

**NASA JOHNSON SPACE CENTER ORAL HISTORY PROJECT  
COMMERCIAL CREW & CARGO PROGRAM OFFICE  
ORAL HISTORY TRANSCRIPT**

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INTERVIEWED BY REBECCA WRIGHT  
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WRIGHT: Today is October 31, 2012. This oral history interview is being conducted with Alan Lindenmoyer at the NASA Johnson Space Center in Houston, Texas for the Commercial Crew & Cargo Program Office History Project. Interviewer is Rebecca Wright, assisted by Rebecca Hackler. Also attending today is Dennis [A.] Stone. We'd like to begin today with you providing an overview of your program office and your involvement with COTS [Commercial Orbital Transportation Services].

LINDENMOYER: I have a number of [printed] references here. One is the White Paper explaining the COTS model for NASA public-private partnerships, something I wrote a couple years ago that is a good overview. It has a bit of background and some specifics in there about unique features of the COTS model. I also have some cost information that I have permission from SpaceX [Space Exploration Technologies Corp.] to share. I'd like to share that at the end, because I think that's important. Cost is a big element of this whole program.

So let's start. I think we should take this back to 2004. President [George W.] Bush gave us what was called the Vision for Space Exploration. That was at the beginning of 2004 by my memory [January 14, 2004]. That Vision gave NASA a very clear and focused direction on what to do over the next several years. It was published as the Vision for Space Exploration and then

it became known as the U.S. Space Exploration Policy, so when I talk about space exploration policy, I'm referring to the Vision that the Bush administration gave NASA in 2004.

In that Vision, it called for NASA to begin a very focused effort of exploring beyond Earth orbit—human exploration beyond low-Earth orbit. We were going to take humans back to the Moon as the first stop in exploration. To do that, we were going to build a brand new space transportation system: the Ares rocket, the Orion capsule. That was going to be done in two phases, Ares I rocket for the initial low-Earth orbit missions, and then an Ares V for the longer missions.

We had a brand new bold Vision of taking humans once again back to the Moon and beyond. To do that though, since we had limited resources, it also called upon the retiring of the Space Shuttle. That was to be done in 2010. This was 2004, so the Vision was to complete the assembly of the International Space Station [ISS], which was really the primary purpose of the Space Shuttle, then as soon as that was done, retire the Space Shuttle and replace it with the new vehicles.

That posed a dilemma for NASA because in our Intergovernmental Agreements with the International Partners in the Space Station Program, we had obligations to resupply the Space Station throughout the service life of the Space Station with both cargo and crew. We were planning to use the Space Shuttle to meet those obligations, but Space Station was designed to go on much longer than 2010.

So we had a dilemma. We had these obligations to resupply the Station, and yet we were to retire the Shuttle in 2010, and there was a conjecture that the new vehicles would not come online soon enough to fill in that gap. Although the initial plan was that we would have the Ares

I vehicle and a simplified version of Orion that could meet our needs by providing cargo and crew services to the Station, the question was how long would it take to do it?

If I remember correctly, I think there was just a couple-year gap between 2010 and '14 [planned first Orion flight]. In our initial strategy briefings we talked about the gap there between the NASA capability and the retirement of the Shuttle. That was really important. NASA had obligations and we had a primary capability to meet those obligations with the new spacecraft and launch vehicles that were coming online.

That happened in 2004, and that was the situation. NASA began the formation of both the Constellation Program [to execute the Vision for Space Exploration] and our program. Now in April of 2005, Mike [Michael D.] Griffin came on board as the new NASA Administrator. Mike had some very strong opinions on providing opportunities for U.S. commercial space industry. He also had very strong opinions on the new Constellation Program, and they were both very important to him.

Mike started speaking about providing opportunities for the U.S. commercial space industry, he started speaking about it right away in April. We had heard in the Space Station Program that there were a number of companies that were interested in providing services to the Space Station, new transportation capabilities. There had been previous efforts to do that, but nothing really took off, and nothing really had a lot of traction to really get going.

At the time I was working for Bill [William H.] Gerstenmaier in the Space Station Program. Then Mike [Michael T.] Suffredini took over because Bill was promoted to the Associate Administrator for the Space Operations [Mission Directorate] right around that time in August 2005. Mike took over as Program Manager and I was working for Mike.

Both Gerst and Mike asked me to figure out what's going on in the commercial space area, what are these entrepreneurs, what are these—venture capitalists is the way it was put—trying to do. Both Suff and Gerst knew that Mike Griffin was very interested in this. Mike wanted to put up a very significant investment in these companies, so he allocated \$500 million to invest in these new capabilities that were potentially out there with both emerging and established space companies.

We knew Mike was willing to make an investment, we believed that there were capabilities out there within the grasp of private industry that could meet our needs. Then I was asked to put that together into a program and a strategy of how we would make those investments, how would we go about doing that. In the summer of 2005 we started talking about that.

STONE: Wasn't there a false start at [NASA] Kennedy Space Center [Florida] put together before that?

