and want to fund it and a part of the condition of funding is we move to Europe and put our company at Europe and we're able to get past any ITAR restrictions to do that. But I put that likelihood pretty darn low right now.
Interviewer:	Okay. So, the issue of government funding, specific sectors, little commercial industries, is the biggest concern, is that what you're saying?
C. Stoker:	Not necessarily government but really any government or private. So we're going to fund our company in one of a few different ways. One, the government gives us money to develop our

technology which that's happening. The US government is doing that for us. You get a private sector to fund which we're also doing.

B. Terry: We are also doing.

C. Stoker: Yes, which we're also doing, and using these investors or you're selling your product. The buyers of our products are primarily going to be US. So our product is launch systems for small sat and launch systems for missiles. Biggest market by far is the US for both of them. Then you go back to well who's going to fund it? Well, just like Brandon said, by far the most money is coming out of US privately. Then I don't know the details on this. I know the Europeans fund a lot of space launch and I don't know much money they likely put into it but I'd be shocked if they put in nearly as much as the US does. So when you're looking at those three sources of cash which is the life blood of the organization, by far that you're going to come out of the US. There's some monumental thing happened which will take a long time to occur.

Interviewer: Right. Okay. Now as far as a shift in the politics, you can be speaking specifically about the Executive branch but Congress as well. Is there a concern among commercial actors over the stability of, let's say long term funding or long-term interest in space, or if it's just accepted that the investment will continue, and that the interest will continue and that it doesn't necessarily enter into the decision making, it's commercial act or is it a particular concern?

B. Terry: I would say for the small sat community it's probably less concerned about the particular current administration than you would for your large satellite launches. I think the reason why the customers for the small satellite launches are not primarily government. Your primary customers are going to be B2B, business to business. So you're going to have businesses that want to put up these small satellites. I think for them the business model doesn't really change as much based on what one administration versus another whereas with the large satellite launches there's not as much private demand for the large satellites as there are government demand. It a lot will be heavily depending on what the current funding scheme looks like in the current administration budget. So I'd take the small satellite is probably in my opinion less moved by current administration in the large satellite industry.

C. Stoker: I agree with that. I mean there's always macro concerns and government classes or something crazy like that but it must have happened. I think people view space as the competition. Now the next frontier, who's going to conquer the next frontier and take their biggest share as they can and control as much as they can? Who's going to win the potential war in space? If there is a country who can take out all of the US satellites without the US being able to do anything about it, that would be a huge, huge, huge problem. So because of that, I think you're going to see a bunch of money from the government go into the space sector. Whether because they want to compete and they want to beat other countries or want to just protect themselves. I don't know… it's just something that I worry about right now.

Interviewer: Okay. I think this is something that's a little bit unique today, the issue of space. Okay. So we covered most of the questions already but I'll ask it directly now. So what are the biggest hindrances to a successful relationship between a private and government space sectors and how can it maybe bit the modest?

C. Stoker: Brandon and I may answer this differently but responsiveness, ability to get things done.

B. Terry: Yes.

C. Stoker: I'll give you an example. So we just raised in our first year of funding, start to finish in two months to get a substantial amount of money committed to our company. We're in the process of doing another government contract right now but our first government contract, start to finish, before we saw money, it's like eight, nine months. It was not even that much money. Maybe it was longer than that, Brandon?

B. Terry: No. That's about right. What makes it even harder is usually government money is split up into stages which makes sense because you want to figure out if there's sufficient, whatever, to move on to the next phase of that particular project. For several months, we are waiting between stages to see if the project gets some huge funding or not. But in the meantime, you're sitting there twilling your thumbs because you're not getting paid to continue work forward. So it's just very hard in terms of time. There's a lot of waiting and there's a lot of time in between phases of the contract. Once the contract is in place and going, it's great.

C. Stoker: Even before that too, it's like okay, who's your champion of your technology? Because we're in space so obviously the natural place for us to go is NASA, right? But NASA is enormous. So just because someone works with NASA or is a part of NASA, I really don't know if they're the right guy for me and there's no way for me to find that out. So we kind of have stumbled through the networking game to try and find a group that might be a good fit. But that's a bit of a challenge whereas if I'm trying to raise private money, it's very clear to me which groups are funding space-based technologies. I mean there's an angel group called Space Angels. It's not hard to find. I can identify them and I know they'll be at least somewhat interested in what I'm doing versus another private group that is the private group for tech company and I doubt they'll be interested, so I'm not going to waste my time. Now imagine if all of the investment companies in the world were under one umbrella and it was called World Investment Inc. I have no idea who to go to find space-based investment. That's kind of what the problem is in a lot of ways. I think with the public sector it is getting in the door …

Interviewer: Okay. So, you're speaking specifically to the bureaucratic nature and in essence, the monopoly that the government has in their role in their current space domain, am I right in saying that?

C. Stoker: Yeah, I think it's fair.

Interviewer: Good. Now I'm sure regulation is a concern as well but if you could expand on anything that is especially concerning or a particular obstacle to the commercial sector, be it like specific laws or regulation or in your experience or is that not so much an issue.

C. Stoker: Well, everything's relative I guess. I mean we're not as highly regulated as the biotech world. Like there's no FDA to make us use cured water for 20 years before we can get something approved to actually use. So, in that regard relatively we're relatively deregulated I think. But now we haven't tried to launch something in the space and if we did that, I might have a different answer for you.

Brett Alexander

Director of Business Development and Strategy (Blue Origin)
14 August 2017

INTERVIEW TRANSCRIPT EXCERPT

Interviewer: Okay. Great. Thank you. I think that about covers that question, so we'll move on to the next one. What are the biggest hindrances to a successful relationship between a private and government space sectors and how can these be minimized?

B. Alexander: Greatest hindrances? You know I think -- I think, first of all, very close coordination, you know, working relationship between US industry and the US government on all sorts of things. Policy stability and budget stability are both advantages and disadvantages because, you know, depending on how you look at it they're not very stable, as far as policy and budget changes quite a bit. But other than that, the fact that US industry has a permissive policy that needs to be in place, and then has government contracts that they get to help finance development and

operations activities. I think that constitutes a pretty good relationship. Any one of the different sectors [can] quibble over whether it works or whether it should be changed, you know, remotes sensing is one that over the last 25 years there's been, you know, a policy question. And there's a market question for the industry, et cetera and whether that's been successful or not you can argue but by and large US industry and US government has a pretty good working relationship across all the different sectors.

Interviewer: Now, would you say that good relationship is exclusive to large companies, such as Blue Origin and SpaceX and ULA or, you know, perhaps it's harder for up and coming companies and innovative companies to have a working relationship with the government. I'm wondering if you could speak on that point at all.

B. Alexander: Well, I think SpaceX has proved that that is not true because they were very successful in getting millions and millions of dollars from NASA when they were very small to begin with. They built their company up from nothing based on government funding so, you know, that goes against the idea that big companies are established have an easier time. I think by and large, larger companies have significant advantages, but like I said SpaceX has been able to show that that is not usually so.

[…]

Interviewer: Okay. Thank you, Brett. So, yeah, we got through all those questions. Just one last question I want to ask you, is there a question that we didn't ask you today that you think we should have or that you think that an effort like this should be addressing towards commercial actors like yourself?

B. Alexander: Yeah, you know, I think the last point I was making which was about the acquisition strategy for the government. How does it interact with the commercial company? I think policy-wise, but from the funding side acquisition, from where you have that ability to go incentivize industry to do something that is both useful for national security and for commercial. You know, the use of public private partnerships, you know the Air Force has done through other transaction agreements, and with SpaceX agreements, but it is that public-private partnership where both sides contribute and requirements are not so tailored towards the government's unique mission, that there is benefit then to private industry and the commercial. And then there's prices coming down for government missions because of the, you know, it's a broader mission or it's a broader applicability of products developed. That's something that would bring a unique way of doing business that is unique to the US, you know. Overall, it's only a few programs in the last 20 years in the Air force, [EELV] and the way we are looking at it now from where everyone seems to agree with the program, NASA commercial and cargo program and others. I do think that that is a major advantage the US government needs to take action on.

Interviewer: Okay. Yeah, we have heard acquisition reform quite a number of times. Just to follow up to that, and you can be as specific or as general as you like, but what would that acquisition reform look like from where you sit?

B. Alexander: Yeah, you know, that's an interesting point because other transaction agreements are basically a way of getting around the acquisition process. Not to get around specifically, but because you want to bring private money in, in that public private partnership manner. And so, it does seem outside the acquisition reform in that sense. Or you could say that acquisition reform could improve, you know, greater use of other transactions agreements and awards. I think the overall acquisition reform effort is much needed, incredibly complex and, you know, I don't think we can wait for that. That's going to take a long time and be very complicated. The use of other transactions, the public private partnerships for example, are a viable alternative.

Anonymous Commercial Executives

24 August 2017

WRITTEN RESPONSE

The contracting process is a a big hurdle, especially the Federal Acquisition Regulation (FAR). Many have suggested the benefits of removing FAR altogether. The U.S. government's unrealistic expectations and changing requirements are cumbersome and a deterrent to effective communication. This set-up would not work in another setting: a 12 oz. can of Coke costs less than $1. But don't ask for a 13 oz. can of Coke and expect to pay anywhere near $1 for the first can.

Anonymous Launch Executive

17 July 2017

INTERVIEW TRANSCRIPT EXCERPT

Interviewer:	Okay. Now, moving on the next question which I'm sure we'll spend a lot of time on and I'm excited to hear about. So, what are the biggest hindrances to a successful relationship between the private and government sectors and how can these be minimized? So take as much time as you need to.
Anonymous:	Okay. So again, don't take this personally, you guys. I know you aren't government but you're still part of the government complex. So if this is offensive, I'm sorry. I don't mean to offend anybody.
Interviewer:	Not at all. We'd love to hear it.
Anonymous:	Okay. The biggest problem we have frankly is the government's attitude towards anybody and everything. It's not universal but the bad ones kind of spoil it for the rest of them. The attitude varies between agencies and so on but it's one of the government sort of knows best and the government has this money and it is the most important customer that you can have. If they studied all the specifications, they'll really know what the answer needs to be. What was it called? The Pentagon wars from like 15 years ago? That movie? I don't know if you ever saw it. If you have it, it's pretty funny and it kind of makes fun of the government procurement process and the secrecy behind it and all that stuff. So this sort of, "We're from the government, we're here to help you," attitude is probably like the number one issue that I run into. They just don't even understand there's another reality out there. It hurts themselves more than it hurts us because frankly we don't care, right? So we're all designing our business. Here's a dirty little secret. When we go to investors, one of the questions they ask is how much government business are you doing. The right answer is none, right? So we're not entangling ourselves with the dangerous quarrels and low budget people and all sort of the underlying attitude beneath that.
	If you go into and say hey, we've got basically a government business, the investment community doesn't want anything to do with that because A, they don't understand it but more importantly they see the government as potentially a dangerous customer they have, from a regulatory point of view. I mean we all know through the government they have to first decide whether or not they allow this with the government. It's not even a fair fight from zero. So there's this whole sort of like men are from Mars and women are from Venus or whatever but it's kind of like the commercial guys are from Mars and the government guys are from Venus. We just go… we still even live in the same worlds but I attribute this to the fact that the military world in particular

and it's also very true with NASAs as well, in a very socialist world and... Trust me, I love my soldiers and I'm a patriotic guy. But guess what, military is a socialist society.

Even the leadership and structure and so on. It's the way it's got to be. But that socialism really seeps through. There's not a lot of room for individualism in the military out of design. So from the get go, the culture is different. Then the way the whole thing is run, it's a soviet economic system, which is the irony in my life that we use soviet economics to defeat soviet economics out of the Soviet Union in the defense of capitalism. What's the difference between us and them is the direction where they point the guns at, the Soviets pointed the gun inwards and we point them out to keep people out. That's because we have a capitalist society. But notably the governments operate kind of the same because at least procurement level. The soviet union have a five-year plan and the government's got five-year plan sort of acquisition. Soviets set the price, decided to build the stuff. Pentagon sets the price in the budget, specs, all that stuff. So you start to see that really this is why the government system doesn't generate creative solutions unless there is a crisis, right? When there is a crisis, then things happen like the Manhattan project, look at the Apollo program. There's exceptions to these rules that they're very big, but there's a general rule when left... to go back to those basic elements. It's the soviet economic system, not capitalist. We are capitalist. Many of us come from this other system having lived in and worked in it and not understood why we didn't like it. Being very unhappy and not able to put our finger on it. Finally, once we're gone and out and been able to make decisions for ourselves and move quickly, we don't want to go back to that.

So to some certain extent, when we do business with the government, we sort of drop back into this abusive relationship with an ex-spouse, right? Nobody wants to move quickly. Nobody can move quickly. I'm just giving you examples. So I'm working with the BIUX guys. I don't know if you're aware of them. They're sort of the air force answer to incutel, which is a CIA venture firm. They came out of the woodwork when we first started. We often say we're going to give you $25 million. So I'm checking under the table for recording devices, thinking this must be an FBI sting. They turned out to be all legitimate guys and they were operating on a legitimate charter, but I just got the solicitation yesterday. So there's express moving and they are fast moving. They're doing it above boards, it's all legal, but they're a little controversial because they're breaking glass. Still took a year to get the money going. These guys think that's fast and I don't want to break their hearts and tell them your idea of fast is like comparing a Nash Rambler to a Ferrari. It's just not even the same class.

Okay. So it's a perspective. So it's like two worlds that will never really truly work together unless one is just a supplier to the other, which is kind of the way I see it. I think that there's ways that the government commercial can and should work together, and that's something I'll come back to in a second. The final arc of the relationship that works the best is where the government buy stuff it needs commercially and it's just fine just like everybody else does and it's not no longer in the R&D business. It gets mostly with the exception of certain weapon systems. It's mostly better for the government to rely on commercial capabilities given the sense that they can.

So I don't know if they (government) ever made computers and I'd be surprised if they did. But the idea of the government-based computer to develop would be something normally would do because you can go buy some of the items. So that's an obvious example, airline flights and everybody still flies commercial, but there are few exceptions and so forth. So there's probably some good examples out there. There's probably good example of things commercial guys will never build that the military needs a tomahawk for example. There's no commercial need for a tomahawk. There's just no commercial need for nuclear weapon. There's no commercial need for... I can give you a whole list of them. Okay, fine. Go develop that. But that's not really what we're talking about. We're talking about sort of the part of the industry that peels off where there's a common need between the society at large and the military and it's a dual use item if you want to call it that. That's the sort of place where really it's just a buyer-seller relationship.

Now where these things kind of get interesting is where I live frankly in the launch vehicle business, we are subject to a lot of government regulatory authority, which I'm not going to argue with. It's just is. There's a lot of other sort of practical things like launch ranges and places like that which the government ends up controlling in most cases and that we**]** that's sort of being on the other shoe, we have to be the customer to the government and use their ranges and so on. So there's places like that where the government would do well to partner better I think with the commercial guys and in identifying how they can be helpful to us. For example, I'll give you a concrete example. I need more than one more polar launch site for my rockets and I got one up in Alaska, at Kodiak Island and It's a commercial launch range.

So our first launch, we attempted to do back in April. We had all scheduled. We had a contract in place. The day we were shipping out to Alaska, we got a call from the Alaska guys. Missile Defense Agency vetoed our launch on that range. It's a commercial launch range, okay. Missile Defense Agency says thou shall not launch out of here because we're afraid you might hurt someone. We got a big test coming up in July which we now know is the FAD test. Fine. But you know what, if you're going to come in, you might as well just own the freaking thing. Let's not call it a commercial range. Let's just call it the Missile Defense Agency range and be done with it. So that kind of thrown your weight around. It really pisses me off. It gets in the way of us getting things done. So we found another way around it. You know what I'm going to do now, I'm going to go build a launch site in Mexico because Missile Defense Agency is not going there. I got to have my own. I can go to Vandenberg but they're assholes to deal with. They're difficult and yeah they're welcoming and all that and they say its in their charter but we'll try to work with them. We tried that with SpaceX and we can't work with them. Again, it's like men are from Mars and women are from Venus thing. We just can't get along and there's not really a fix that I'm aware of that will fix this stuff except… something at the very top knocking heads and saying, "Hey. You're not going to stop it." It's really… because there's no practical reason why this stuff should occur. It's just a pissing contest and sandboxes and things like that. So I go back to my original comment which is we just don't even… we're like Vulcan and humans, we're just not even the same thing. So there's an issue there.

Let me see. What's the last of the question? I can see one blank here.

Interviewer: Well, if I could press you a little further that if I could summarize… you're saying the government lacks the business acumen to operate confidently with the commercial sector, right? But if I could… is there may be like revolving administrations or specific regulation or bureaucracy of course. Are there more tangible things you could identify?

Anonymous: Well, launch ranges are… by the way, can we just back up? I wouldn't say the government lacks a business acumen. They're not in the business to begin with, right? And we are. They're in the business of fighting wars or building space agencies or whatever. The reality is that's just different from being a business. They could have the acumen. They probably do in some cases but they're not… the system doesn't reward that way. In fact it punishes some of the government sites. I just think it's two different worlds rather than lacking. It's not like criticism of the government. It's just a recognition that we are different. We're completely different.

Interviewer: Right.

So we'll talk about concrete things. So launch ranges, for example. One of the things that the government could do and particular the military is have a more aggressive program of using existing launch ranges on a commercial basis. It can't be just hey we're open for business to commercial guys. If we're already doing that, it has to be operating in a way that is truly commercial because you know, like I just told you. I'm going to go to Mexico because it's easier for me to go to Mexico. Even though you know what I'm saying, don't deal with corrupt local officials in Mexico. You deal with all the export regulations and all the crap that I have to deal with and it is easier to deal with the people that are going to shoot holes in my rockets all the

way to Mexico, than it is with the deal with the air force in southern California and their "commercial" way of doing business. So it's just… you pick the lesser of your two evils and two pains So if they did truly reform the way things like launch ranges which I consider national assets in a way, it's tough for us to build launch ranges in this day and age. Both physically I mean there's a lot of coastline that's just gone and because of population you never truly get an environmental regulation with the EPA and so on. You got to to the point where they just said oh, this looks great. Get the bulldozers out and dig it. So that was during the cold war whenever who did got bulldozed themselves. So we're not in that situation anymore. We can't do that. This is a physical limitation as to what we can have. As it turns out, the government is sending out a lot of really high value property in strategic locations where you can actually launch rockets from. By the way, you can probably charge a lot of money and none of us would complain, but again you got to be able to do the deal and I have to go through all of this red tape and all the bullshit and so on. So launch range reform would be big on my priority list from my rocket point of view.

The other place where the government right now I think is doing a good job working with the commercial is on the collision avoidance and the JSPOC does a really nice job of doing a conjunction analysis and so on. The third, I was working with Iridium when they lost that one bird and it was 2009 or 2010. We had just gotten done doing an analysis for investors, seeing how long their existing consolation would last and another guy. I even said well, the next bird can be lost by solar panel failure because the strings are failing very predictably and that the other losses to date had been other things that they fixed. Within a week of submitting that report, a piece of Soviet rocket debris slams into one of the Iridium satellites and takes it out. It creates a secondary debris cloud so on.

So the JSPOC got setup as a result of that, that is where the US air force had a national resource in terms of case surveillance capability that it said, "Hey. We need to bring this to there. We give the data for free to the commercial guys." It's an inherent interest for the United States to do this. That's what I'm talking about, right? They put the data out in an unclassified format so everybody can see and I'm sure a lot of glass had to be broken to make that work. So that's a success story. That ought to be kept going on. I want to make sure people get credit where credit is due. They engage very directly with the commercial guys. They do a fine job and still to till this day they're doing a better job anybody else can do. Those commercial folks were trying to stay in the company. Maybe eventually they will to do this conjunction analysis charge for it. The air force doesn't want to be the space traffic cops forever. But at the moment they're doing a gentleman's job. They really, really are. So they deserve that. The only other thing is the FAA in particular. It has a regulatory authority over air craft, over launched vehicles and all that sort of thing. That's all fine but they're still understaffed right now. They got a process that you go through and it's all the fun process but it takes so much time it becomes a major hindrance to developing new vehicles and getting them going.

There's a lot of practical things that people could do if they were so inclined. We've recommended… we just set this to the DARPA meeting a couple of days ago that hey, why don't we get through and make a difference. Give us a range that's sort of out in the middle of nowhere that we don't have to launch all the stuff. Flight termination systems where there's no possible way we can really hurt anything if that's how we choose to do the development. If you really want to help open some of those existing resources up there so we could go do that, that would be more sort of a proactive help that the government could do. But by in large we just want the government to stay out of the way to be honest. So apart from a couple of these things, it's mostly just sort of leave us alone. If you need the stuff, we're happy to talk to you. We're happy to give it to you. Write the check and we'll check clear and you can have it. This sort of leads you to the next thing that's a hindrance which is the government accounting process.

Nobody wants to touch government money that's cost twice because there's a good possibility you're going to jail if you don't do it just right. So like I say, even dealing with the government is

seen as a liability. That's one more reason why. You mix the color of money up on how you're spending the money, you'll go to jail. It's been done and it's still being done. The government can make its way towards more commercial acquisition of things and not getting the requirements from out of the books and all that other stuff out there. It's pretty important I think for the government to be able to take advantage of commercial stuff. We've passed up money people wanted to give us because we just didn't want to accept the complexity because it wasn't worth it. We're not the only ones for sure. So this is something that the government wants to do, its going to have to do. It's kind of our terms, not theirs.

There was another thing I wanted to mention but… oh yes, security. That's the other thing. So we've got government customers already in our launch area and I used to hold **c**learances at a pretty high level. It used to be the FSO, one of my consulting companies. I know all about it and I gave it all back years ago. So some of these customers want us to get clearances so that we can understand what they're doing and we don't think we need to understand what they're doing with one of their stuff. So, we're like we don't want your clearances and we don't want to go up through the whole process of walking down the company now because everybody on the board has to be cleared. Oh yeah, this investor here, he used to do dope and he can't be cleared. So he's got to get off the board and you can kind of start to see the complexities that comes from all of this. So in one case with one of our government customers which you can't identify, we just told them no and then they came back to us and I said well, we gave it a special letter that says we can share certain information with you, as long as you treat it as if it's classified. So, they had no choice and we just said no. So, listen. Most stuff are classified, you and I know that. The government has got to start rethinking some of this about the requirement on the other the other folks and Figure out a way he can do it so you don't need to tell us. Just frankly, I don't care what you're doing. I don't want to know about it. Just do it. Some stuff, you do have to go. I've seen them do it. It's happened to me a couple times of my career where someone makes a judgement call, fine. You're not formally cleared but this piece of information is treated confidentially fine, get it. So, we can keep secrets in the commercial side, no problem.

Interviewer: Okay. All right. Well, thank you, Anonymous Launch Executive. I think you answered that pretty extensively.

Major General (USAF ret.) James B. Armor, Jr.[17]

Staff Vice President, Washington Operations (Orbital ATK)
7 August 2017

WRITTEN RESPONSE

The biggest hindrance is the acquisition process in the military domain … A primary reason the Acquisition process struggles for space is a poor requirements process – it can't decide what it wants.

There are MilSatCom, Weather, OPIR, and other system cost and schedule overruns --- the list has been embarrassing, but all current systems are executing well. Next generation systems – virtually all systems must be re-capitalized – threaten poor acquisition results.

Intelligence is more open to working with private space firms, but there is limited scope and failures of imagination sometimes (NGA does buy commercial imagery data). The civil sector (NASA, NOAA) more readily reaches out to

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[17] The responses here represent the sole views of Major Gen (USAF ret.) James Armor, and are not intended to represent the position of Orbital ATK.

the private sector, but it is overly-controlled and private firms compete with NASA Centers. (It took Congressional direction for NOAA to buy private, commercial environmental data.)

Another cause is that there is "conservatism" across the USG, for both good and bad reasons. An autonomous military space corps would help clarify the requirements process, focus on the unique aspects of acquisition of space systems (e.g., high R&D costs, low O&M costs, exactly the opposite of most military equipment).

There are two classes of military space evolving: 1) traditional force enhancement – use of space-based systems to support terrestrial operations; and 2) space security – the use of space-based systems to secure the space domain for all legal uses; that is, warfighting in space to secure space.

The USG should identify space industry and technology as of significant importance to the future of the US economically and geopolitically, and incentivize it in every way possible. ITAR and export control reform would massively help as would allowing exports of US space to foreign customers (of course there needs to be some security protections). The EXIM bank can incentivize space exports, S&T/R&D budgets for space (military, intel, civil) need to increase steadily.

Marc Berkowitz

Vice President, Space Security (Lockheed Martin)
12 June 2017

WRITTEN RESPONSE

[Q9a] What are the biggest hindrances to a successful relationship between the private and government space sectors?

Only a small subset of commercial satellite communications and remote sensing enterprises, however, have business plans that lead them to seek to be integrated into the US national security space architecture. In the case of those enterprises, they typically are seeking additional compensation in the form of indemnification from liability, war damages, advanced funding, and access to classified information and/or technology to do business with the government and support national security operations because they have a profit motive and business case to do so.

While many privately owned and publicly traded US companies have boards of directors and corporate officers who are patriotic and most likely would respond favorably to requests for support from the US Government in crisis or conflict, there are many who do not believe it is in their best interest (i.e., believe their business case will suffer) if they are perceived to be aligned with the US national security apparatus.

Commercial space businesses are primarily concerned competition in their market.   As noted above, many commercial businesses do not want to be seen as aligned with the US Government because of the risk of losing customers and revenue because of privacy, civil liberties, and other issues that would adversely impact their financial bottom line. …

Perhaps the biggest hindrance to a more successful relationship between the US public and private space sectors are the US Government's difficulty in coordinating and synchronizing its multiple roles as regulator, consumer, and investor. US Government authorities and responsibilities for regulation of commercial space activities are spread among many departments and agencies. Inconsistent implementation of policies and regulations adversely impact the predictability and stability of commercial space markets, create incentives for commercial behaviors that are counterproductive or unintended, or add time and cost to commercial businesses. US Government departments and agencies are also insufficiently resourced and staffed or are staffed with personnel without sufficient expertise to address the complexity, volume, and velocity of issues posed by a dynamic commercial space sector.

Another major hindrance is the lack of knowledge and familiarity in the US Government with private enterprise. A variety of factors, including non-competitive compensation and benefits, the unintended consequences of the perquisite wars between the executive and legislative branches that led to stringent ethics laws and practices, etc., have nearly closed off the "revolving door" between the public and private sectors and exacerbated this problem. The last major hindrance, that is, the US Government's unrealistic expectations (and frequent excessive exuberance) about the perceptions, perspectives, and actual capabilities of the private sector is a byproduct of this condition.

[Q9b] How can these be minimized?

Strengthened accountability within the National Space Council or National Security Council, an invigorated interagency coordination mechanism, increased executive and legislative priority, and strengthened insight/oversight can help minimize the lack of coordination and synchronization. Review and streamlining of commercial space regulations, additional resources for regulatory departments and agencies, and encouragement (rather than disparagement) of federal workers would help to increase the speed, agility, and competency of regulatory processes and regulators.

Modified personnel policies that encouraged the best talent to enter into public service, enabled rotational assignments between the public and private sectors, and facilitated pragmatic, collaborative relationships between government and private enterprises can help to increase both public and private sectors knowledge and familiarity with one another, and thereby gain more accurate and realistic expectations and perspectives.

Bryce Space and Technology

Carissa Bryce Christensen
Chief Executive Officer

Brigadier General (ret.) Ian Dickinson
Chief Operating Officer

Phil Smith
Senior Space Analyst and Artist

26 July 2017

INTERVIEW TRANSCRIPT EXCERPT

Interviewer: …What are the biggest hindrances to a successful relationship between the private and government space sectors? I know you mentioned regulation is a big concern for the commercial sector. That's no surprise, but if you could expand on that and maybe get a little more specific in terms of what areas of regulation or whatever elements of that relationship are hindering the success between the private and government space communities.

C. Christensen: Absolutely. For many years there were discussions of what barriers to the commercial development of space that the government is creating and how we can get rid of those areas. Those conversations really don't happen very much anymore. Generally speaking, the regulatory environment around commercial human spaceflight has been favorable and the regulatory environment around commercial launch has been favorable. The regulatory environment that approves very small satellite systems and large constellations of very small satellites has also been favorable.

But one regulatory area that has become a source of discussion and contention in the U.S. is associated with spectrum allocation. We, as an increasingly mobile society, are consuming increasingly large amounts of data. Many actors are vying for that resource, and the satellite industry has allocations that are coming under dispute. Other potential users are asking whether

they can or should get access to those allocations. That's a major area of regulatory conflict. In terms of other relationship issues, I think there's been quite a successful evolution of the viewpoint of decision makers in government space agencies and organizations to view commercial space capabilities as potentially valuable augmentation of the capabilities and resources that they rely on.

That's not to say there's never conflict or never disagreement. The narrative really has shifted to other interesting points, such as what can we do with this and how can we use these resources. One of the challenges that this raises is the acquisition process. Both government actors and industry actors find it difficult to accept certain kinds of uncertainties. Government decision makers are frequently asking the question, "If I rely on this commercial capability today, and that commercial capability no longer exists in the future, what is the consequence for my ability to achieve my mission?"

Sometimes, the decision makers seek confidence by looking at an individual company's business case, which generally is not a very effective way to assess that risk and manage it. Increasingly, in the current environment, decision makers can look at the market and see multiple actors competing. I think that is a reasonable frame of reference to evaluate risk and to view that risk as reduced. But nevertheless, a government decision maker wants high confidence that a critical capability will be available in the future, and the risk that it might not be tends to drive decision making.

Commercial operators on the other hand, try to reduce uncertainty with predictability, particularly in regard to the customer base and their ability to generate revenue. They often make the argument that if the government seeks to be a customer for a product or service, then providing some guarantee or assurance that the government will be a customer in the future, enables those companies to raise capital. This allows them to plan more effectively to provide the right capabilities in advance, and to offer those capabilities at a lower cost but the acquisitions system typically does not allow for those kinds of future commitments.

Those are very common sources of discussion. If I'm a government program and I'm going to rely on this system and take the risk, that it might not be in business, I'd like to raise the issue of durable infrastructure. Let's take launch, for example. Let's think about the question of if I rely on a commercial launch provider for my critical national assets, what if that commercial launch provider can't sustain its business (we've been through this as a nation before), what's the consequence?

I would argue that there is a model that says, "They don't have enough business; therefore I'm going to have to pay quite a lot of money to keep them in business," is not the necessary pathway. There's another pathway that could be shaped around how contracts are negotiated with those providers. If I am reliant upon a provider and that provider is going to go out of business, contractually, there should be some optionality that I can acquire that hardware and that capability. If a company has a struggling business, it's not going to go out and blow up its launch pad and destroy its tooling.

I think that there are solutions around effective and thoughtful contract relationships that take into account the risks under consideration and try to solve them by recognizing that there's durable infrastructure that solves the problem and its ownership in control. That's the challenge, and that's a contractual issue.

Robert D. Cabana

Center Director (NASA—Kennedy Space Center)
27 September 2017

WRITTEN RESPONSE

The Federal Government should ensure long-term budgeting and planning for United States sustainable leadership in space. There are several principles for sustainable space exploration, including but not limited to, fiscal realism, gradual build-up of capabilities, economic opportunity, architecture openness and resilience, and continuity of human spaceflight. We need a coherent commercial space policy across agencies such as NASA, DoD, FAA, Commerce with adequate resources and consistent, streamlined requirements, such as pricing models, to support the ecosystem between private and Government space sectors.

Caelus Partners, LLC

Jose Ocasio-Christian
Chief Executive Officer

24 August 2017

WRITTEN RESPONSE

… The number one issue between private and government space sectors is that policy forces commercial space to pick a side when dealing with the US government. Because of US contracting practices, it is incredibly difficult to commercialize a technology supporting the US government for use in other markets. This leads to a lack of collaboration and interest in the growth of the industry. It also sends a message to our international allies that the US is not interested in partnerships that improve human well-being as described in the principles underlying the Outer Space Treaty.

Elliot Carol[18]

Chief Financial Officer (Ripple Aerospace)
7 August 2017

INTERVIEW TRANSCRIPT EXCERPT

Interviewer: …on to the next question, and you can approach this broadly as you would like maybe, sort of in an abstract fashion in your experience working in US and European markets, and working with Australia as well. What are the biggest hindrances to a successful relationship between the private and government space sectors? How can they be minimized?

E. Carol: Ripple is such a good example of this. Right now we are developing launch technology that would greatly benefit, or at least could greatly benefit the US military assets. We have gone through every channel that we could think of. We have attended conferences. We have had personal meetings, we hired people to give us the right connections. There has almost been no communication at all between us and different acquisition offices. In our opinion, there is little

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[18] The responses here represent the sole views of Elliot Carol, and are not intended to represent the position of Ripple Aerospace.

interest [within the Government] in looking at early stage companies to assist in developing technology. The biggest issue we have is we just don't receive any communications with decision makers compared to countries like Australia, or Europe where I could call a high-ranking official and have a meeting with him next week. I mean I have met numerous people in the military, each one said, "I think this needs to be pursued. We will contact you." I wait a month with no contact. I even contact their office and it's always, "We will contact you… in the future." And then you never get any contact. So first and foremost, communication. Number two: assisting development. I don't think the military really understands what it takes build a startup. Such as to bring in engineers, to get the right facilities, to get the right equipment, to get the right licenses and put this all together and while all of this is going on you are under major time constraint. …

Interviewer: Maybe the government needs to take on that risk management rather than the large commercial companies you're working with, in other words.