LINDENMOYER: Yes, there was previous effort at Kennedy [ISS Commercial Cargo Services]. That was directly under the Space Station Program. I believe they issued an RFI, Request For Information, and they assimilated that into what was called a pre-ASM, a pre-Acquisition Strategy Meeting. That was briefed up at [NASA] Headquarters [Washington, DC]. At that time they talked about issues. There were a lot of issues associated with moving forward. From what I could tell and what I read in that pre-ASM, there was no clear strategy on how to proceed.

STONE: They had an industry day at the [JSC] Gilruth [Center] if I recall.

LINDENMOYER: Yes, I think they did. They had an industry day, but there was no real strategy on how to proceed. I just recall there were issues that they had to deal with. That was briefed probably earlier that year, and it didn't go anywhere. It just languished. From what I could tell it didn't have any momentum.

So at this point when they asked me to do it, I was to pick it up and take it forward to the next step. What also happened is I transferred out of the Space Station Program into the Exploration Systems Mission Directorate [ESMD]. This was the directorate responsible for Constellation and human exploration, leaving Gerstenmaier to run the Space Shuttle and the Space Station Program primarily. Those were the two big operational programs, and the new directorate was going to do the development of the new vehicles.

It was decided that this effort with the commercial companies would be managed under Exploration Systems. Scott [J. "Doc"] Horowitz was appointed as the Associate Administrator for ESMD in September 2005. At the same time Mike [Michael L.] Coats came on board as the new [JSC] Center Director in November 2005. We had the three of us starting together around the end of the summer, fall of 2005, Mike Coats, Scott Horowitz, and myself. As well as Jeff [Jeffrey M.] Hanley, who was the Program Manager for Constellation. All of us were getting grounded and standing up our new programs and taking on our new roles right at the end of 2005.

I did that, and that certainly became my priority immediately. I put together a small team of what we typically call a PPT, Procurement Planning Team. That team included an adviser from Headquarters, Marc [G.] Timm. They had been following this activity up at Headquarters, and this has been going on in Headquarters for a while too, this thinking about partnering with

commercial companies. Marc Timm was involved with that, and there was a contracting officer named James [W.] Bailey. He was working up there doing a rotation at Headquarters.

Brant Sponberg was the Program Executive for this work. He was doing other things, prizes and Centennial [Challenge]. He had prize money he was managing, and we're looking at this. Brant Sponberg, Marc Timm, and James Bailey were the folks at Headquarters that had been tracking this for a while, so I came to know them. Actually it was Marc Timm and James Bailey that came down for our first team meeting.

Of course legal and procurement. Very important, legal, the lawyers. Amy [V.] Xenofos was there as our lawyer giving guidance and advice. Procurement was James Bailey. Even though he didn't work for JSC he came down.

STONE: I remember Jon [Jonathan A.] Arena was the lead.

LINDENMOYER: Jon wasn't at the time. He was not involved in the initial planning, it was just a small group. Were you with us, Dennis, during the planning sessions, or did I bring you in after? You don't remember going to Building 226?

STONE: Don't remember, maybe not.

LINDENMOYER: The main point is I had people at Headquarters, legal, procurement, and myself. We started talking about how we can formulate this program, what are the fundamentals, what are our objectives, what are we trying to do. We put together an outline of what we believed would be a reasonable approach for investing this \$500 million over five years. Typically we

have a five-year window when you talk about a new program. That's as far as out as we project our budget and submit through the Office of Management and Budget. That's how we start our program planning, so it was \$500 million over five years.

One of the first things we decided was there's a lot of policy written about providing opportunities for commercial industry. You can pick up the [National Aeronautics and] Space Act [of 1958] itself which chartered NASA. It was amended in the '80s and it talks about providing opportunities for commercial companies so that it can provide economic growth for the U.S. and all the advantages of dealing with private companies. That became part of the NASA Act itself.

Then we were seeing the space policies and different documentation that really emphasized we need to be providing more opportunities for commercial space, such as the Commercial Space Act of 1998. I knew that was out there. Even in the Vision itself, the U.S. Space Exploration Policy highlighted that we needed to provide and promote commercial space industry. So it's rooted in our background, and our current policies were stating that.

There were a number of articles written and recommendations made from different panels and organizations that talked about turning over access to low-Earth orbit to commercial industry. That was a theme that came around. Reducing the cost of access to low-Earth orbit, very very critical. Reducing the cost and the barriers to access low-Earth orbit became a foundational theme. Because we believed by doing that, well, then new markets would open, and the growth of the commercial space industry would take off.

But the barriers were simply too high to enable the growth of these new markets. Even to enter into new product development and capabilities, the barriers—such as cost and infrastructure needs like launch pads, test facilities, and manufacturing—were too high for

private industry. So although there had been several attempts, nothing really was successful over all these years of having a viable and sustainable and thriving commercial space transportation industry.

I should distinguish between the commercial space industry and commercial space transportation, because the commercial space industry is very vibrant and thriving. The commercial space launch industry and the commercial communications industry have grown tremendously over the years. The commercial communications industry is a multibillion-dollar thriving industry. That's something that did take off. NASA has been buying commercial launch vehicles for a number of years now too. When we buy our rockets for our science missions, it is done through a commercial contract.