E. Carol: I would say the majority of the engineers in the larger companies want to be pursuing more interesting technologies, it's just they aren't given the resources to, and that's who actually starts up some of these smaller companies – actually guys in these larger companies that have pretty much had enough of working on the same thing they've been working on for 40 years.

Chandah Space Technologies

Dr. Helen Reed
Co-Founder & Chief Technology Officer

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Andrew Tucker
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17 August 2017

WRITTEN RESPONSE

What are the biggest hindrances to a successful relationship between the private and government space sectors? The biggest hindrances could result from the lack of communication regarding key priorities of government, particularly as they may sit orthogonally from the private sector's own interests and risk appetite. Additionally, unreasonable expectations on either side can add to the cacophony and lead to a squander of opportunity to collaborate together. How can these be minimized? By actively fostering a dialogue around key priorities and risks of each segment (government and private sector), and then building a fair and equitable working model (which takes into account areas of mission overlap) would build confidence and minimize confusion. Having said that, USG's role is to defend America and its priorities/interests, and by definition it cannot depend on the private sector or afford to put the private sector in its critical path.

Matthew Chwastek

Director of Product Management, Public Sector (Orbital Insight)
22 July 2017

INTERVIEW TRANSCRIPT EXCERPT

Interviewer: Okay. Moving on from legal obstacles, we'll segue in the last question here. What are the biggest hindrances to a successful relationship between the private and government space sectors and how can these be minimized?

M. Chwastek: Sure. I'd say one of the biggest hindrances is really funding and the speed of operations. If you look at venture-backed startups that are working in the space domain, they generally want to work very, very quickly. The U.S., being a conservative culture when it comes to space, often wants to feel more strongly and move more deliberately. A lot of it, I think, comes from the space program and those programs where you only have one shot to get it right. So, you want to be very confident that you're going to get it right the first time. Whereas, as I mentioned before, the decreased cost of launch and the decreased cost of satellites have made the risk tolerance in space for new commercial companies much higher than in the past.

So, a company can afford to launch a satellite and lose it, or two satellites and lose them, and then launch another one in three months, versus when a company would be out of business in four or five years if it had to build a new one to replace it. I think that's probably the biggest hindrance. The other focus is the amount of R&D investment that goes into space and what it is focused on. There's a lot of focus on launch. What I think is often lacking is kind of the endpoint. You're putting all the stuff in space, but what's the end of the value chain it supports? Who's the end user who is going to benefit and ultimately purchase the service or use the service? And how are you investing to make sure you're extracting the maximum amount of value from the space assets and services you're providing?

Interviewer: Okay. Thank you, Matthew. We went through those questions pretty quickly. Before I open up the floor from questions from my colleagues here, we always end the interviews by asking our experts if there's anything that you think we should've asked you or anything you would like to highlight or bring up and expand on? So I'll tee you off with that.

M. Chwastek: Sure. I'd say the one thing that is really important to talk about is where investment is going in space and what happens if it doesn't happen in the U.S. Companies do look to the U.S. as the location for innovation. But with the burden of regulation, or stretching out the process for getting into space to prevent it from going as quickly as possible, the industry will look to move out of the U.S.; out of the country. If the U.S. doesn't invest in space and understand what it is to be an innovation leader there, someone else in Europe, Asia or elsewhere will.

Interviewer: Okay thank you, at this point, I want to open up the floor to everyone else on the line. We'll start with you General Elder if you have any questions for Matthew?

Gen. Elder:[19] I have a couple. I guess one interesting question for you is I know you operate with a lot of different satellite companies. Do you have diversity in terms of your information sources and is it just by accident or do you specifically go out to have the diversity and redundancy in your sources?

M. Chwastek: Yes, it's actually very intentional for two reasons. We have diversity and partnerships because we want to use every facet possible in our products to give value to our customers. I started saying "every pixel has its place and every place has value." I believe that if we can see something in the world, that's valuable to someone. The second piece is that the nature of business is that we're

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[19] Lieutenant General (ret.) Dr. Robert Elder (George Mason University).

all about operating at scale. Adding more data is fundamental for our company. The more data we can find, the more we can bring in, the more we can use. We can then build larger and more diverse products. In a large geography, no matter how many satellites we have in space today, any one satellite can only see small part of the Earth. And until we have access to enough satellites that see every part of the Earth at every possible resolution, we're going to continue to desire more data sources.

Dr. Damon Coletta & Lieutenant Colonel (USAF ret.) Deron Jackson

Dr. Damon Coletta
Professor of Political Science (United States Air Force Academy)

Lieutenant Colonel (USAF ret.) Deron Jackson
Director, Eisenhower Center (United States Air Force Academy)

8 August 2017

INTERVIEW TRANSCRIPT EXCERPT

Interviewer: …Some of these kinds issues with respect to sensitivities and transparency regarding information sharing is certainly something we've been hearing. So, I'm wondering, in addition to the transparency hurdle, what other hurdles and barriers do you see with respect to cooperation between the commercial space realm and government space realm?

D. Jackson: That is a good question. I'm trying to think on the transparency piece because that's kind of a central thing that a lot of elements get attached to.

D. Coletta: Can you give us an example of some of the other kinds of barriers to cooperation between the commercial space realm and government space realm that you have heard and we can tell you if we've heard something similar?

Interviewer: So, if I can jump in here quickly, one common thing we've been hearing is the barrier of regulation, particularly with respect to the acquisition process on the military side (i.e., red tape and giant slow-moving bureaucracy). Another thing we've heard from smaller companies is simply the issue of communication—it seems that it is sometimes quite difficult for small innovation based firms and companies to just get on the phone with their military or government counterparts to address concerns.

D. Coletta: Well, I guess out of the ones that you mentioned, I think the transaction cost of communication, particularly for the smaller operators, would probably be the second largest barrier behind transparency in our minds. To elaborate, in this scenario you have a smaller operator who would like to be transparent and would like to participate, but under the current circumstances the cost of participating in this information sharing are high for them. That seems to me like a candidate for the second most important barrier.

When it comes to regulation and acquisition, the way that I guess we've envisioned this scenario is that you are really asking not for the commercial operators to build hardware for the DoD—they are building commercial hardware—but you would like them to share information according to a set of rules that have been built and approved by the DoD. The DoD isn't necessarily acquiring anything from these companies; it just wants them to play by certain information sharing rules. If that's the scenario you have in mind, then concerns about transparency is the first barrier, and then just the transaction cost of communication even when you have the willingness to be transparent would be the second barrier.

D. Jackson: I guess one of the perceptions is that transparency on these issues is predominantly a one-way membrane. Sending information in is welcomed, but again you've got the basic challenge of what you can share outward. That is where things usually breakdown in a partnership relationship because it's fundamentally unequal. I guess we need to identify what the government really wants out of the commercial side, other than maybe them feeding information in or being willing to comply to a certain set of rules and regulations—is there something else that the commercial side can offer the government side?

Maybe it's a communications issue. For example, if the DoD can do a better job of explaining that "we are doing certain things for the sake of maintaining the order and stability of this entire domain," and then try to get credit for that because of what it allows people to go off and do, because you are working towards a more stable international relationship. So, that's sort of the other side of the partnership. It's not equal, but it's mutual—each side gets something out of the exchanges they want, even if they are not getting it in the same currency, if you will.

I think it's a challenge, though, because the DoD doesn't want to be scare mongering out there that there are all these horrible threats in the contested side of the domain, but the DoD should also clearly make the case for what it is providing in terms of ordered stability and what's necessary to maintain that.

D. Coletta: While we were talking, I thought of another potential barrier. As certain orbits become more crowded, then you are going to have to be dealing with not just American businesses but also foreign corporations. So, other barriers to getting everybody to play ball on a common set of rules would involve the different types of relationships between business and government for those foreign countries, and the competition between American space companies and foreign space companies. So, as space becomes more crowded, this third barrier will start to matter more. It's already difficult to get American companies to play, but at some point it will be necessary to get foreign companies to play as well.

Interviewer: Just to add one additional comment, what we've heard from the commercial side is that they want the US government to take the initiative and take the lead on this because they prefer to work with the US government, but they have faced issues with communication. Additionally, we have heard that if the commercial actor's exasperation with the bureaucracy gets too high, then they have to take not only their business elsewhere but look to the other nations for leadership in a given area, maybe at launch or launch services or mitigating orbital concerns.

D. Jackson: I would say that this essentially opens you up to being contested. If there's a level of frustration with bureaucracy and the way things run, then that opens the door for a third party to come in and say, "hey, we'll cut you a better deal. Wouldn't you rather join our system? Our regulation is light and our process is easy, so come to us," even though that down the road this might have a negative implication. This clearly illustrates a friction that we have on our side, which sort of self-creates that opportunity for a contested environment if we can't sort of solve those problems of our own design.

D. Coletta: You talked about these difficulties that arise when the US government is attempting to cooperate with American commercial companies, but we also see similar barriers or concerns when we are talking about US government cooperation with allied governments. So, I'll use US cooperation with Brazil as an example. The US-Brazil relationship in the space domain is quite a mixed relationship. What made me think of this example is that you said that the companies that you talked to would like to cooperate with the US government. I've heard the same thing from Brazil, and I think the same is probably true with a number of potential partners—they would like to work with the United States but if a certain point of exasperation is reached, they are very interested in seeking out deals with other partners, which, as Deron was saying, makes things more contested. It seems that as time is going on, those other partners are becoming more attractive.

D. Jackson: It seems like the United States still has a lot of positive political capital in this area, and there is a desire—a pent up desire, rightly so—that people would prefer to work with the US. The challenge is how to convert that positive political capital, which has been sustained over a decade, into some meaningful form of cooperation.

Faulconer Consulting Group

Walt Faulconer
President

Mike Bowker
Associate

Mark Bitterman
Associate

Dan Dumbacher
Associate

15 August 2017

WRITTEN RESPONSE

Thank you for inviting us to participate in you open-source SMA Space request for information. The questions you ask regarding the commercial space sector is exactly the type of work we perform for many clients.[20] These are extremely important and timely questions and discussions… What are the biggest hindrances to a successful relationship between the private and government space sectors? How can these be minimized? Who gets the money is the biggest issue. The US Government is the largest player (funding source) and therefore viewed as being in "competition" with private enterprise. What gets done within the government, i.e. national labs, NASA, NOAA, DOD, etc. is often times in competition with what the commercial providers can provide. Other times, the government is purely the customer purchasing commercial services. There needs to be discussion around the roles of government and private industry, using transcontinental railroad and the development of commercial air travel as case studies. It is imperative that the incentives be established to drive desired outcomes.

- US National Space Transportation Policy has articulated guidelines but the current state of the industry may dictate a near-term policy update.
- The USG using excess missile assets is in potential competition with emerging systems, stifling investment opportunity, etc.
- Recent Orbital ATK lawsuit challenging DARPA's right to fund a space servicing capability

Other considerations include:

- The outdated acquisition processes are burdensome and slow. Some have proposed a Space Corps to help minimize problems with acquiring new space systems, for example.
- The Office of the Undersecretary of Defense for Acquisition, Technology and Logistics has been reorganized, per direction in last year's NDAA.
- The Strategic Capabilities Office, DARPA and the Defense Innovation Unit Experimental (DIUx) have both been subsumed by an Undersecretary for Research and Engineering.
- Range accessibility in an era of high volume activity and only two major launch ranges in the US
- Deconfliction has become problematic as commercial demands increase

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[20] Just a few examples, we have performed market studies for commercial and government: Small Launcher Market Study for Virgin Galactic; LEO Commercialization Study for Axiom Space; Launch Vehicle Competitive Analysis; Cost Effectiveness for Reusable Launch Vehicles for NASA; Large Space Structures Manufacturing Relocation Study; NOAA Weather Satellite Commercialization Study.

- There have been major improvements accomplished by the FAA Office of Commercial Space Transportation and industry groups
- Satellite providers continue to raise concerns about launch slot availability at US ranges.
- Despite optimistic forecasts, commercial spaceports have been slow to develop and grow business bases.
- Minimized by cross-cutting oversight such as the newly revived National Space Council, where commercial, military, intelligence space will meet

Gilmour Space Technologies

Adam Gilmour
Chief Executive Officer

James Gilmour
Director

13 July 2017

INTERVIEW TRANSCRIPT EXCERPT

Interviewer: I see. Now, looking forward, as far as working with NASA, what if any, obstacles exist for you at this point in time or do you anticipate, being an issue, a few years down the road, that you feel the US could improve on?

A. Gilmour: Not really. We have a good understanding of what it takes to do business with the US government. It's been well-explained to us. We have the United Stated subsidiary based in Texas that we will intend to compete, the US government business with. We understand we have to make 50% of the launch vehicle, the right value in the United States that compete with government business. We have a pretty good understanding of what we have to do. I don't see any roadblocks ahead of us. It's just an execution issue.

Michael Gold

Vice President of Washington Operations and Business Development (Space Systems Loral)
4 September 2017

WRITTEN RESPONSE

Compulsory policies and procedures remain the most significant barriers to a robust and successful relationship between private and government space sectors. While improvements are being made, the transaction cost of doing business with the government can, in some instances, still remain high. Various compliance and mandatory Federal Acquisition Regulation provisions have hindered the relationship between the US Government and commercial space sector. Many small companies lack the attorneys and procurement officials necessary to interface effectively with the US Government, and even large commercial corporations can hesitate when faced with the internal investment that working with government can require.

However, a solution to such challenges has already been established in the form of innovative government contracting/partnering methodologies. Other Transaction Authority, Cooperate Research and Development Agreements, Broad Agency Announcements, and Space Act Agreements, are all examples of legal vehicles that substantially reduce bureaucracy and enable rapid and efficient public-private collaborations. The U.S. Government should encourage the use of these legal vehicles whenever possible to leverage private sector investments and capabilities.

Moreover, the US Government must remain wary of entrenched corporate interests that eschew public-private partnerships, requirements for commercial investment, and/or utilizing innovative procurement strategies. Many organizations and personnel within and outside of government have a strong interest in preventing additional competition and changes to the status quo. When new public-private partnerships are executed they have often faced resistance from incumbent contractors. US Government officials must stand strong behind innovative programs and reform measures, resisting external and internal pressure brought to bear from parochial interests that oppose change and competition.

Perhaps most important of all, the US Government should act as a robust and smart customer for commercial services. The most powerful incentive that the US Government has to influence the private sector is its massive purchasing power. By purchasing commercial services, particularly while leveraging innovative procurement methodologies as described above, the government can influence the private sector to better meet national security requirements, enhancing the overall relationship between industry and government in a constructive and mutually beneficial manner.

Joshua Hampson

Security Studies Fellow (Niskanen Center)
26 July 2017

WRITTEN RESPONSE

The biggest obstacles to a successful relationship between the government and private space sector can be broken down into two generalized issues: financial, and political/bureaucratic.

The private and public sector have differing funding environments that do not neatly overlap. Because the private space economy is not fully mature (though certain subsections, such as satellite communications are), companies see the government as an important funding stream. Because private space activities have historically required large initial capital investments, contracts with the US government can serve as a valuable signal of confidence for investors.[21] Losing a government contract can bankrupt space companies.[22]

Government funding can be fickle, with changes from year-to-year. For example, in 2016, NASA's Asteroid Redirect Robotic Mission (ARRM) selected companies to undertake design studies: Lockheed Martin Space Systems, Boeing Phantom Works, Orbital ATK, and Space Systems/Loral.[23] However, in 2017 the new administration indicated it may cancel the program and redirect its funding.[24] These types of programmatic changes can strain relationships between the US government and the private sector. For smaller companies that cannot afford to lose a large contract, such changes may de-incentivize entering the market or working with the US government.

Not all of this financial tension can be mitigated, but the government can help strengthen the private space sector to be more resilient. Reliance on a single source of support, either for a company relying on government funding or the government relying on a single private provider, exacerbates the financial mismatch discussed above. Focusing government investment on the two ends of the business cycle⸺development and market introduction⸺reduces

[21] Brown, Mary Beth, "SpaceX Wins NASA COTS Contract to Demonstrate Cargo Delivery to Space Station," *SpaceX*, August 18, 2006 [accessed July 12, 2017] http://www.spacex.com/press/2012/12/19/spacex-wins-nasa-cots-contract-demonstrate-cargo-delivery-space-station.

[22] Oklahoma Gazette, "Rocketplane Kistler Files for Chapter 7," *Reprinted on SpaceNews.com*, Oct. 1, 2011 [accessed July 13, 2017] http://spacenews.com/rocketplane-kistler-files-chapter-7-oklahoma-gazette/.

[23] Webb, Carlyle, "Companies Selected to Provide Early Design Work for Asteroid Redirect Robotic Mission Spacecraft," *NASA*, Jan. 27, 2016 [accessed July 12, 2017] https://www.nasa.gov/feature/companies-selected-to-provide-early-design-work-for-asteroid-redirect-robotic-mission.

[24] Malik, Tariq, "Trump's 2018 NASA Budget Request Would Scrap Asteroid Redirect Mission," *Space.com*, March 16, 2017 [accessed July 12, 2017] https://www.space.com/36090-trump-2018-nasa-budget-request.html.

the odds that a monopoly or monopsony develops in a sector of the space economy.[25] R&D investment by the government can ensure that the bare necessities for a capability, such as new rocket engines or uses for millimeter wave communications, are in the pipeline. On the other side, government contracts for specific services incentivize private actors to translate that R&D investment into usable products. The need to attract private investment in between these steps will focus private companies on viable business cases and reduce the risks to both government and private sector from unexpected cancellations or schedule delays.

This model was used in the development of Space Exploration Technologies' (SpaceX) launch vehicle, with government R&D underpinning the technologies used in the Merlin Engine. [26] SpaceX, however, had to invest to produce a viable launch vehicle. This "skin-in-the-game" approach meant that when the launch vehicle did come to market, commercial competitiveness was baked into the system design.

Not every capability can be developed this way, but this should be the approach for capabilities that have commercial applications. This includes launch, communications, remote sensing, and potentially on-orbit servicing.

While parts of the above financial issue are political, investments and contracts are not the only way that politics can cause problems between the government and private space sectors. There also exist separate political and bureaucratic issues.

Politically, there has been a lack of attention paid to changes in the private space sector over the last few decades. The rapid pace of development has meant that the regulatory environment for sectors of the space economy, such as remote sensing, remain outdated. The international environment has also changed, and export controls that once made sense in preventing other countries from catching up to US capabilities now simply make American companies uncompetitive in the global market.[27]

This lack of focus may be changing,[28] but specific changes still need to be made to improve the regulatory environment for private space companies. Recent reforms to export controls are an improvement,[29] but continuing reviews need to be done. Allowing American companies to provide capabilities to the international market that *already* exist abroad will make them more competitive. Unresponsive export controls damage American competitiveness and hurt U.S. national security in the long run.[30]

National security concerns about commercial use of space do have merits. That being said, the process for government oversight on these concerns can be improved. Many entrepreneurs seeking to provide new space capabilities understand the national security importance of space.[31] There are frustrations, however, at the seeming capriciousness and opaqueness in the decisions made about constraints on commercial activities. These concerns have been of particular concern for the remote sensing industry,[32] but may also be a problem for new developing markets like on-orbit servicing.

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[25] Hampson, Joshua, *The Future of Space Commercialization*, Niskanen Center, Jan. 25, 2017 [accessed July 21, 2017] https://science.house.gov/sites/republicans.science.house.gov/files/documents/TheFutureofSpaceCommercializationFinal.pdf.

[26] Barber Nichols, Rocket Engine Turbopumps, [accessed July 12, 2017] http://www.barber-nichols.com/products/rocket-engine-turbopumps.

[27] Hampson, Joshua, "Controlling Outer Space," Niskanen Center, May 26, 2016 [accessed July 10, 2017] https://niskanencenter.org/blog/controlling-outer-space/.

[28] Committee on Science, Space, & Technology, "Smith Introduce American Space Commerce Free Enterprise Act of 2017," *United States House of Representatives*, July 7, 2017 [accessed July 13, 2017] https://science.house.gov/news/press-releases/smith-introduces-american-space-commerce-free-enterprise-act-2017.

[29] Foust, Jeff, "Federal Government Tweaks Space Export Control Rules," *SpaceNews*, Jan. 12, 2017 [accessed July 13, 2017] http://spacenews.com/federal-government-tweaks-space-export-control-rules/.

[30] Weeden, Brian, "Commercial Space Innovation Needs More Government Certainty," *SpaceNews*, March 15, 2017 [accessed July 13, 2017] http://spacenews.com/commentary-commercial-space-innovation-needs-more-government-certainty/.

[31] Colby, Elbridge, From Sanctuary to Battlefield: A Framework for a U.S. Defense and Deterrence Strategy for Space, CNAS, Jan. 27, 2016 [accessed July 12, 2017] https://www.cnas.org/publications/reports/from-sanctuary-to-battlefield-a-framework-for-a-us-defense-and-deterrence-strategy-for-space.

[32] Satellite Industry Association, "Commercial Remote Sensing (CRS): Modernizing the Regulatory Environment," March 15, 2017 [accessed July 12, 2017] http://www.sia.org/wp-content/uploads/2017/03/Final_SIA_USCRS_Reform.pdf.

The US government can address these issues with relatively simple reforms. Instead of simply listing constraints on approved licenses, regulators can be more transparent about the reasons behind restrictions (up to the level of clearance held by applicant). This would assure companies that similar decisions are being made across applications for the same reasons. Introducing an appeal process would also help reassure companies.

Ideally, there would be an industry single point-of-contact that would run the inter-agency process, consult with government experts, would be responsible for decisions, and harmonize the process across the industry. While there are debates over which agency should be this point of contact, most experts agree that having this single point of contact would be an improvement.

Enforcing the deadlines for decisions, and preventing tolling—the practice of stopping the clock by requesting more information—would also improve the relationship between the government and the private space sector.[33] Finally, providing a sense of certainty for missions that are in development, but are not under any oversight mechanism, would improve the investment environment for companies. This oversight could be a relatively simple certification process, but without some form of determination from the government that a new mission can move forward, investment remains stalled; even in areas that could benefit the U.S. government.[34] This includes sectors like radio frequency remote sensing, on-orbit servicing, and space resource harvesting.

Harris Corporation, LLC

Brigadier General (USAF ret.) Thomas F. Gould
Vice President, Business Development, Air Force Programs

Colonel (USAF ret.) Jennifer L. Moore
Senior Manager, Strategy and Business Development, Space Superiority

Gil Klinger
Vice President; Senior Executive Account Manager for National Security Future Architectures

15 August 2017 (Interview #1)
21 August 2017 (Interview #2)

INTERVIEW #1 TRANSCRIPT EXCERPT

Interviewer: Okay, so I'll sort of use this as a platform to lead into the fourth question here while we skip forward and will sort of circle back later. As far as that failure in mitigating the proliferation of technology with the example you mentioned Gil, what needs to happen within the government to avoid such failures. I'll provide a specific example of the possibility of a Space Corps to handle or least to take the lead on consulting for such an issue but what are your thoughts on how… what that needs to be done on the government side to avoid stuff like that?

G. Klinger: …It doesn't matter how tight our safeguards are, somebody's going to violate. It is just the nature of the beast. It doesn't matter what warfare domain you are talking about, whether it's submarine plotting technology or, you know, high performance metal milling to make submarine propellers much quieter. It doesn't matter what it is, it's going to get compromised. You can't make policy on that basis. So that's one thing. I think the other thing is that is incumbent upon the executive branch is to recognize where we are realistically, not to use hope as a strategy. There are still, and I'll use commercial imagery as an example. There are still people, some within the Defense Department but mainly within the intelligence community who still would like to roll

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[33] Montgomery, Laura, "Procedural Protections of ASFCEA," *GroundBasedSpaceMatters*, June 17, 2017 [accessed July 12, 2017] http://groundbasedspacematters.com/index.php/2017/06/17/procedural-protections-of-ascfea/.

[34] Hampson, Joshua, "The American Space Commerce Free Enterprise Act," Niskanen Center, June 15, 2017 [accessed July 14, 2017] https://niskanencenter.org/blog/american-space-commerce-free-enterprise-act/.

the clock back to 1994 and every time there's a request for a new remote-sensing license by an American company to sell abroad we relitigate policy issues that were adjudicated asked and answered 25 years ago.

I'll give you an example, the rest of the world has cornered the market, or is well down the road selling commercial synthetic aperture radar imagery from space. We've never issued a single license because every time, the few times, that an American company came forward with a request to export SAR imagery and SAR technology, what ensued was as Soviet-style show trial. What I mean by that is, yes, there's no way to avoid the risks associated with the downside consequences of exporting a technology that is dual use. You know it is a classic risk management decision. Way too often in my experience, the US space community tries to avoid the risks, sort of legislate them out of existence and that is an utterly unrealistic thing to do and frankly it has killed our companies, it really has. I doubt very much for the foreseeable future that any American company is going to catch up with the Germans, the Italians and others with respect to commercial sales of high performance SAR imagery. We have got nobody to blame about that but ourselves. I think it is keeping the politics to the extent that it is possible within the Executive Branch out of this, focusing on what the real risks are and recognizing that these are risk management decisions that have to be made under uncertainty. There's no certainty here in terms of managing or of controlling risk or eliminating. It.

Because if that were the metric, if you look at other warfare domains, we would never had allowed the export of anything, any armaments. There is case after case of it. We sell the UAE the most advanced version, or at least last time I checked, we sell then UAE the most advanced version of the F-16, a lot of the munitions that go with it, a lot of the supporting equipment but when the UAE came to us to by high resolution, to buy a turn key electrical optical satellite so that they could use it for targeting and could use it to support the use of the F-16s we were selling them, we dithered around for ten years and what we got for that was the French are now building the two EO satellites the UAE bought. Now, it is not that simple. The UAE, there are two sides to this but at the first order we have no one to blame but ourselves. You know, those are the major features and I do not think, to your point, I do not think anything having to do with DOD space management or Space Core or Aerospace Core, I think those issues in and of themselves have nothing to do with the issue of exported administration and creation of a space core separate for whatever alternative one would chose in and of itself would not, would not in my mind materially affect the likelihood that we streamline export administration when it comes to space, make better decisions or anything like that.

Interviewer: Keeping from a commercial perspective, you know, what is the mechanism for reforms or systemic overhauls that you suggest to avoid those situations you mentioned?

G. Klinger: I think it would be very useful to, for DOD, well I think DOD needs to make a decision. Given that there is now a national space council, DOD needs to make a strategy decision. If DOD is interested in further streamlining and further enabling US industry to compete more effectively on the international market with regard to space capabilities, the rationale for that being both economic security and national security, because if somebody else buys American as you know probably better than I do, we will know more about that purchaser's uses and what they do with that information and what they do with that technology. We couldn't pay spies enough money to find out. So if DOD were to make a strategy decision that there is a link between continued liberalization or continued review and modernization of space-related export administration, then the strategy decision is that someone in the interagency that should be led by DOD and, you know, whatever we're calling GITSA these days hand in glove with the State Department and the intelligence community, or is that something that one might hand over to the National Space Council to arbitrate in terms of meeting the interagency? I would have to think about what I … I do not have an opinion about that sitting here… I could certainly argue both ways. I think the way to do this is to… you know both State and Commerce have a very good handle on the universe of

technologies that are related to high performance space capabilities whether you are talking about Comm, PNT, weather, imagery, frankly signals intelligence early warning, across the board.

I think what needs to happen is a very, very cold-blooded appraisal with Commerce and the intelligence community in the middle of it taking a look at: "Okay, what is out there on the commercial market?" The intelligence community taking a look at where our foreign space-faring countries, especially the ones that are potentially adversaries, what is their state of technology now and where are they going? That's the template that we should then use to compare our capabilities and if something is about to be out on the market in terms of performance or soon will be. In my judgement there is really no point in continuing to keep it under an export administration which is guided by a presumption of "no" like the USML. Don't get me wrong, there may be other policy reasons to say "no". I'm not saying we should just say yes based on technology-like signals. I am not a big believer that we should license overt space-related signal technology for the foreseeable future. I do not care what the state of technology is, we don't want American companies in that business, we don't want, we certainly don't want, you know, other governments to the extent we can control that but I think for technologies that support space capabilities and services that do have a viable commercial market either in the offing, or that exists, that is the approach I would take. Just scrub the technology base, you know. I'll give you the best example, Honeywell makes Control Moment Gyros, CMGs that are the core of lots of our spacecraft, commercial and certainly national security. There is no way on God's green Earth, in my judgement, that we should ever allow for export the highest performance CMGs that Honeywell makes because they allow things the size of Greyhound buses to dance across the sky with the stability and with the maneuverability that hardly anyone would believe.

I think there are very strong policy reasons to prohibit under any circumstances those sales. But CMGs and reacting wheels that are at the heart of the guidance systems for a lot of satellites and they're more and more commercially available. So, I think we need to make sure that we are not guarding the barn door after the horse has left. Sorry, I do not mean to suck the air out of the room about it.

T. Gould: I think to summarize, when space was exclusively the U.S. and less than a handful of others, the policy made a lot of sense.

G. Klinger: Yes.

T. Gould: But as the space-faring nations have expanded, as commercial space has expanded we are really just shooting ourselves in the foot if we do not use what I'll call an air domain model of how we share technology. Gil mentioned the F-16. When you look at the F-16, we give just enough of that technology away for people to keep coming back to the well and not produce that capability indigenously. What has happened in space obviously is nations for their selfish reason have decided they are going to make the investment, invest on their own and so the capability is there now, we no longer corner the market. As a result, it costs us more to produce the same capability. I mean literally the UAE example Gil uses funded the JSF. The Block 60, a lot of the technology in Block 60 that they funded we turned around and rolled into fifth generation aircraft or upgraded our own fourth generation aircraft with some high-end capabilities.

G. Klinger: I was just going to say earlier you made the point about and Tom made the point about Space Launch. Space Launch is an interesting example. In the late '60s, the French particularity, and the Europeans came to us and they said, "We would like an indigenous European rocket launch capability because we believe It is very important to the collective security of Europe as well as our individual member states." They wanted to cooperate with us. We told them to pound sand. What we got in return from turning our back was Ariane which from the time it has been in business has been kicking the American country's behind in the commercial space launch business from one end of the planet to the other. Now, there are lots of protectionist reasons why that is the case, it is not just a matter that they even necessarily produce a better product…

there are lots of other reasons for that. My point is when we made that decision and the Europeans and the French in particular decided to go it alone, we lost 100% of our leverage over a lot of the policy issues and a lot of the technology issues associated with rocket propulsion technology in Europe. The only areas in which we are able to collaborate with them or sit down with them are where our mutual security interests coincide which are not necessarily the same place. I'm 100% with Tom. It's a contortion of the "give a hungry man a fish and he'll come back the next day, teach a hungry man to fish, you've changed a life." Well, if you teach a hungry man to fish with just enough information that he can catch some fish but not others but sees you catching others, that's what you want.

INTERVIEW #2 TRANSCRIPT EXCERPT

T. Gould: Again, we just went to this trade show. What I found interesting …and it is just a single data point, at this point, but my sense is that the US government isn't telling the industry necessarily what they want, so much as asking for what's in the realm of the possible. To Jen's point, I think some companies are hesitant to throw their cards on the table first for fear that someone else will grab the idea and run with it. It's a challenge, I think on both sides, to say "Okay, how is this a win-win for both industry and the USG?" We look to be more resilient, be more innovative, be more effective in what we're now calling a war-fighting domain going forward. I think the Air Force has done a great job, the DOD has done a good job of articulating, "Okay, space is a war-fighting domain, we have a war-fighting contract and space enterprise vision." But there's a lot of what I'll call dots, missing between the visionary or the aspirational goals of those documents, and where we are today.

J. Moore: Right. If I could add on to that, we hear a lot that we need new ideas, we need to be innovative, we need to come up with a new architecture, new ways of looking at things. That sounds like it brings a lot of freedom. But in actuality, I think it's just really difficult to leave such an open-ended desire on the part of the DOD to bring in something new because there's not really a great avenue to be able to do that outside of the standard acquisition processes… which don't necessarily encourage innovation and new thinking…and quick response. We are going to have to meet in the middle somewhere, where we can find a way to bring new ideas in and the DOD can be a little bit more specific, without driving down to this very key requirements that really lead to a particular solution. We can't just leave it wide open until you give something new, bring you luck kind of thing, which I think is why we are where we are right now.

T. Gould: I think Jen brings up an excellent point from a business standpoint. If there's a commercial utility to whatever innovation is out there, at least in my short time with the industry, there's a strong desire or there's at least the ability to go, "Okay, this is a dual use capability and there's a business case for moving out. But if it's a dedicated DOD capability, there has to be a pretty good business case for companies to put research and development into that capability. To your earlier point, smaller companies might not have the revenue to do that, so only your biggest companies can take that kind of risk with their R&D dollars, because frankly they don't know if there's going to be a return on their investment without the standard, "Okay here's our requirements going forward." We're stuck in this place where the government says, or the Air Force says, "We want industry to be innovative." But at the same time, they can't guarantee that there's ever going to be a requirement that will utilize these innovative technologies.

Dr. Jason Held

Chief Executive Officer (Saber Astronautics)
17 August 2017 (Interview)
22 August 2017 (Interview annotations [in bold])

INTERVIEW TRANSCRIPT EXCERPT

Interviewer: What are the biggest hindrances to a successful relationship between the private and government space sectors? How can these be minimized?