But the ability to provide transportation services—now I'm talking about the transportation with a human element—has not delivered. When we talk about transferring cargo, I'm not talking about launching satellites into space, whether it be low-Earth orbit or geosynchronous orbit or out into deep space with our science explorers. I'm talking about cargo. That means there's a supply of goods to a destination in orbit. Well, that implies for human consumption. Doesn't do any good to send cargo somewhere you can't use it. We were talking about transporting cargo and crew to low-Earth orbit, and that's the whole human element with the Space Station.

That's what we haven't seen, these transportation services. Which also could involve point-to-point transportation on Earth. We did hear a lot about that too. By developing orbital transportation services, that could even evolve to point-to-point. That is a point on the Earth and landing on another point on the Earth, either suborbital or on an orbital basis. That's what I



mean by commercial space transportation. It really is cargo and eventually crew to a destination in low-Earth orbit. That's what we were trying to promote and stimulate.

Lowering the cost of access to space is an important part of stimulating a commercial space transportation industry. Because it just hasn't happened. Mike Griffin would also talk about the first 50 years of aviation. In the first 50 years of aviation, there was tremendous growth that led to the huge aviation industry we know today. Well, there certainly wasn't that growth in the space transportation industry in these first 50 years. Mike believed that placing these very strategic investments of the government to break down some of these barriers and provide opportunities for the growth of this industry was very important.

You can read about a lot of similarities between what we're doing and what we saw in the early days of aviation with the Kelly Act [Contract Air Mail Act of 1925]. The fact that the government was a customer for airmail transportation was very important to help grow that industry. You can even take it back to the earlier days of railroads where the government played a very important role in providing incentives to enable the transcontinental railroads. I don't want to get into specifics of that, but you can see there's a common theme where government strategic planning and investment led to the success of these new industries.

That's what we were talking about, placing very strategic government investments to help achieve these goals. Low cost, transportation, and then breaking down the barriers to enable this new industry. We established those as our fundamental objectives. We wrote down these three objectives that haven't changed since 2005. I'm proud of that, because that means to me we had it right, we had the right idea.

The first thing we did was write these down because I wanted to be sure when I looked the Administrator in the eye and said this is what we're about to go do, that we were on the same

page. We said we're going to implement U.S. Space Exploration Policy with investments to stimulate the commercial space industry.

There's a couple important things there. The policy existed. We were given guidance on what to do as an Agency, investments to stimulate. I'm using this word investment very carefully, because I really do mean investment like you would invest in any financial portfolio, which is different for NASA. Sometimes we refer to our contract investments in developing new spacecraft. That's one form of the word, but I really mean literally financial investments. That's something that we were not accustomed to doing. NASA is accustomed to establishing requirements and making sure we can build spacecraft and launch vehicles to meet those requirements. We usually do that with a traditional cost-plus contract and a prime contractor.

That's what NASA traditionally does, but we were not planning to do that. We didn't want to do a traditional procurement. We certainly knew how to do it, and we certainly could write the requirements to do this, but we believed in this different approach where we would become a lead investor instead of a customer. We wanted to become a consumer of services instead of a customer for requirements. I think that's an important distinction.

We wanted to be able to go out and buy a service from commercial industry. Go to a catalog, pick it up and say I'd like to transport X amount, X pounds of cargo to the Space Station. Just like you could call up FedEx [Corporation, shipping service] and say I want to transfer my cargo from here to there. This is what we wanted to do in space.

Well, it certainly didn't exist. That's a problem. We didn't want to take the traditional approach of paying full cost, because we believed that there was a market for this capability and that NASA would not be the only customer. So right off the bat we were thinking as a lead investor, not the technical director and customer of requirements for a prime contract.

By doing that, that opened the door for NASA to use its Space Act authority. NASA is one of the few agencies in the government that has the authority to enter into an agreement with a private entity outside of the federal acquisition requirements, outside of the FAR [Federal Acquisition Regulation]. Normally when the government procures anything—any good, any service—we do it by following the Federal Acquisition Regulation.

That's the way it's done in the government, but NASA has the ability to enter into a separate agreement outside of the FAR when it is in the public interest and the best interest of NASA, when it serves a public purpose. NASA was given that [Other Transaction] Authority because we were a very unique agency back in the late '50s and early '60s when we were developing all these new capabilities. We needed flexibility in our contracts in order to move forward as quickly and efficiently as possible.

NASA has had this authority for a while and we've used it in various forms, but never in a major funded capacity. This is what we call a funded Space Act Agreement. We were now going to implement our investments with the funded Space Act Agreement. Why did we do that? Well, this was the approach we proposed because number one, the Space Act allowed us to tailor all the terms and conditions of the agreement to be as commercial-friendly as possible. We knew that for this to be successful we needed to level the playing field.

There are a lot of emerging companies out there, and there are established companies. We wanted to make sure these companies could compete on a level playing field. When you're dealing with the FAR there are a lot of requirements under the FAR that can be construed to be burdensome and difficult for emerging companies. They don't have, for example, certified cost and pricing systems. They don't have established health and safety procedures and documentation and other things that are required under the FAR.