J. Held: Comparing the way the U.S. and Australia work you can see the model of success depends on how funds are distributed and in the purchasing habits of government customers. The U.S. has excellent funding mechanisms (SBIR, STTR, and others) which encourage strong relationships between private and government sectors. The U.S. also has decades of heritage in the space sector both in understanding what it takes to manufacture new technology as well as a culture which is open to new innovation and new partnerships. As a result, the U.S. government is a customer—willing to buy and with mechanisms to do so.

Australia, in contrast, is a far more insular country and while they have excellent research funding for universities and government bodies such as CSIRO, they historically have very limited funding mechanisms for private sector innovation. Acquisition reform is a big problem but Australia's Defence sector is showing signs of growth. **"Australia did nothing for 10-years then in the last year Defence started an acquisition program."** That program is young but quickly broadening opportunity for the private sector.

Australia's future is very much based on small business which has many barriers ranging from purchasing patterns to regulatory (Australia signed they ITAR agreement in 2013). A lack of a national space agency in Australia is also a hindrance and results in a fractured market. **"Space in Australia is very much a downstream services market with some work in space control. There is no real space manufacturing sector here except for the small businesses I mentioned previously. Most small satellites in Oz are manufactured in the USA, either by Tyvek or Pumpkin, while the few large satellite purchases for the telcos are also manufactured overseas by US Primes."** Without customers civil space manufacturers don't get to fly and get experience, which leads to the decision for Prime contractors to send multi-billion dollar programs to the U.S. where there is a more robust set of suppliers. A space agency decision was announced by the Australian government in September and is currently under review by an expert panel.

Theresa Hitchens

Senior Research Scholar
(Center for International and Security Studies at Maryland, University of Maryland)
19 July 2017

WRITTEN RESPONSE

In the U.S., that does again depend somewhat on sector and size of company. It is harder for the USG to work with smaller commercial entrepreneurs because of the creakiness/complexity of the acquisition process at DoD and NASA. There have been zillions of studies, there are current efforts regarding acquisition reform – but it has never been resolved. For remote sensing, the lack of a clear policy on export controls is slowing the licensing process; this is going to be a problem with the Space Situational Awareness (SSA) industry. Despite new licensing rules that purport to loosen national security restrictions, those restrictions are problematic for competition. This will further

inflame current issues and frustration with the Government regarding SSA data provision. The failure of the government to put resources to keeping regulatory processes rolling is another problem, rather generic in the USG but particularly bad in DoD.

Dr. T.S. Kelso

Senior Research Astrodynamicist (Analytical Graphics, Inc.)
4 August 2017

INTERVIEW TRANSCRIPT EXCERPT

Interviewer: So, in addition to some of these issues with transparency and government processes that you have noted, what are some of the other main hindrances to a successful relationship between private and government space sectors, and how can these hindrances be minimized?

T.S. Kelso: That's a good question. I regularly poke USSTRATCOM and JSPOC on these types of issues because they do impact our operations. The biggest challenge we run into is regular problems with the Joint Space Operations Center (JSPOC) data because the system is designed to do a different task than what we're trying to do with it today. The system was designed to be able to keep track of an asset, and it had to do this in a non-cooperative way (i.e., when we were dealing with the Soviet Union, for example, they weren't going to tell us when they were going to maneuver, so we had to figure out when they maneuvered, where they were, etc.). So, the JSPOC data system was designed to operate in that kind of mode.

On the commercial side, one of the things that we've started to do in the last decade was to say, "well, the things that are actually the most interesting targets and the ones that are the most difficult to track are the operational satellites that maneuver, and the operators actually have that information so we could just ask them for it." Then, we can always go back to the USG—though we haven't been particularly successful with this—and say, "you told us you were going to be here and we monitored your actions with a given asset on a periodic basis to verify that what you're telling us is accurate, not necessarily that you're intentionally trying to mislead us." Essentially, we'd keep track of this kind of data so we'd know which things we could trust, which ones maybe we shouldn't trust, etc. So unfortunately, we don't really have that kind of dialogue with the USG, but at least we have a way to know what is going on and where things are moving (i.e., if somebody maneuvered yesterday, we will have new data on the satellite and will know exactly where it is) without having to wait for the data, which sometimes requires 3 to 4 days of waiting for the JSPOC systems to catch up to where that object really is. This kind of government delay has tremendous implications for some of the newer ion propulsion systems—we have a couple of ion propulsion systems out there right now that are basically in a constant thrust mode going to GEO, and JSPOC is absolutely incapable of tracking these satellites. Sometimes JSPOC's tracking of these satellites is off by easily 10,000 kilometers, and sometimes even several tens of thousands of kilometers. So, now commercial entities are able to do this type of tracking on their own as long as everybody is sharing the proper information.

But, again, we run into the issue of a lack of transparency, which is what this all really comes down to. And we just don't seem to be able to break through on the transparency issues.

I don't know what your familiarity is with some of the orbital data products, but the one that is considered to be the best quality is what's referred to as Special Perturbations (SP) data. We have finally, after many years of trying to get access to that data, just in the last couple of years finally got USSTRATCOM approve access to it. One of the advantages of having this SP data over the two-line element set data is that it actually comes with the uncertainty information, which is something that we really need to have to be able to do an assessment of how good the data is

that we're using (i.e., if somebody says there's a close approach of a kilometer, is that plus or minus 100 meters or is that plus or minus a couple of kilometers), which really makes a difference in what you can do with the data. However, the decision when they released the data was that they could provide the additional information but they couldn't provide covariance (i.e., the uncertainty). So, we constantly run into this kind of a situation where the government is trying to protect processes or capabilities or systems or whatever it happens to be (they don't really tell us what the specific issue is), but, at the same time, we are putting hundreds of satellites that the DoD relies on for things like communications at risk because we could think that we understand the situation and actually maneuver into a collision rather than avoid one because we don't have that specific uncertainty information.

So, from a national security perspective, I think it's important that we establish a solid foundation with respect to transparency and information sharing so that we are able to make effective decisions today, so when we do get into a situation where we have an enhanced state of conflict, or whatever it happens to be that drives these military assets to be focused somewhere else, that this part of the problem doesn't all of a sudden degrade to the point where now we're not covered in the day-to-day stuff and we're worried about what might come after that.

Interviewer: So, it sounds like there are some clear hindrances—transparency, information sharing, red tape, government processes—between the government and commercial space entities. However, it also sounds like there is a general awareness, particularly amongst commercial actors, of these hindrances, and some progress is beginning to be made to overcome some of these barriers. Do I have that right?

T.S. Kelso: That's right. The primary driver of this has been that the commercial sector has asked to do certain things with the USG, explained why the specific information is needed, but often times the government has simply responded with a "no." It's often not the decision of the people that we're asking directly, it's typically the case that somebody up the chain had decided for whatever reason that the specific information is not something they're willing to release, so the answer is "no" and that's all we're told.

In looking at the problem from the perspective of the commercial side, admittedly these systems are set up to make money, and whether the customer is the DoD or somebody else, the commercial entity needs to protect the safety and flight for those assets while also trying to protect the environment so that it's not a risk for their operations. So, if they can't get this from the USG or they can't rely on the USG, then there is a concern. And I don't mean to be poking at the US government because, honestly, the US government is really the only one we get any of this from, and the US government has at least been somewhat forthcoming; however, the commercial sector is still not getting the type of information that it needs to be able to protect these assets, regardless of whether it's for a commercial customer or a US government customer.

Sergeant First Class Jerritt A. Lynn

Civil Affairs Specialist (United States Army Civil Affairs)
17 August 2017

WRITTEN RESPONSE

The proliferation of space activities amongst state and private commercial enterprises is changing the contemporary political and security environment. This calls for United States policy-makers to recognize the domain of space as being integral to U.S. national security, international diplomacy, and the U.S. commercial sector. U.S. policy-makers must work to create a new U.S. Space Strategy that addresses the potential consequences and benefits of additional actors being involved in the space sector, whether it be conducting

unilateral space activities or utilizing cheap space launch capabilities to create international partnerships. Through the examination of historical precedent, as well as the contemporary political and security environment, realistic strategic goals and policy recommendations are identified that allow the United States to remain the world's leading nation in space. These goals and recommendations promote U.S. national security objectives, empower a thriving commercial sector, and safeguard the domain of space for the international community.

The space economy started in the United States during the space race and since has been dominated by Americans and the U.S. Federal Government.[35] To highlight this point, the U.S. government and military space budget in aggregate comprised about 54% of space spending by all world governments in 2014 (Space Foundation, 2015). Despite the U.S.'s preeminence, the global space economy has been growing since the 1980's and slowly changing the status quo. The private sector is continuing to expand, global commercial space enterprises are building, and foreign states are escalating investment into technological innovation and the manufacturing industry. All of these factors coupled with U.S. Federal sequestration, restrictive export practices, and overall market volatility are diminishing the hold the United States Government and its commercial partners have in the space industry. This, in turn, reduces U.S. leverage and control over an integral aspect of international diplomatic relations. Scott Pace, Director of the Space Policy Institute at the George Washington University Elliott School of International Affairs echoes this in writing:

> *Underlying erosion of the industrial space base has further exacerbated the problems of cost growth and weak innovation…With limited technology spending in civil and military sectors, increasing reliance on global supply chains, and export controls that limit the size of addressable markets for space technologies, we should not be surprised by evaporation of the United States space industrial base from the bottom up (Pace, 2009).*

This is not to say the United States is not still currently at the head of the table or without recourse. If policy-makers chose, they could sponsor regulations, funding, and legislation that promote U.S. economic interests and by proxy, assist in satisfying security and strategic concerns. Space flight and activities require capital and a strong economy; therefore, the state must act in its capacity to foster economic activities that encourage growth in the space industry. For example, the Reagan administration recognized the need to expand the ability of the U.S. commercial space industry and sought to promote their growth in the expanding market to create a symbiotic relationship between the USG and commercial space industry.

Currently, U.S. laws, such as the International Traffics in Arms Regulations (ITAR) control the export of items identified on the United States Munitions List (USML). Over the past twenty years, certain space-related items have shifted between the Export Administration Regulation (EAR) and ITAR, confusing the commercial industry and decreasing their ability to do business within the global space market ("U.S. Space Industry Deep Dive Assessment 2014" 2014). Dealings between U.S. companies and China in the late 1990s caused rumblings within the USG that culminated in the 1999 National Defense Authorization Act which transferred export controls for all satellites and related items from the Commerce Department to the Munitions List administered by the State Department (Hays 2011). This move led to a significant decline in satellite exports in 2002, as foreign satellite manufacturers (e.g. Thales, European Aeronautic Defense and Space (EADS), and Surrey) replaced U.S. built components on their satellites to make them "ITAR free" (Hays, 2011). U.S. export controls have also caused concern for businesses such as Virgin Galactic and XCOR, whose supply chains and vendors are located internationally. The controls limit their ability to compete with European, Russian, or Chinese space industries who do not have the same stringent national security protection laws (Galliott, 2015).

It is necessary for a state to safeguard particular trade secrets and technologies. Still, blanket regulations and categorization that generalize a market, such as the export controls list, do more harm than good to national security and domestic markets. Restrictions provide commercial enterprises with a perverse incentive to reduce

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[35] The Space Economy as Defined by the Organization for Economic and Cooperative Development (OECD) in the OECD 2014 Space Economy at a Glance Report (created every three years): The global space economy comprises the space industry's core activities in space manufacturing and satellite operations, plus other consumer activities that have been derived over the years from governmental research and development. OECD, The Space Economy at a Glance 2014, (Paris: OECD, 2014), http://www.oecd-ilibrary.org/economics/the-space-economy-at-a-glance-2014_9789264217294-en

investment and research that additional markets would have spurred. There has been progress made, as the Obama Administration launched the Export Control Reform Initiative (ECR Initiative), which is intended to reform the U.S. export control system (International Trade Administration 2015). As of July 2015, the USG has made progress in developing and publishing revamped Munitions Lists and changes to the ITAR, but they have yet to be formalized and implemented. Thirty-three of the seventy-five largest space manufacturing firms are based in the U.S. and have generated 70% of global space revenues at an average of $1.7 billion in sales (Sadeh, 2013). Congress must continue to consistently re-evaluate its regulatory and classification process to take into account, the second and third order effects of closing off outside markets to specific technologies if the United States is to retain a competitive advantage internationally.

References

Galliott, J. (Ed.). (2015). Commercial Space Exploration. England: Ashgate.

Hays, P. L. (2011). Space and Security. Santa Barbara: ABC-CLIO.

International Trade Administration. (2015, October 7). About Export Control Reform (ECR). Retrieved January 4, 2017, from http://2016.export.gov/ECR/

Pace, S. (2009). Challenges to U.S. Space Sustainability. Space Policy 25.

Sadeh, E. (2013). Space Strategy in the 21st Century. New York: Routledge.

Space Foundation. (2015). The 2015 Space Report.

U.S. Space Industry Deep Dive Assessment 2014. (2014, September). U.S. Department of Commerce. Retrieved from: https://www.bis.doc.gov/index.php/forms-documents/technology-evaluation/1081-employment-report-final-100714/file

Dr. George C. Nield

Associate Administrator for Commercial Space Transportation (Federal Aviation Administration)
1 August 2017

INTERVIEW TRANSCRIPT EXCERPT

Interviewer: …What are the biggest hindrances to a successful relationship between the private and government space sectors? How can these be minimized? I know you just mentioned that DOD often does not communicate effectively with the commercial sector, so you could just take it from there.

G. Nield: Let me start by pointing out that I feel like there are significant potential advantages for the government to increase its reliance on the private sector, and they include things like lower cost; increased innovation; a greater risk tolerance; new products, markets, services, and customers; and new sources of funding and investment.

The catch is, the reason we don't do that in spite of all those nice advantages, is that to be able to take advantage of that, the government would probably have to give up some control, and they're reluctant to do so.

So the primary obstacles or hindrances to achieving those advantages would be, again, the government's desire to be in control, what I would consider to be a deeply ingrained habit of doing things the way we've always done them, the slowness of government decision making, the inherent bureaucratic characteristics of the DOD acquisition system, and the nature of the DOD organizational structure, namely lots of people can say "no" but no one's empowered to say "yes".

I feel very strongly about this set of questions and I think that this is something we really need to think about as a government. I believe that obstacles and hindrances can be minimalized through re-organization, such as the establishment of a Space Corps. I know people do not like to talk about that, but that was put forward as a proposal because of what we've just been talking about. That may not be the right solution, but that is one way to attack it. Acquisition reform -- that is something that is talked about a lot. We've begun to see some progress there, with the increased use of public/private partnerships, fixed price contracts, and other transaction authorities, prizes, demonstrations, competitions, the kind of things that are common in the commercial world.

Interviewer: I see. Thank you for providing those specifics. Now, speaking on a systemic level, what do you think would be the fastest and easiest way to, not revolutionize but certainly introduce a shift in policy, on the government side to have a better relationship with the commercial sector?

G. Nield: It has to come from the top and so the White House can say, "This is what we want to do." We can issue executive orders, we've got the re-establishment now of a national space council and the vice president can certainly use that to indicate what the administration's preferences are, their positions are, and their directions are in terms of how government agencies like DOD, like NASA, like other organizations ought to operate. It can filter through everything we do; how we work contracts, how we run programs. NASA has done a lot of interesting things in recent years with the commercial world that are contrary to the traditional government aerospace contracts, such as with commercial cargo delivery to the Space Station, and prize competitions, and things like that. NASA really, if I can be honest, went kicking and screaming and "that's not the way we do things", and there is a tendency to revert back to the comfortable government contracts, with an attitude that "government needs to be in charge of all this, and we'll just tell the contractor what to do." There is a real challenge there to transform how the government is going to take advantage of innovation and other positive attributes that exist in the US and in our free enterprise system.

Interviewer: Okay. Wow, that was a great answer. Is there anything that you think on the commercial side that the commercial sector could do to help improve the relationship or is it really just a one-sided base of reform here?

G. Nield: I'm not aware of anything that the commercial sector is doing that is impeding it. They're trying to make their customers happy and so if the customer says, "Here's what we're going to do going forward," then they'll bring lots of ideas.

Interviewer: Okay.

G. Nield: I think it really has to come from the government side.

Jim Norman

Director, Launch Services, Human Exploration & Operations Mission Directorate
(NASA Headquarters–Washington, DC)
27 September 2017

WRITTEN RESPONSE

If the U.S. government takes the position that it needs to prevent the U.S. private space sector from performing or providing a certain commercial capability or activity in space, that would be the biggest hindrance. Given the current state, the U.S. is no longer the only country with the ability to have an end-to-end space industry. A better basis for a successful relationship between the private and government space sector might be for the U.S. government to sponsor, partner and facilitate the growth of the U.S. private space sector with the goal of growing

the number of competitive providers, and creating a business environment that is better than any other location in the world in order to attract the best ideas and businesses to our shores.