So those companies that have done business with the government for a long time really could have an advantage under a FAR contract because they're used to doing government contracting. Newer companies were not and could be at a disadvantage, so we wanted to level the playing field. We wanted to make sure that the terms are attractive to commercial companies, so we ended up tailoring our framework of the Space Act Agreement to be as commercial friendly as possible. The use of the Space Act agreement was a very innovative approach I think in our whole program.

The second objective—we said how to put some structure around this investment. We were not interested in just becoming a grant agency. We didn't want to hand out the money and say, "Well, here you go and good luck," and hopefully we'll get something out of it. No, we wanted to put some structure around our investment. We believed the best way to do this was for the companies to demonstrate their capabilities to transport cargo, start with cargo and then crew.

Once those capabilities were demonstrated, we would assure the companies that NASA would be a very interested customer, because we had the market of the Space Station. The Space Station was a perfect market for these capabilities. It was predictable. We had a certain number of tons of cargo required a year, and we knew with the retirement of the Space Shuttle that we needed to have some way to meet these obligations. We also needed to get our crew members up there.

So we had the market, we had the need. It was clear that NASA would be a very interested customer for these services, but it had to be proven first. We were going to put up a fixed amount of investment. The \$500 million was fixed. Mike Griffin was very clear that we're not adding any more money to this agreement. This is it, this is our fixed investment. If

something emerges from it, great. If not, we're going to go down our other path of developing our own vehicles.

The other thing we had available to us was the International Partners. We knew that if a capability did not emerge, well, the Station was not going to fall out of the sky. We had Russian partners who had the ability to carry cargo and crew to the Station, and we had the Japanese [Japan Aerospace Exploration Agency] HTV [H-II Transfer Vehicle] and the European [Space Agency] ATV [Automated Transfer Vehicle] on the books under development. They didn't exist either at the time, but we believed that these were parallel paths to providing at least the cargo part to the Station. Then we had our own vehicles with the Orion and Ares.

All of that was there to provide backup if this investment didn't materialize, very very important point of our program. I don't think back in 2005, 2006 anybody would agree they were going to put all our eggs in this basket, and if it doesn't succeed, well, then we're going to not be able to support Space Station. That would not have happened. We just could not take on that much risk as a nation, and we could not have let down our International Partners by not meeting those obligations. That wouldn't have happened.

So the ingredients are starting to line up here. We had some sizable investment authority, we had the need. We had commercial providers that said they could provide this capability, and we believed they could, because this was not new technology. This wasn't like developing a new rocket motor or a new nuclear power system or something that's leading-edge. That, by the way, is what NASA should do. We focus on the hard things, the cutting-edge space technology. Once those trails are blazed, then turn it over to private industry, who should be able to operate this as a profitable business. We believed it was time to do that.

That's the American way, and that's worked out many times. Traditionally we talk about commercialization in terms of spinoff technology. NASA will develop something and then it spins off into other private and commercial uses. Okay, that's fine, and we do that all the time. But that's not what we were doing with COTS. We were doing the opposite.

We wanted to take a capability that the industry could provide and use it for our needs, so this was a little bit different variation of commercial use. Wasn't commercializing a NASA capability, but take a commercial product and use it for our needs. We knew it wasn't quite ready, but we believed that with a little bit of investment, breaking down the barriers, it could emerge and come to market.

We then established the structure of helping demonstrate the capability, with the goal of achieving safe, reliable, cost-effective access to low-Earth orbit. I talked about that at the beginning. Lower-cost access to space was a really critical key, that's what we were trying to achieve.

I say cost effective, versus low cost. We originally wrote low cost, but it's just not low cost. Space is not low cost. It takes millions and millions of dollars, tens and hundreds of millions of dollars to create a capability in space. We talk about cost effective because we knew it wouldn't do us any good if we helped develop a capability for the United States that was so much more costly than anything you could buy from the International Partners. We didn't believe that would survive very long with our overseers on the [Capitol] Hill, our Congressional authorizers and appropriators. With the very tight budget and economy, it wouldn't be practical to pay so much more for a domestic capability when you could go buy it cheaper from the internationals.

We believed there was some tolerance for that. Perhaps it would cost us a bit more to buy domestic, but the benefits would so much outweigh buying outside the United States that it would be tolerated. We didn't know what that threshold would be, how many dollars per kilograms, dollars per seat, or whatever metric you want to use. We didn't know what that threshold would be, but we knew it had to be at least cost effective. Whatever the threshold was, we wanted to make sure that it was reasonable to invest in American capability versus buying from overseas. That's how we came to that term cost effective, that was our goal.

The third objective we wrote is we wanted to create a market environment where these commercial space transportation services are available not only to the government, but to other customers. I think that's a very important ground rule. That really meant two things. We were committed to becoming a consumer of these services. We had a real market, a real need, and long term. Those are very attractive parameters to a company.

This could also be a big multibillion-dollar market industry for potential providers. We had a market, but we didn't want to be the only customer. That's important because if the government was the only customer, the price could creep up to the point where only the government could afford to buy it. That wasn't what we wanted to do. We wanted to open new markets to create this brand new space transportation industry.

It had to involve other customers, and that was for a couple reasons. One, to sustain the new industry, because NASA wouldn't sustain it forever. The other thing was to attract other private capital. Who else was going to invest in this new capability? Well, the only way they could attract other investors was if they were going to make a return on their investment by bringing a new product or service to market. That's why we added that in there. It was to be bigger than just the government, because if it was just the government we could certainly issue a

contract, develop capability, and pay the cost for whatever it is that was developed. Again, that's more the traditional way, but that's not what we tried to do.

So the model we established is very much the U.S. capitalism model. Starts with a value proposition. What is it that these companies are proposing of value to us as a consumer? What is it that is unique? That's how a new product comes to market. It's either something new that has value to us or something better that opens new markets, or something that is so much better that it can capture a share of an existing market. That's the value proposition. If it is not sound, well, then those things are not going to happen. But if it is and it has potential, then the next step is to attract the capital necessary to bring that product to market through either corporate investment or private investment. The first one that brings that product to market is the one that is successful. That's the American way, that's the way it works.

That's the model we were using here. It had all those ingredients. It had to have a good value proposition, had to be able to attract financing. It had to come to market and be sold for a profit. For example, SpaceX now has multiple international, commercial, and other government customers on contracts for launch services. That's what we were doing, and this was new for NASA. How do we become an investor?

Our team put together this basic structure of what we called COTS. This is where we came to the name Commercial Orbital Transportation Services. It's a play on words, because COTS normally means "commercial off-the-shelf." Commercial off-the-shelf software is how it started. Anything commercial off-the-shelf is something you can go to a catalog or a store and buy. By the way, that is the easiest form of contracting in the government. You go to the FAR, there's a definition called commercial item. The easiest form of acquiring something in the government is a COTS item, off the shelf. It is a much more streamlined procurement process.



We liked that idea of easy commercial acquisition. When you're buying something it has to be under a contract, so we want to be able to go to Part 12 [Acquisition of Commercial Items] of the FAR and say I want this commercial service. That's what we wanted. It just didn't exist, so we couldn't do it. That's where we made this play on words. We did want a COTS item, so it was a convenient acronym for what we were looking for. Commercial Orbital Transportation Services fit in very well.

In the outline of the service that we would eventually like to buy—by the way, I need to make an important point. The use of the Space Act Agreement had to be very clear. We're not buying anything, there was no purchase of goods or service. Because if there were, there was no way we could use our Space Act authority to do that. So that's when we evolved to a two-phase process. The first phase was to be a demonstration phase using the model we're going to establish as an investor. Then, once demonstrated, we wanted to be able to enter Phase 2, which was buy the service under the FAR commercial contract. That was the model. Phase 1, Phase 2. Now we're focusing on Phase 1.

Phase 2 was a promise, wasn't a guarantee—which became problematic by the way. If we could have guaranteed a contract, that would have been very helpful to companies trying to raise money. But it's next to impossible to obligate the government to buy something years from now when we don't have the authorization to do it, the appropriations from the Congress to do it, and we cannot obligate future Congresses to any obligations like that. It is very hard, probably next to impossible to obligate the government for something so far out. But we did have a promise, and we had a commitment. We demonstrated that this is something we wanted to do, that we're serious about. We certainly had the market, Station was there.

So two phases. First was a demonstration phase. It was to be done in a partnership arrangement. We did not write a bunch of requirements. Remember, we were trying to make this as commercial friendly as possible. We wanted to encourage innovation. We wanted companies to be able to freely innovate, to take maximum advantage of whatever concept they had, whatever strengths they had in their company that could bring this capability to market with the minimum constraints possible.

We did not tell the companies how big the vehicle needed to be, how much cargo it needed to carry, where it could be launched, things like that. We did not specify those things. But we needed to give them some guidance, because there are constraints. If NASA was to become a customer for the Space Station, well, there are certain constraints. We couldn't have a vehicle launch every day, we couldn't tolerate that type of traffic. Every couple years wasn't going to work either, so we gave them some guidance like, you can expect anywhere from two to eight launches a year. That helped size their systems. We needed to provide that level of initial condition, boundary conditions for the company. We told them we were interested in approximately 58,000 kilograms of cargo a year, very basic capabilities.

Then we said you can decompose this into four basic capabilities, A through D. Capability A is external cargo to the Station. External means all the equipment on the truss. The pumps, batteries, radiators, what we call ORUs, or Orbital Replaceable Units, external of the pressurized volume on the truss. The Station is designed to be serviceable, so that's a basic capability.

We also need the ability to transport cargo internal to the Station, pressurized cargo, Capability B. That's the food, the equipment, the clothing, the science, the payloads. Everything that's handled inside the pressurized module, the habitable environment, is another

need. We also had a need for some of that equipment that's inside the Station to come back. Not all of it, but some of it has to come back. That's how you support the Station as a national laboratory research platform. Scientists are very very interested in getting equipment payloads back, as well as other things like malfunctioning equipment that you want to investigate on the ground. The ability to carry some of that back, which we called Capability C, the return, was important. Then D is the crew transportation.