Dr. Luca Rossettini[36]

CEO and Founder (D-Orbit)
16 August 2017

WRITTEN RESPONSE

What are the biggest hindrances to a successful relationship between the private and government space sectors? How can these be minimized? Large corporations for space asset manufacturing and operations have been actively working with governments for decades; the new firms in the new space industry sector, generally speaking, rarely include government involvement in their business strategies. This is mainly due to the following reasons:

1) Bureaucratic obstacles, often requiring long time and special and expensive expertise to be dealt with. Long lists of formal requirements represent extra and unwanted costs for these new businesses; they are often funded by private money, and government involvement, with the attendant costs and slow bureaucratic pace are seen as obstacles in aggressive go-to-market strategies. The major requirement of generating strong revenues to satisfy current investors and attract new rounds of financing – hence more and faster growth – tends to lead new space companies away from government programs. Only on a second – and more mature – step of their growth do these companies start to get involved within government projects, often driving new services or applications demand, when their cash situation becomes more stable.

2) Slowness and low reactivity. Currently, application to a government RFP is not only expensive for the preparation and requires special "RFP writing" expertise, but response times take several months, with results published after 6 or more months. A new space commercial company cannot rely on such a revenue source, and focuses on business opportunities that can be realized more quickly.

3) Special business restrictions. US is showing the highest creation of innovative companies worldwide, and this trend is positive and growing. However, many of these companies are led by founders that are not yet American citizens or permanent residents. Often graduates of US universities, these individuals and companies are nevertheless forced to focus their businesses on the commercial sector or with governments less restrictive in terms of the nationality of the founders.

Although much has been done in recent years on the simplification of government driven RFPs, this is not yet the case for the space sector. Small and medium enterprises are often considered only in partnership with a large space player, and the economics (among other factors, i.e. IP protection) of this type of participation is not always acceptable. A clear path should be put in place for new space companies. The SBIR contract model is a good example of how it could be structured. The following characteristics should be taken into account:

- Open dialogue with SMEs to retrieve innovation opportunities, products and services not available on the market. Focusing on government-driven technology definitions/requirements – often derived from lobbying actions – may sacrifice the opportunity to find better and more performing technology.

- Test the SME capabilities with short-term study assessment on the application. It is most likely the target "new space" companies have already developed the technology for non-military use. Small contracts to study adaptations of privately developed and available technologies for defense applications are the best

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[36] Dr. Luca Rossettini's response to this question reflects the point of view of D-Orbit, which operates across the space domain, focused on the new commercial approach to space as its main driver, but taking account of considerations related to our business with the more consolidated "standard" space industry practices.

way to assess the companies' capabilities and the potential benefits for defense agencies. Application time should be in the order of weeks, evaluation on the order of one month, while contract execution should not last more than 3 to 6 months. Payment should be made half at contract signature and half at report delivery, with no financial statements requests.

- A successful previous step should lead into customization of the product for defense use. This phase should last no more than 1 or 2 years and adopt a simplified verification methodology. Eventually, a clear government program should be identified as "first customer" for the developed new technology. These simple steps would allow the government to safely detect eligible and promising commercial partners, and on the other side, to commercial entities to see a potential real market in which to invest internal resources and time.

Victoria Samson

Washington Office Director (Secure World Foundation)
22 August 2017

INTERVIEW TRANSCRIPT EXCERPT

Interviewer: Okay. Great. Thank you so much for running through all of those questions with me. So, we always conclude with a final, general question. Is there anything I haven't asked you that I should have, or is there anything you would like to highlight as a concluding remark?

V. Samson: …One of the things that drives me crazy is the over-classification of space, and there's so many ways in which that happens. One thing that's absolutely ridiculous is the idea that you can have classified satellites where you don't even acknowledge that they've been launched, because we should recognize that we aren't the only ones with telescopes—anyone can see what's being launched, though you don't always necessarily know what it is that is being launched. And I'm not saying that we have to tell everyone where every single one of our satellites are going—you don't need to say that your satellite is going to spy on North Korea—but we need to start getting better at acknowledging what's going on.

The reason why this is a concern is that the military has their satellite catalog, but there are a lot of satellites that are not necessarily in their catalog because we don't want to acknowledge that they're there. Countries notice this, and then, in some cases, request for their satellites to be removed from the catalogue. And this makes the catalogue become an unhelpful resource because then you don't actually know where everything is. And, like I said, it's problematic because anyone can see that we launched.

With respect to the Chinese ASAT Test done in 2007, of course the US saw it. We had seen the previous two tests, but we didn't say anything because of intelligence that we didn't want to mess up, or we wanted to keep our tracks open or covered. But it was the amateur satellite observation community that saw it happen. They were watching, and they saw a satellite in one place, and then at the next place they saw a bunch of debris, and they thought it seemed odd. And the amateur satellite observation community were the ones that notified the media. The media then started asking questions, and that actually brought it to the public 'attention. And, of course, 11 days later the Chinese actually say the same thing.

So, the time for that that level of secrecy is done. I just don't think it's helpful because I think it puts a burden on what could be discussed, it puts an unnecessary burden on who you can work with, and it puts a burden on the sorts of things you can accomplish, and it's not doing any good anyways. And, again, I would point to ITAR as an example where you have strict, strict, controls

on things that are being done elsewhere anyways, and that's kind of ridiculous—why even look at it that way?

Another thing I would like to point out, on a positive note, is that I think NGA is really interesting because they have embraced the idea that their mission can be helped by the commercial sector and that there can be unclassified input that can be really useful. NGA talks about darkening the skies with satellites, which sounds kind of ominous, but the idea that they're recognizing is the prevalence of small satellites and things like that. These are all opportunities for that agency to get information as well as continue their mission, and it's being done at, I would say, very little cost to NGA, as opposed to putting up billion-dollar satellites that take 20 years to build and launch, and then if something happens then you're screwed. So, I think that's a really interesting model. I think it's very helpful, and I think that it's kind of the way we need to start thinking in the future.

Spire Global, Inc.

Peter Platzer
Chief Executive Officer

Dr. Alexander E. (Sandy) Macdonald
Director of Global Validation ModBD

Jonathan Rosenblatt
General Counsel

15 August 2017

WRITTEN RESPONSE

One of the biggest hindrances to a successful relationship between the private and government space sectors in the U.S. is that procurement cycles can be a very long and difficult process. In addition, understanding requirements can often times be a challenge, which also causes delays. In a positive development, NOAA has recently initiated a Commercial Weather Data Pilot (CWDP) program, to begin to make it possible for private companies to sell weather data for use with government weather forecasts.[37] It will be interesting to observe the development of this program (as well as similar programs in DOD/Air Force) to be able to determine whether U.S. government agencies are successful in collaborating with private industry in this manner. If so, it would help streamline the participation of U.S. commercial participation in providing weather data.

For the satellite licensing process, there needs to be a "shot-clock" mechanism for decision-making, as applications from private companies can sit with the Federal agencies for a significantly long period of time without any indication of the status. In addition, if a Federal agency does eventually return with a decision, there is a lack of transparency in how it came to its decision. There are a number of ideas of how to remedy these difficulties; some of these remedies appear in sections of the recently released American Space Commerce Free Enterprise Act of 2017 (H.R. 2809).[38]

An additional challenge is that launch opportunities are hard to come by for secondary payloads. For example, U.S. government launches do not allow commercial operators to take advantage of ride-share opportunities. Commercial operators could provide various space-based services to government, but cannot quickly enough—or at all—because they are not allowed ride-share opportunities with the U.S. government for access to space.

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[37] Information on the NOAA Commercial Weather Data Pilot program is available at: http://www.space.commerce.gov/business-with-noaa/commercial-weather-data-pilot-cwdp/

[38] See: https://www.congress.gov/bill/115th-congress/house-bill/2809

Dr. Patrick Stadter

Principal Professional Staff, National Security Space Mission Area
Program Manager, Space-Based Kill Assessment Program
(Johns Hopkins University Applied Physics Laboratory)
9 August 2017

INTERVIEW TRANSCRIPT EXCERPT

Interviewer:	Okay. Do you think there are any major hurdles or barriers to the potential collaboration and leverage opportunities that you have mentioned?
P. Stadter:	A couple things that I think you need to be aware of, one is the speed of government, right? Commercial tends to move much more quickly than government. Commercial can make a deal, they can sign on the dotted line, and then they can go and they're beholden to shareholders and private interest. The government has to goes through a number of procurement processes. There is a fundamental impedance mismatch there. You see it in the flow down of federal acquisition regulation (FAR) clauses in contracting, and there are companies that more and more even the supplier-based just are finding it is not worth them dealing with the government when they could just deal with commercial and not have to address some of those issues.
	The other one, and this is another kind of symptom of that whole speed of government factor, is basically cash flow and funding, right? If a commercial entity wants to do a deal to host a payload, it'll take a couple few years to put it together and get the payloads on there and get them launched and operating. They do that deal, and they make a commitment upfront. The government works on the fiscal year boundary, and, as a result, can't commit to a year out because they don't know what the budget is, and that can cause very significant challenges relative to resolving the difference between government contracting and commercial contracting. There are ways to deal with that, but those are very, very significant hurdles.
	Not to mention the security hurdles and all that kind of stuff. [Note: I did not address security in particular because I think the details are important and generally I'm not comfortable discussing those specifics in an open forum. I do believe security is an issue relative to commercial/government but I would note that I have seen more significant conflicts over security between government programs/entities than most government/commercial entities.]
Interviewer:	Okay. Certainly, one of those hurdles we've been hearing is with respect to transparency issues. On the government side, there are clear concerns over classification. On the commercial side, there seem to be concern with respect to IP and protecting that IP. So, do you have thoughts on the transparency hurdle?
P. Stadter:	Yeah, I think the transparency thing relative to classification as it pertains to insight is a red herring. The reason I say that is because there's a level at which commercial will not care what the particular aspects of classification are as long as it does not impact what they're doing. For example, if I have something that I'm going to put a payload on, and I have to insist that it is only US citizens that have access to that spacecraft while it gets integrated, and that is inconsistent with the fact that they may have foreign nationals working or have partners that are foreign that might be hosting or integrating other things, then that's a problem. But if that's not the case, then they don't care. I don't say that glibly, but understand that the transparency and the classification thing comes down to unknown impacts on what their processes and best practices are, in my opinion.
	It's not a, "we need to understand what's going on in order for us to be able to do a better job" issue. That's just interest, but money solves that problem as long as you're not impacting them.
	What was the second part of that question?

Interviewer: So, just regarding the commercial side and protecting IP and possible concerns over protecting IP and sharing IP.

P. Stadter: Yeah, that depends. I think if it's a service, it's not a big deal, in the sense that the government is buying a service, right? If it is integrating payloads or capabilities on, then that is the discussion, and in my opinion the government should not give up its rights and should be able to protect via a do-no-harm approach (in other words, here's an interface control document, these are requirements to be met relative to do no harm to, say, a primary mission that the commercial provider has). This is how we operated for the Missile Defense Agency for space-based kill assessment (SKA) that we are hosting on a commercial entity. We operated through do-no-harm, maintaining very careful control of all their proprietary data and interfaces, but are able to do that integration and flow from there.

Stratolaunch Systems Corporation

Steve Nixon
Vice President for Strategic Development

Melanie Preisser
National Systems Director

18 August 2017

INTERVIEW TRANSCRIPT EXCERPT

Interviewer: What are the biggest hindrances to successful relationship between the private and government space sectors and how can those be minimized? Let's tailor this question specifically to the launch industry and the experience of Stratolaunch as well.

S. Nixon: Yeah. Okay. I describe that as… it goes hand in hand with the space segment of these questions so I'll leave those to… you can't really separate them in this question. I'll tell you, mostly of the DOD. The DOD's architecture has evolved in a way that seeing space is as kind of a benign environment. Adversaries couldn't really mess with our stuff. That contributed to building more and more efficient architectures, which means bigger and bigger and more complex satellites that last a very long time, are complex, take a long time to build. But it's probably a good way to go based on the technology you have so far, unless you think space can be contested.

Once you think space can be contested, that all changes because right now we have three- or four-ball GEO constellations that are, yes, very efficient. But you don't have to take out many of those satellites before you put a big hurt on us. But there are so many things that we're finding in the system just to perpetuate that architecture. I mean there's always… there's obviously the legacy factor, but there are cultural things about the bigger the program, the better. If you're a program manager, if you're a military service, if you are a contractor, if you are a budgeteer, almost every dimension of the process and system prefers and rewards large programs.

If you believe that space is contested, then it demands a greater shift towards, or at least augmentation with small satellites that can be very responsive and can be more resilient because there are more of them, and can be easily replaced if there's attrition, and can be reconstituted if there's a major conflict. All these things point towards greater use of small satellites. But the largest system just can't accept that and can't turn to that. There are other fine ways to defend and perpetuate the large satellite systems that we have today. We find that very difficult to work within that system. When it usually takes years and years and billions to budget for these things and then to go build them, or years to even think about it before even deciding what they have to do, which all works fine with the current system. But it's not particularly well-suited for a

contested war-fighting situation in space where you need to be more agile, you need to have not all your eggs in one basket. Some of them is creating an architecture that looks like battleship row in… whatever it was, 1940 whatever year prior to Pearl Harbor. Our assets are just like large sitting ducks. That's not a way to deal with the contested space environment.

We've done things like we're advocating for adding layers of architectures and small satellites and low earth orbit. That allows you to change the deterrence calculus of an adversary. It allows you to surge in times of impending conflicts. It allows you to rapidly fill holes that may appear via conflict or natural problems and then allow you to reconstitute it during some attempt to take out capability. All those wonderful attributes you have only with small satellites. You do not have that with the large satellite. You cannot do any of those things with a large satellite. You're not going to be responsive. You can't proliferate them because of an affordability issue and time issue. You can't reconstitute them. You can't be responsive with them. I'm not saying to do away with large satellites or anything... We're just saying add to that architecture another layer of small satellites. But it's really, really hard for DOD to… and I'm convinced it'll happen eventually. But will it be 10 years before they make the shift? Hopefully, we won't be in any conflicts during those ten years. You think that if people are serious about contested space and the parts of the system that are really important to our military because we can make that stronger… But gosh, it's just that everything that is being built may not be fast enough when everything else is moving really fast.

Interviewer: So to build on your example of small satellites…. You're saying there's an issue of the DOD accepting or even realizing the advantage of small satellite. Rather than issues like acquisition or lots of red tape and bureaucracy, you're saying that your counterparts and the DOD do not even realize the advantages of the technology you're speaking of. Do we agree with that?

S. Nixon: Probably to an extent, I think there are several camps. I don't think that the DOD is monolithic on that certain thing. I think that there are definitely camps of forward-thinking folks in the DOD that believe small satellites in LEO orbits is the future and that we should be moving there as fast as we can. There are other camps that say they totally agree with that. But they acknowledge that it could be years and years and years before that happens and they got other things they need to worry about first. Then you have another camp that is skeptical that small sats really have value at all. It's a waste of time that we worry about them.

Interviewer: Okay. The point of this discussion really is to figure out how to overcome problems like this. So, how would you suggest the government overcome that level of discord? Is the inherent problem the nature of the giant bureaucracy of the Department of Defense or is it the leadership issue? What are the possible solutions to communicate better between the technological advancements that you're citing and what the US government could stand to gain from engaging them?

S. Nixon: I mean I can tell you… yeah, let me answer that this way. I think the most important thing is the DOD needs to be very conscious and aware of two things. One is the utility of space in warfare. I think it would pretty easy to demonstrate that it's not just important but it's absolutely critical and it's the way we structured our entire military to operate the use on space. You can think of communication, navigation and timing and targeting etc. Everything we do in trying to win a war critically, critically depends on space. We have to be reminded of that and hold that forefront in mind.

The other thing we have to really think about is, is there a threat or not. If there's not a threat, then maybe we can just keep doing what we're doing. If there is a threat, then… and if there's a threat and this is really important, then I think we've got to really be serious. I think what happens in my experience is people will think about the threat and introduce the notion of small satellites and resiliency and all the things that comes with it. When they forget about the threat and forget about the value that space provides, they begin to say that they can't afford another

layer of the architecture, that no one is going to pay for everything we have plus something else. By the way, there are a million antibodies that think like that. Until we can demonstrate small sats and understand the price of an augmenting layer, then probably you're not going to make much progress in those issues.

I think what happens is when we say that they've forgotten how important space is to them and they've forgotten about the threat, if we can just keep those two things forefront and be serious about them, then we will make the hard decision and do what has to be done because they don't think the downside is too good. The other thing I would say is what we're doing is I think Congress can help a lot in pushing through what would otherwise be really years and years of stalling and internal deliberations and help kick off something and they can advocate and get something started. So we've kind of pursued that front.