We decomposed our needs into four basic capabilities, and any combination, or any one that could emerge from this effort would be very very useful to us. We said industry could bid on any one or any combination of these four capabilities. It was to be an end-to-end service, NASA was not going to be in the middle of this. The model was NASA would hand over our crew or cargo, they would handle all the ground transportation, all the ground handling, integration into the launch vehicle, the launch service, the ability to rendezvous and dock or berth with the Space Station. And then if they proposed to take it home, well, then they would handle the orbit maneuvers and the landing and recovery and return operations. All of that was to be the commercial partner's responsibility.

So NASA said we'll hand it over, and hopefully we'll get our payloads back similar to the form that we delivered it. The same for our crew. We didn't say you had to launch our crew from the Kennedy Space Center. In fact the Announcement said you'll pick up the crew from the Johnson Space Center. This is their home, take them to Station and bring them back. That's how flexible we were.

The only exception to the rule and the requirements is in regard to the Space Station interfaces. I'm sure you can imagine, if you're going to visit this multibillion-dollar facility, then you have to meet its safety requirements and interface requirements. We weren't planning to

redesign the Space Station to accommodate a new vehicle. There were certain docking ports and berthing ports on the vehicle that we said are available, and if you enter this control zone, then it is to meet the requirements of Space Station safety and interfaces.

That became a firm requirement if the company decided to demonstrate the capability of the Space Station. This became an important debate, an important point with the legal community. Could we require the companies to do this demonstration phase to the International Space Station? That was a subject that was debated intensely because remember, we always referred back to those three objectives. What were we trying to do? Well, you'll notice the objectives don't talk about buying a service for the Station. We're trying to develop a new industry, new capability for America. It may or may not have involved the Space Station. We were hopeful that companies would be compatible with the Station so we could use it, but it may not have been.

We didn't require the Space Station in the demonstration, but we said we would offer it as a test bed. If the companies elected to complete the demonstration to the Space Station, well, then they had to meet these requirements. But they were not requirements in and of themselves. In other words, it didn't say in this Announcement, "You must go to the Station and meet its requirements." All we said is if that's where you want to do your demonstration—and we encourage that, because that's where our interest lies—then you've got to meet its requirements. That's what we were firm about, to follow the same level of standards and integration and safety reviews as any other vehicle that visits the Space Station.

That's the way we worked it out. The legal and procurement community were okay with that. It wasn't a requirement, but if they chose to do it, then we would help them do it and facilitate that. That became a very important part of NASA's role, facilitating the integration of

the vehicles to the Space Station. How to walk them through that process became a very important role for us at NASA.

So we then transcribed this structured approach to our investment strategy into the Announcement for Proposals. We talked about goals and objectives. That's what we were trying to have these companies achieve, not requirements. We listed these capabilities as goals and objectives, "This is the type of thing we would like to see as an outcome of the service." So we had to learn to evaluate these proposals based on goals and objectives and not firm requirements. That was interesting—but now that moves into the competition phase.

I think in terms of the initial conditions, the context and the strategy that we put together, that's what we were about. We took this strategy up to Headquarters and proposed it to the Administrator and his senior staff, including the General Counsel, the [Assistant Administrator] of Procurement, the Associate Administrator Scott Horowitz, and the Chief Engineer's Office. The primary offices were all involved. We presented the strategy and it was agreed to.

At that point then we put together our Participant Evaluation Panel, which is analogous to a Source Evaluation Board. If this were a contract, we would establish a Source Evaluation Board. But since it's not a contract, we established a Participant Evaluation Panel.

There are a lot of sensitivities to the terms. We are so accustomed to contracts. There are very very structured processes and terminology, so we were advised to stay away from any of the contractual terms, because it was not to be a contract. That was really important. Remember, this was the first time that we were planning to invest hundreds of millions of dollars outside of a contract, so it had to follow very strict guidelines to be sure it was within the authority of our Space Act Agreement. I commend the legal community highly for keeping us in line.

We worked very closely with the legal office and procurement to make this happen. They did a super job and really helped make this successful. I can't emphasize enough how important the upfront planning was, because this was all new. NASA has never done this before. It's a new way of doing business with the private sector, where stepping through all this in detail was really important. We spent many months doing that and it paid off big time.

The environment we were working in that led up to the actual release of the [COTS] Announcement—just the title of this was one of those sensitivities. Normally we call them RFPs, Requests for Proposals. That was not going to work because it sounded too much like a contract. We said, "Well, what do we call this?" Bill [William P.] McNally [NASA Assistant Administrator for Procurement] said, "It's an announcement." Well, that's what it's called, an Announcement. That's all we could say. So I coined the term Announcement for Proposals, an AFP. Because we are asking for proposals, and it is a solicitation, but it was not for a contract. The RFP was so synonymous with contract that we just called it Announcement.

In the Announcement, this is where you'll find the outline of these objectives of the program, the schedule, the anticipated budget that we talked about, the \$500 million. We called that "Anticipated [Funding]" because we didn't have it yet. It has a phasing of the \$500 million we expected over the five years, and it had the basic information of these four capabilities I laid out. Just a very small number of pages.