We're also helping the… the same can happen from the White House that they can short-circuit the internal hammering and BS that happens. But that is part of leadership from up high in a good position. But can they be persistent and push through that? Arguably, the Joint Staff could do it, the Secretary of Defense could do it too but it's going to require a real push. I would always recommend everyone to focus on how serious you think the threat is and how important space is to you. That should help a lot.

Dr. Mark J. Sundahl

Charles R. Emrick Jr.- Calfee, Halter & Griswold Professor of Law
Director, Global Space Law Center
(Cleveland State University, Cleveland-Marshall College of Law)
19 July 2017

INTERVIEW TRANSCRIPT EXCERPT

Interviewer: Okay. To quickly change gears a little bit here, one of our questions has to do with the biggest hindrances to a successful relationship between private and government space sectors and how these can be minimized. I think you might provide a unique perspective to this question, so I'm wondering, from a legal perspective, do you see any hindrances to a successful relationship between the private and government space sectors?

M. Sundahl: Just right off the bat, no. Corporations and NASA have been working together from the very beginning. Then, of course, we've got the Dragon resupplying the international space station. I think we are just at the beginning of commercial and government interaction in the space domain. So, I don't see problems there.

Certainly, I think contracting with the government can always be a little tricky, and it might be a hindrance in the sense that it can be more difficult than contracting between two private parties. But by and large, I think the partnership between public and private parties has been very robust and healthy, and this cooperation is continuing to grow.

John Thornton

Chief Executive Officer (Astrobotic Technology)
11 August 2017

INTERVIEW TRANSCRIPT EXCERPT

Interviewer: As you contend with these issues that are in the future, do you find it easy to cooperate with the government, to have contact with them and to communicate with them in regards to these issues or do you have a hard time doing that?

J. Thornton: So far, we have had a very easy time with NASA and the FAA. The defense side, though, we have not had those same kinds of contacts. I don't think that this is on the defense radar as far as I can tell. We've had no serious conversations with them or not even feeler conversations with them. I don't know how serious they take it or if they consider it a potential concern in the future. …

Interviewer: We'll move on to the next question here. What are the biggest hindrances to a successful relationship between the private and government space sectors and if you could be as specific as possible?

J. Thornton: I guess I should start with the biggest positives there. First, we have a fantastic public-private partnership program with NASA that I think is really forward leaning and really smart. Essentially, they're spinning their technology into commercial with public-private partnership. It's called Catalyst. It's modeled after the COTS program that SpaceX and orbital sciences were built on. It's the idea that NASA is always going to be pushing outwards and always going to be doing the new frontier and then they should be having a really robust program of building commercial building blocks behind it. And they should all be American so that we have the full vertical pipeline of capability there. I think they're doing that well. It doesn't have the kind of funding that it needs to ensure that the US is the leader in the area. I think that's where the one shortcoming is. For example, we've had other countries and other international groups buy payloads from us and we've not had anyone from the US government buy payload yet.

It's just basically other people are more interested in investing in this area than the government side. I think maybe that's our biggest challenge is that we're seeing some hesitancy and concern about that. It's increasingly getting better and I think people are recognizing that this is going to be a key commercial stepping stone and then a key thing for the country to strategically control.

Interviewer: That's interesting you bring that up because often as we've reached out to commercial actors and posited this question to them, we've seen that NASA has almost universally been the best point of contact for commercial actors in relationship to, let's say, their point of contacts in the DOD and the military, etc. What would you say is the reason for the success of the program you just described or that NASA is so able to communicate with the commercial actors successfully?

J. Thornton: I think the first thing is that they're very open to commercial activities and collaborations. We have intentionally tried to pursue defense opportunities in space and we've had a very difficult time finding the right people and communicating with them. NASA makes it very easy. You can knock on almost any office and walk in and have a conversation at least. We have not seen the same thing on the defense side at all. It might just be that we're running in the wrong circles, but in the 10 years of operations we've had all 23 of our contracts come from NASA and none coming from the defense side. We're spending a lot of effort, money and time to try to change that, but it's challenging.

Interviewer: First and foremost, it's an issue of communication, correct?

J. Thornton: Yes, communications and having the front doors and the programs that can be accessible. One of the most accessible is the SBIR program. But increasingly, that feels like you have to know

someone that is going to pick you ahead of time or seed your topic ahead of time. We see that the ones that aren't done that way have extremely low odds of success on wins and we've never had successes in that front. It's really taken efforts to try to network and find the right people and basically build the club of folks that know about our technology and are interested in it and then they follow through with solicitation. That's what's taken a lot of time.

Interviewer: I mean, of course, we're speaking specifically to your experience, but is it a common sentiment across the commercial industry that NASA is the preferred avenue of contact with the government?

J. Thornton: That I don't know. There are pros and cons of working with NASA. The pros are that you can typically get smaller research opportunities fairly easy. The negatives are that NASA tends to move slower than defense organizations. I've heard a lot of stories from friends and other companies that the defense side moves so much faster and a lot of times with bigger money. But the question is how do you get into that circle? I guess NASA is easier to get into. Harder to do bigger things with, I'd say. And for defense, once you're in feels like it's much easier to do big things with…

Interviewer: This touches on another interesting point where there is a question of whether moving - and this possibly relates more to the satellite industry - but a big argument is whether or not the government is more capable of regulating industry wide concerns or if this is something that should be hashed out between commercial actors themselves. If you could relate that a bit to your perspective, i.e., this nexus between government regulation or such ubiquitous concerns regulated within the commercial sector themselves.

J. Thornton: Sure. I think on this one it's about finding where the best talent is and where the best capability is and then using that as the input. I have no idea how capable the defense side is versus the commercial side is on the IT front. No clue. It's not really my forte. I think whichever is the best in the business on that should probably advise on whichever structure you use. They should at least provide review or approval or some kind of authorization that yeah, these guys are compliant with such and such, so use their service. As long as it doesn't put the commercial out of business and doesn't drive up costs too much, seems like that could be a really healthy relationship.

ViaSat, Inc.

Richard A. VanderMeulen
Vice President of Space & Satellite Broadband

Ken Peterman
President - Government Systems

Shannon Smith
Executive Director of Strategic Initiatives

Fred Taylor
Vice President - Space and Cyber Applications at ViaSat – Government Systems

Bruce Cathell
Vice President - Government Operations

15 August 2017 (Written Submission)
21 August 2017 (Interview Submission)

WRITTEN RESPONSE

Likely the most significant accelerator to successful private and government space sector relationships lie in gaining a much more robust common understanding of goals and capabilities. Finding a common understanding

will require both commercial and private sector to gain knowledge of the needs and capabilities of the military/government sector and the military/government sector to gain a broader understanding of the needs and capabilities of the commercial or private sector.

For example, private sector Satcom ecosystems hold the promise to enhance National Security Space with significantly higher end-user performance at significantly lower costs. In addition, they promise to enhance the National Security Space posture by delivering this higher end-user performance and lower cost while closing mission gaps including:

- Operations within 25 nautical miles of Near-Peer very High-Power Jammers
- Operations in presence of co-orbital Interferers
- Operations in presence of Near-Peer sponsored Cyber attacks
- Operations in presence of Kinetic attacks
- Operations in A2AD Airspace
- Operations with Denied GPS locations
- Operations in Nuclear Scintillated Environments
- Operations in LPI/LPD Modes
- Operations with real-time EO Tasking/Dissemination
- Operations with Global Emitter Geolocation
- Operations immune to Teleport monitoring, Traffic Collection, & Terminal Geolocation
- Multi-Domain situational awareness (SA) sensor ingest into JSpoC/NSDC

These current and forthcoming capabilities are a result of National Security Space leadership, like Gen Hyten, providing frank and open assessments of the National Security Space needs and their alignment to similar needs in the private sector market. The significant improvements cited above are all derived by the alignment of military/government and private sector needs and the leverage of private sector capital investment into service offerings. This is an example of "encouraging" investment into what the military/government considers unique to their mission instead of "directing" the investment with its RDT&E and Procurement funding.

In many cases, the government seeks to direct the actions of commercial or private sector contractors, rather than collaborate, which can result in a conflicted relationship rather than a functioning partnership. This has occurred in part due to conflicting motivations: the government is motivated to have a contractor implement the government-led design for the lowest cost possible, while the contractor is motivated to charge as much as possible to implement the requirements given to them, especially in the change order process. The government also attempts to create a market with several contractors bidding against one another to implement the government design. This approach creates an artificial private sector market. It leads to vendor lock-in, artificial pressures to preserve the industrial base, increased costs and stagnant performance. Conversely, when open private sector market forces exist, commercial or private sector providers are motivated to create the best possible capability for the lowest possible cost as rapidly as possible. If a private sector provider fails to innovate (and sometimes even when it does), it will often be disrupted by a lower cost, and/or higher performing capability. US Air Force Secretary Heather Wilson's recent statements that proprietary interfaces will not be accepted when interoperating with government systems is an example of a key misunderstanding of common terminology. Interoperability and Proprietary are not mutually exclusive. Proprietary is the protection of intellectual innovation typically within the implementation, consider Windows versus MacBook. These devices interoperate, for example email, Word, PowerPoint, and other applications. Though they interoperate, they are proprietary. Proper terminology highlights where finding common ground will be mutually beneficial, but not doing so will result in significant degradation in US space and warfighting capability. Into the 2020s, commercial or private sector communications networks and capabilities will far outperform purpose built military systems in multiple dimensions (capacity, availability, resilience, security, privacy, cyber defense, anti-jam, affordability, etc.). As discussed above these systems will increasingly be designed holistically and well implementation interoperability their implementation design trades ripple throughout the system, including over the air waveforms/protocols, space segments, ground infrastructure and terminals.

INTERVIEW TRANSCRIPT EXCERPT

Interviewer: I'm wondering if when ViaSat feels threats like this... maybe not necessarily are imminent but are of a concern to your commercial interests. Can you effectively communicate that to your counterparts in the DOD? Or is there just a big gap in communication that isn't being addressed?

VanderMeulen: We think there's a pretty big gap, and we think part of that gap is caused by the fact that the government has had this belief that they historically were the investment leader. They think that anything that they've done is very, very exotic and anything that's being done on the private sector is less exotic. We think there's a general bias from that perspective. But we're talking about here, is if we expand on this sentence... I don't know how much you remember or have the history of ViaSat. One of the first consumer broadband satellite networks were set up by a company called WildBlue which we acquired. We were their equipment supplier and we built the network out on the satellites that they started with, which was Anik F2 and WildBlue-1.

One of the threats to the network was they filled the network up. They had 400,000 subscribers. This was back in the 2005/2008 period of time, when at-home broadband was considered 5 megabits, by 1 megabit. As those people kept using more and more data, the network got congested. When the network got congested the customer's broadband would become slow and customers would leave the network. They would turn off, and they go to DSL or some other service. Even that is a threat. Failure to provide a network that's pertinent by the standards of the day causes you to lose customers, which causes you to lose revenue, which causes you to cease to be pertinent and maybe even fail.

[…]

Interviewer: …Moving forward to a solution to this problem, from your perspective as commercial actors how would you feel... what do you think is the best way to overcome this gap in communication? Is the DOD in need of systemic reform, or is it just in need of better leadership? Or do they just need to spend more time listening to their commercial counterparts, or providing a new institution for concerns like this? What do you think would be the best solution to this current problem?

VanderMeulen: We don't know. We think a couple of these questions touched on that, but it would be presumptuous of us to talk about how the DOD or the government should be organized. We definitely follow these discussions and the constructs in the current draft NDAAs, one construct from the House side through Chairman Rogers. There's another construct in the Senate and their NDAA, we understand that is for a chief warfare information officer. We are not sure that any of these constructs are better or worse than anything else. We think that you must have a holistic view. Sometimes when your view is only from the domain that you live in... I live in the cyber domain, I live in the sea domain, I live in the ground domain etc., then you don't have this holistic view.

If you think about it the way that maybe Air Force Space Command through SMC builds the satellite and DISA builds the ground segment. The Air Force, or the Army or the Navy build a terminal onboard a ship or an airplane or an army deployed unit and all those things have to work together. The history is that they haven't done that very well. We think it's not just from the operational perspective; you have to think exactly the same way if you want to protect it. Because it has to operate as a holistic ecosystem and it has to be defended as a holistic ecosystem.

[...]

Interviewer: Right. So with goodwill opening up, the DOD should be allowing a new economy to advance and prosper rather than just throwing money at a problem. Correct? That it's a lot more than that.

VanderMeulen: If you want to go on, let's say on the launch side, just consider SpaceX, versus United Launch Alliance (ULA). Here you had a company that was investing its own money in order to make an affordable launch capability. We were actually restricting it by wanting to retain United Launch Alliance's sole means for launching national security payloads.

Interviewer: Yeah. I think that's a perfect example.

VanderMeulen: We think the other point we were trying to make here is that as much as it's easy for us to direct things we as Americans... I'll say it this way...we as AmeriCANS, not AmeriCAN'Ts... we as Americans tend to be more open and more open for private sector investment than some of the countries that you listed. One would believe that these other countries will tend to be even more controlling than our country will be. Thank goodness that's probably one of the reasons why we'll always stay ahead, because we do have these entrepreneurs.

Dr. Frans von der Dunk

Professor (University of Nebraska College of Law)
25 July 2017

INTERVIEW TRANSCRIPT EXCERPT

Interviewer: Okay. So, just quickly changing gears a bit for a second, one of our questions has to do with hindrances between the commercial and government space sectors. So, I'm wondering, from your legal perspective, what are the biggest hindrances to a successful relationship between the private and government space sectors, and how can these be minimized?

F. von der Dunk: I would answer that question by saying, well, that depends very much on the nation of issue. The baseline in outer space is the freedom to do what you want as a state. This means that if the United States, because of its regional, political, philosophical, economic, etc. interests or general policies, is usually in favor of private space operations, there is no fundamental obstacle to that, as long as they properly take the responsibility and the liability for those operations, and that's basically what's been going on. If you are, however, a communist country such as the Soviet Union was until 1990-91, then obviously you would not at all be willing to allow private enterprise, because the essence of communism is, of course, that there is no room for private economic activities, and rather that everything should be very much controlled and run by the state. That's something that even in those days was not in violation of international law because every state is basically sovereign to declare its own political philosophy, as long as certain rules and rights are not violated and international obligations are not violated. But, vice-versa, the Soviet Union could never find legal fault with the United States or any other countries in allowing the private sector to go ahead.

So, again, it boils down to the extent to which individual countries are, for whatever reasons (violent or non-violent), obstructing or stimulating or conditioning activities. If I look at the global community, it's clear that the United States is still the country which is by far the most amendable to private access in space and the most willing to give private space actors all the reasonable opportunities to do. Even in Europe—Western Europe has for a long time also been part of the free market world—there is much more reticence and interest in only allowing certain categories of private actors to become active in space.

To give you just a very plain example, I mentioned space tourism earlier, and space tourism is a hot issue in the commercial sector right now. The US approach to space tourism is, well, let them fly anyone they want as long as these passengers know that they take the risk of travel. So, with informed consent, if passengers sign a document whereby they recognize that they are flying on

basically an unsafe vehicle, then the United States government isn't going to put anything in their way if that is what they want to do. So, the entrepreneurs are putting up their investments and taking the liability and risk, and the US government is allowing them to do so, creating a kind of working environment. In Europe, the governments are a little bit more careful—hence, sometimes Europeans wants to try and protect people against their own stupidity. So, in Europe it has been stressed that one cannot simply have a regime of informed consent because there are people who don't really think everything through. So, instead, European governments tend to want to only allow this kind of space tourism to happen if there is some form of a certification regime in place, which of course makes it safer, but at the same time makes sure that it will not happen for the next 10-years because in the first part of such a venture it will simply not be safe—it can't be safe until you know what could be wrong, and only from thereon can you develop certification.

This is just an example to illustrate that many countries in the world have different takes on the extent to which they allow private enterprise to go ahead. The only thing I can say on outer space is that the bottom line is always the state responsibility and state liability, which should also serve as a guarantee to the rest of the world that in spite of its pro-private sector policies and stances, the United States also has a strong interest in making sure that no cowboys go to outer space and create all sorts of problems because, ultimately, it will be up to the United States government to pay the bill.

Charity Weeden

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24 July 2017

INTERVIEW TRANSCRIPT EXCERPT

Interviewer: Okay, so to tie in the next question, how can we keep the startups over here in the US? What are the biggest problems to a successful relationship between the private and government space sectors?

C. Weeden: Yeah, that's a great question that we work on here at SIA. One thing that comes to mind in no particular order, is balancing the services that are purchased versus specially acquired satellites, dedicated satellites. I think we're at a precipice where the services portion is becoming more available and so how can the DoD successfully leverage those innovations and that capability? Right now, it's difficult due to acquisitions processes to reach in and really utilize these incoming services.