We talked about some special terms of the Agreement that we had to tailor to be commercial friendly. What was different about the competition? Since this was a new way of doing business as the lead investor, we are not good at that. NASA does not know how to evaluate business plans very well, and this is a new business that we were trying to help emerge.

We know how to do technical work, we know how to evaluate technical proposals, and we know how to evaluate cost. We're very good about breaking down the elements of a development into its basis of estimates. We know how to do that. We've been modelers of that, we've been analyzers. But how to evaluate financial risk, investment risk, is something new for us, so we hired a venture capital business consultant who ended up being so useful to us, I can't even say enough good things about him. His name was Alan Marty.

We did an open competition for a consultant to help us, and it ended up he was selected. This is a guy who worked with [NASA] Ames Research Center [Moffett Field, California]. Ames has a lot of experience dealing with Silicon Valley [high-technology region around San Francisco, California]-type ventures. He knew about NASA, he was an entrepreneur himself, and he was also an executive from a large computer company, Hewlett-Packard [Company]. So he certainly had a great deal of experience in private industry and the financial and business world. He was an entrepreneur, and he was familiar with NASA, so it was a really really good fit.

Alan taught us how to ask for and evaluate a business plan. That was something really important to us. In this plan you will see we asked companies basic information, their value proposition. What is it they're proposing to do? How did they propose to demonstrate it, when were they going to be operational? He asked us to look for all the financials, five years of financial pro forma. That would be income statements, sources of cash, sources of financing, projected look ahead, expense statements and cash flow predictions. What are their markets, what are they trying to develop, what is their management structure, who is the management team? According to Alan this is a very traditional business plan. This is what investors do. They evaluate them all the time.

We had to learn to write one and then learn how to evaluate it. That was really really important to us. That became a big element of the proposal, the technical plan and the cost, so that's what we asked for. This whole idea of becoming a lead investor and how to evaluate that was really important, and we did a good job of that with our consultant.

We had our team together off-site across the street from JSC. There used to be a set of office buildings that NASA leased for extra space when we needed it. It turned out we didn't have the space on site, so we were there in an offsite facility dedicated to our team. We brought in about 30 people to formulate this Announcement and then evaluate the proposals.

What was different about this competition? We talked about the Space Act versus the FAR, and we talked about the business plan, using financial criteria very similar to private investment models. This is what investors do all the time. Read plans, get briefings. What gets your attention, how do you adjust and make considerations for what you're reading in these plans, and what is really important? We talked about a short list of goals and objectives, as opposed to detailed requirements. They didn't have to meet all the goals, they didn't have to meet all the capabilities. But for whatever it is they proposed, how well did they meet the goals? If they didn't, what was the reason for not meeting them?

Then there was another very important point. We expected and encouraged companies to invest and share the development cost. NASA was not going to pay the full cost like we normally do. We expected the companies to have skin in the game. They're going to be a partner. We're equal partners here. We had a very strong investment and a lot of technical expertise, they had the innovation and flexibility and agility to develop what we expected to be a very cost-effective system.



Having skin in the game, we thought, was very important. They're at risk, we're putting our capital at risk. We wanted this to be a joint partnership. That's something that's not traditionally done, but again we weren't stretching the limits of technology here. We were expecting that these companies were going to put together existing technology in a new and cost-effective way. We expected it to succeed, but that's what we were looking for.

By having these companies share the cost, it enabled us to think in terms of a portfolio of an investment, multiple companies. The less we had to apply to any particular company means the more we had to spread around. We believed it was important to spread it around because we didn't know if companies would bid on any one of these capabilities or all four. We didn't know, but we had a need for all four. Maybe only one company would do external and maybe one would do crew, and we wouldn't have the internal.

So we needed a portfolio of companies for several reasons. Number one to spread the diversity of capabilities, make sure we had all of that in our portfolio, number two as a backup. What we learned from our VC [venture capitalist] consultant is maybe one out of ten startup companies survive when there's a new product coming to market. How do you mitigate that risk? You mitigate it by investing in a number of companies, because some of them aren't going to make it. That was almost a given. We didn't believe that, but he told us that's what would happen.

So we wanted to invest in multiple companies for several reasons. Help mitigate the risk of something that doesn't materialize, help to broaden our portfolio of capabilities. It also helped stimulate the industry. Because maybe if they didn't succeed for NASA, we got them started enough that they could go finish and they'd have other customers. They'd start up a company for other uses, just maybe.

There was a lot of goodness about sharing the cost, not the least of which was being assured that this company was all in to this venture, meaning their success was on the line. If they didn't succeed, well, then they were going to face a loss just like we would, and their other investors would too. So there was a very strong incentive to have a good plan, good financing, a good schedule, and a solid engineering approach. This idea of sharing cost allowed us to make multiple awards.