Perhaps the acquisition processes, like pilot programs or things like the US is doing to leverage startups and engage with them, that can always benefit both sides, right? Public private partnerships get these satellites in orbit. There's a lot of great capability being planned, but it was having the government as a customer. That would certainly help move this forward quicker.

The second thing is spectrum; everything hinges on spectrum. These are essentially flying pieces of metal in space without that connectivity. Right now, there's a lot of effort going on to prepare the US and the world for connectivity, Internet devices, self-driving cars, and things like that, but spectrum must be accessible.

Having the government understand where satellite requires spectrum now and into the future will really just pave the road for a successful satellite industry. Then finally, supporting any reforms for commercial capabilities, for example, remote sensing – commercial remote sensing.

It's high time that these regulatory reforms be enacted. You'll find a lot of those observation satellite companies call themselves data providers. They see themselves simply as data providers and that is the sort of culture shift that needs to occur when you're regulating this industry. We're going from an era of the 80s and 90s where the last regulations were developed or legislation was developed. There wasn't a big boom going on in data. We have that now and so governments helping to support commercial remote sensing regulatory reforms will help move things forward as well.

Interviewer: Sure and I think you even addressed a bit of the next question in terms of what opportunities are there to leverage satellite commercial capabilities. I think you spoke a little bit about the major hurdles to doing so. Would you like to expand on that at all?

C. Weeden: The only thing I'll add to that is the government is likely to be a purchaser of commercial services and SatCom services, now and into the future. Essentially, the government and the commercial world are tied together when it comes to spectrum policy.

Interviewer: Okay and could you actually explain sort of what spectrum policy is?

C. Weeden: This would be essentially regulating the electromagnetic spectrum, the radio frequency spectrum that is used by anything that is wireless, satellites, or cellphones, or whatever devices we have that are wireless. That falls upon the FCC to carve out who gets which band of spectrum so that you don't interfere with each other. Again, radio frequency interference is a big problem for the satellite as it is for the wireless community here on Earth. The policies around how do we carve pieces, how do we enable the future connectivity to come online, but protect really our invisible critical infrastructure in the meantime and the investments that have been made in the satellite community.

Interviewer: This is a concern for both the government and the commercial sector, correct?

C. Weeden: I think both sides are being squeezed for spectrum. I do understand more the commercial side of things, how for example there are satellites being built right now to provide broadband services from space, which could be useful for the DoD. That spectrum being used right now is also going to be shared with the terrestrial wireless community to enable 5G connectivity

[…]

C. Weeden: If we're talking about relationship between government and commercial with respect to leveraging capabilities, it would be the acquisition and procurement process in making that easier to navigate, easier to leverage. I think that that is most certainly an issue. I'd also go back to the regulation piece both on spectrum and standing up as a partner saying, "Look, we're going to be using commercial assets down the road. We need to make sure these commercial assets have spectrum available." Then also the remote sensing regulatory piece, encouraging reform and the utilization of remote sensing commercially.

Gen. Elder:[39]   I guess if I could follow up to that is I know there's a lot of different places where you can get the SSA, the space situational awareness. Of course, the government provides a catalogue, but others provide catalogues as well. If you heard from the commercial entities if there's anything they think or if the catalogues that are commercially available are easier to use than the ones that DoD has or any kind of comments like that?

C. Weeden: I think what is needed is more data, and more accurate and actionable data. When it comes to a conjunction, there needs to be more data that commercial entities could use to make a decision of whether to maneuver or not. There are more pieces to be discussed and shared among those operators and the government.

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[39] Lieutenant General (ret.) Dr. Robert Elder (George Mason University)

Dr. Edythe Weeks

Adjunct Full Professor (Webster University)
16 August 2017

INTERVIEW TRANSCRIPT EXCERPT

Interviewer: Okay. So, let's transition into the next question. What are the biggest hindrances to a successful relationship between the private and government space sectors, and how can these be minimized?

E. Weeks: Okay. So, what are the biggest hindrances to a successful relationship between the private and government space sectors, and how can these be minimized? I would say that any hindrances between private sector actors of space and the US government are likely to stem from the existence of a deeply seated ideological ongoing passionate tension, which began shortly after the end of the Cold War. So, from around 1991 until today, this assumption that I just made is evident by numerous documents and discourses, various published articles and hearing transcripts before the House and Senate, and verbal articulations made by key private actors steering public discussion at space conferences.

Now, at the core of this tension is the idea that private actors know how to move forward with the outer space agenda, beyond satellite telecommunications and other established and critically essential, but often viewed as being somehow at stake, commercial industries. The sentiment fueling this tension, I believe, is rooted in the very idea of what America means. So, you have discourses evidencing the tensions, and the private actors tend to say that they know how to speed up development and that can do it more efficiently and effectively than the government. And, for many people, that seems to represent the very freedom that makes Americans proud, and makes us the envy of the world, so it feels right and true even to the very government actors caught in the middle of this ideological struggle. So, there's this an invisible, dormant, unaddressed dilemma.

Okay, so this tension tends to pivot around the issue of who knows the best way—the key actors within the private sector versus the US government—and who knows the best way to push the outer space development agenda forward to next step. So, it is within this paradigm that I just described, the US government and NASA are often said to be too slow or too bureaucratic or too unreliable in comparison to the private sector, and this is an ideological debate that seems real to most people. To many, this seems like it is a real description of the reality. For the key actors involved in this process, both the US government and the private sector, this is consistent with how we're all socialized to view the history of business enterprise and innovation. So, it seems right—it seems like, "yeah, yeah, that is right. The government is slow and we want our freedom."

But the invisible social and psychological structure that I just described is a fabric upon which these hindrances are molded to play out. So, historically, it is a myth that the private sector usually gets its way and usually has the upper hand against the government. Now, the problem with this scenario is that the assertions launched against the government ignore the extensive history of the US government being the way in which we get the funds for research and development for space technology. The US government has been very successful in providing billions of dollars over decades for space, and I think this gets forgotten in the process. The US government has been very successful in securing funds for research and development space technology. NASA has been extremely successful if you look at its history. So, this is why space technology exists. People get excited about the commercial sector, but where does this technology come from? Elon Musk could not have created his space vehicles without the government, without NASA.

So, for decades, the private sector has been receiving grants, loans, contracts, technology transfers, etc. from the US government and from NASA, and this pattern has enabled the private space sector and commercial space operations to happen. Ignoring this reality is problematic, especially when it comes to elected officials every year having to approve NASA's budget. I've been a part of the blitzes that usually involve about 30-40 hand-picked individuals representing space to go around meeting with elected officials in Congress and the Senate. Usually, these teams meet with interns, sometimes with the elected official directly, and pretty much have to beg for them to renew NASA's budget every year. And, listening to what elected officials say, makes perfect sense to me. Some elected officials are in districts where the people say, "We are not being paid. We need education, we need government, we need food, and we need jobs." This makes it unstable, and makes advances in space unstable because every year we're not sure whether or not NASA is going to have their budget.

Many member of Congress and the Senate feel obliged to pay homage to the expressed feelings of their constituents. That's understandable. And these constituents have often indicated that space activities are usually meaningless to them. So, the private sector's ability to put innovation to work is mostly funded by the American taxpayers. Most Americans like the idea of NASA and having a space program, and view it as an asset; however, many are completely unable to interpret any real value or personal realizable benefit for themselves and their families and people they know. Unwittingly, the private sector discourses, which attack NASA and attack the government, help to fuel emotions—people are seeing this stuff on the Internet and they're getting upset because they're paying for the space program. So, these discourses tend to fuel these emotions of suspicion and disdain for elites, and these are the people who are truly funding space activities—the taxpayer, the constituents of elected officials who vote on NASA's budget.

If something catastrophic happened out there in space (e.g., some private actor does something that causes a chain of events to cause a catastrophic incident), private sector actors are likely to look to NASA or the USG or US military for the solution. The US government and the American public remain legally responsible for private activities in space, according to the Outer Space Treaty of 1967 Article 6. This is the reality, and it seems that the US government is buckled down by the private sector's ability to consummate an ideological, philosophical win, and the USG is adhering. For example, there was a 2001 joint hearing between the Congress and the Senate, and during these hearings, one after another members of the space community came out advocating for private space and articulated an argument against the USG and against NASA, arguing that these government institutions are slow and bureaucratic.

So, it seems that the US government is buckled down by the private sector efforts to constantly make this ideological, philosophical win—because it sounds right. But this is causing a barrier that both parties need to realize. The private sector can do nothing substantial in the long-term without the US government, US military, and NASA. So, the hindrances that you asked about, come from an unwillingness to see the human aspect of this dynamic. This is how I would suggest the hindrances be looked at. It's only once we can see these hindrances and what causes them and what is fueling them, that we can really step back and ask that question of, "what can we do to ensure successful relationship between the private and government space sectors?"

Interviewer: Okay. So, it sounds like you are again highlighting the idea of cooperation and working together for mutual benefit, but in this case between the government and commercial space sectors.

E. Weeks: Yeah, but when you say it like that it reminds me of debates in international relations courses. What I'm saying is that cooperation is always preferred, but we can't ignore the effect of this realizable conflict. So, I'm not just simply hanging my hat on cooperation because sometimes you can't get people to cooperate. So, I guess what I'm saying is that cooperation can't happen until the key players realize what's real, what's not real, what's happening, etc. So, yeah, I guess it

would boil back down to letting them see that there's no need not to cooperate because the "conflict" was filled by imaginary phenomena.

I just don't like the word "cooperation" because it too often leads to certain thoughts and ideas that we should shy away from. But, ultimately, I just want to say that hindrances between private and government actors are caused by the myth that the private sector can do space better than the US government and better than NASA and better than the military, because I think that's a myth. If anything, it has been true that, historically, the US government has initiated the commercial activities and has granted the private sector laws, contracts, technology transfers, etc.

But, there is something special about our country. There is entrepreneurship. There are people who come up with ideas and they are ready to roll, and they might be more creative than the people who are contracted by government. There certainly is that. But, I think the all or nothing debates that tend to operate in the space community, needs to be looked at realistically, because I don't think it centers on anything real. The US government doesn't need to fight with the private sector. There's a history of the US government providing the private sector with whatever it's asked for, and, in my mind, why bite the hand that has fed you and that may have to protect you down the road?

Deborah Westphal

Chief Executive Officer (Toffler Associates)
17 August 2017

INTERVIEW TRANSCRIPT EXCERPT

Interviewer: Yeah. I think that's a very good point. Okay. We'll move on to the next question here. What are the biggest hindrances to a successful relationship between the private and government space sectors and how can they be minimized?

D. Westphal: I believe the biggest hindrance in a successful relationship for private and government space sector is the disconnect created by the rate of change of each. The government moves so much slower than the rate that which commercial moves; so there's a de-synchronization that is happening. Commercial can turn from order to design to manufacture a satellite in 18 months. The government can't do that, the government will take 8-10 years.

The risk the government is willing take as part of a commercial relationship is very, very different than that risk commercial entities take. The government demands a lot of redundancy, a lot of testing, a lot of checkouts, a lot of oversight — commercial entities don't. Commercial manufacturing of satellite is just as robust as the government, but there's so much more oversight the government puts on their manufacturing. The government still demands the oversight. They like the redundancy. They tend to need lots of meetings and reviews, so that's an issue with trying to buy commercial.

The funding cycle also is an issue. When commercial gets an order, the check tends to be in the mail, so to speak. Government has complicated planning and budgeting processes and sometimes the money is there and sometimes it is not there. Program managers think they have the money, then the money is being taken away. So this action just creates time delays. Again, it's a de-synchronization of time and focus. I think for me… and this is my opinion, of course, I think the government needs to realize that they don't necessarily lead space anymore — there is commodity space capability and they probably should just get out of that business and just buy

services. The government can refocus their efforts on what commercial will not do, which is the protection of space and preparation for warfare in space.

Interviewer: Okay. Two follow-up questions. To begin, if you could put on your government hat for a second, what is the best way to start to act on those observations you mentioned? Is it existential systemic overhaul or the specific programs or mechanisms that could be introduced, or organizational reform? What is the best way to address those? Secondly, if you could put on your commercial hat for a second, is there anything the commercial sector could be doing better on their end to facilitate that relationship?

D. Westphal: This has been studied so many times. If you guys don't already have it, you should probably get the classified report the national academies call National Space Security and Protection. I was on that panel and we discussed these two questions in depth. The first thing to consider is who inside government owns space? Who is ultimately responsible? Inside DOD, there is Air Force Space Command and STRATCOM, there is also a little bit of space in the Navy. There is also the Intelligence Community that has major space efforts, such as NRO, with NSA and CIA having a voice. Authority is segmented. It is hard to tell who's on first. I hope you have or are going to be speaking with the Air Force Space Command commander about his frustrations of what he is having to deal with... He can't make decisions that are right for the Air Force space – he can't even get a study on a new acquisition out the door in two or three years, which is much too slow.

First, it's the structure inside. Who is really responsible and who is accountable. We need to get rid of all truly unnecessary layers of bureaucracy that they can say no. Second is the acquisition process. The acquisition process is a no risk, heavily oversight, heavily burdened, heavily expensive, time-consuming process that does not necessarily ensure the best system at the best price for the government. Over the last few decades, the acquisition process may be doing the government more harm than protecting it. Ultimately it gets down to lack of leadership, lack of structure, and the lack of ability to acquire quickly.

Then the third biggest hindrance is financial or budgeting. If you want to go buy a new car, you would buy the new vehicle and you would pay it off in those monthly payments over the course of the four or five, six years. Once you made the decision to buy, you would have the money to pay it off.

Inside the government, the process tells you that the money is there and then next year you may not have the money. Using the car analogy, you may have to renegotiate with the car company and say, "I know I was paying you $400 a month. But can I give you $100 a month?" The car company says, "Okay. Fine. We're going to take three tires off, I guess." It's ridiculous. Inside the government as budget fluctuates, so does requirements. Requirements creep as time goes by to keep up with demand and changing threat. It is a cycle that is almost impossible to get out of.

Interviewer: I think that's very interesting what you said. If I could just summarize, you mentioned the organizational structure, who's in charge, acquisition and then finally the financial cycle you mentioned. But more importantly, I think you touched on the major obstacle is just getting through the red tape to fix any of those changes. Right? So, we may have solutions to those problems, but to get them off ground is perhaps the biggest obstacle. Would you agree with that?

D. Westphal: Yes, it becomes something that is... I would hate to say but it's almost insolvable at this point. On a positive note, I've seen incredible leaders inside the government who have dedicated their life; they know this area, the problems, the threat, and they understand the urgency. They are trying to change the situation within. You see such frustration that you wonder if it can ever be solved. Thank goodness commercial is doing what they're doing... I believe the government shouldn't try to manage commercial. I believe the government should just let commercial do what it needs to be doing because then there's a hope for new capability for the government to have access to.

Of course there is some unique capability the government needs, that does and will always do, such as nuclear hardened comms. Commercial is not necessarily going to do that, at least not anytime in the foreseeable future. The government needs to worry about that. Those types of capabilities are also much more targeted. The government also needs to worry about space warfare – the space control mission.

Interviewer: Okay. Is there anything the commercial sector could do any better? We've often encountered the sentiment that government needs to get out of the way. But from the other side, if there's maybe a specific regulation that wasn't in place or just something the commercial sector needs to be more aware of?

D. Westphal: More aware of... for what?

Interviewer: The relationship between the government and the commercial industry.

D. Westphal: Why would commercial want to work with the government? You're assuming that the commercial would want to work with the government. Why would they? If they're making money and they're doing what they were created to do, why would they want to work with the government?

Interviewer: Right. I was just saying that the game is the government's to lose and the commercial's to win. Correct?

D. Westphal: I think commercial would say, especially on the operational side, you don't need to try to dictate to us what we are already better at doing — do what only you can do. "Get space surveillance up and running, get the ability to protect our space assets, get the ability to just even know what we've got in space, work the space debris problem." I believe they would say "worry about the truly military side of space versus managing us building space commodities." Maybe I'm not understanding the question you're asking. What could commercial space businesses do better? Run their business better and ensure they stay in business by delivering quality on today's systems and looking forward into the future for what is needed. But if you're talking around security and protection, I believe commercial space would say, "make space a safe place for us. Work the policies, work the partnerships with the other governments, get some of these treaty signs, build security and protection systems, make sure that the Chinese and the Russians are following suit to keep space a safe place that is safe for everybody to be in, work on that."

Interviewer: But you're right, there is a ton of capabilities. I don't think it's not technology. It's really around what I heard, what I've learned, is it's structural and it's acquisition and it's funding that's getting in our way here of making really great progress.

D. Westphal: I would caveat that there's been a lot done in the last 12 to 18 months to address the structure and to give authorization and some clarity. It's not like we're not doing anything. I just worry about how fast are we trying to attack the problem. We are way too slow and it is putting us behind.