We didn't define how much we were going to invest. It was completely up to us, so they had to guess. They had to be very smart, they had to anticipate what NASA would think. We told them we expected multiple awards, but we didn't say how many, so they had to figure out how much is really available. Some companies bid the full amount, and obviously they didn't get it. We were very clear that was not going to work, so they didn't rate very well. Some bid very little, saying that they were going to cover all the costs, and there were issues with that too. There are holes in all of this. Again, this is all part of how you evaluate all elements of the business plan. We had to figure that out.

In the business plan we also asked for the strengths and history of the management team, the person. Who's on the team, by name? What was their history, instead of company past performance. See, in the FAR you're required to look at company past performance. Well, guess what, some of these companies didn't have a history. That wouldn't have been fair, because the best you can get on a FAR competition is a neutral if you had no history. That's not leveling the playing field, so to level the field we said we're not going to look at past performance, but we did want to know the history of their successes and failures of the management team. That was a different approach to the competition.

I'm touching now on some of the unique things in the Announcement and the competition. When we get a contract proposal, we typically score them on a numerical rating for mission suitability. How well does their proposal meet our requirements? You can compare one to the other. You can just start scoring how well they met our requirements, because they all had the same set of requirements. Well, these didn't. The companies bid on different capabilities, so we didn't score it; we based our evaluations on color ratings, levels of confidence.

How confident were we that these companies could do what they said they were going to do? We gave them three ratings: technical, business, and cost levels of confidence. White being moderate, green high confidence, blue was very high confidence, yellow was low confidence, and red was very low. That was our rating scale as we were evaluating everything. What was increasing or decreasing our confidence levels?

Then we wrote strengths and weaknesses. Some things brought them up, some things brought them down. In the end we rated them in terms of our level of confidence that they could technically do what they said, that their business plan was viable, and that they could do it for the cost they proposed and the ability to raise the financing necessary to complete the demo [demonstration]. Level of confidence rating was something new for us. We followed a rigorous and strict evaluation, very similar to a source board that you'd find on any other contract.

That was unique in the planning. In the Space Act itself—we put a draft together. Putting this draft Space Act Agreement together was a great deal of work. There were a lot of new things in here that you won't find in a contract. Some of the features that we felt were very important were fixed price payments. That's how we were going to incrementally make payments to the partner. We asked the company to propose a series of milestones throughout the demonstration period.

We would evaluate the success of whether or not they met those milestones incrementally along the way. We said do at least one every quarter. We didn't want to give them this big tranche all up front, or weight it all to the end. We wanted to have insight into incremental progress, so milestone payments were fixed. They were to be paid after the company met the milestone, not before. Therefore they were facing risk. They had to raise the money to make it from one milestone to the next. If they succeeded, NASA would make payment and keep them going.

If they did not succeed, well, then that would be a criterion for termination. But that was one of the only ways to terminate the agreement, if they did not perform to the agreement. We did not have a termination for convenience clause in the Space Act. In most NASA contracts, there is a clause stating we can terminate for whatever reason we want. There could be lots of reasons, but we did not put that in the Space Act Agreement.

Therefore when we signed this agreement, we were committed 100 percent to partnering with this company. We were going to stick with them. The only other way they could be terminated was for reasons outside of NASA's control. This is the federal government, and we get annual appropriations. If for whatever reason we didn't get an appropriation, then of course we couldn't make the payments because we wouldn't have the funding. But that was not going to be NASA's decision. That was going to be outside of our control.

Companies don't like that. Companies do not like dealing with the government in terms of financial obligations for future years, because you don't know what's going to happen. That was a risk for them, but we mitigated that by saying we're not going to terminate for any other reason. We can terminate per mutual agreement. If we both decided to walk away that's fine, and for nonperformance we can unilaterally terminate. Anything else was just beyond control.

And they couldn't walk away unilaterally either by the way. No, they were committing the company to this.

The other thing very innovative is we said we would give companies rights to all their intellectual property and personal property. We were not going to take rights to their property. That's not typically done. Under a government contract we, by law, have rights to the intellectual property and other property. That's the way it is. Well, companies were not going to be very interested if we could potentially give everything they did to somebody else. That's not very commercial. So we said if you perform, we will refrain from using those rights. They are yours, and you could go market it and sell. You do whatever you can do to make money and profit on this. That's perfectly fine. We had to tailor that into this agreement, and they were very happy about that.

Another thing is we said this would be FAA [Federal Aviation Administration]-licensed. Most all NASA launches are typically certified by NASA. If there's anything that we launch—our science, our payloads—we have our own safety organization and launch certification down at the [NASA] Cape [Canaveral launch site, Florida] that do that for us.

But this was not to be a NASA launch. Doesn't do us any good being in the middle of that if they're going to try to sell this service to somebody else. NASA is not going to be there to certify, so we had to turn it over to the FAA. They are set up under the Commercial Space Launch [Amendments] Act [of 2004] to do that, so we declared this is a non-NASA mission. They would use the FAA and its provisions to license the launch. That was out there for NASA, we don't usually do that.

Those were some of the features in the COTS Announcement that were specifically tailored to be commercial friendly. Those were some examples of the unique features of

competition. The Space Act itself was so commercial friendly, companies loved this. They knew this was not business as usual. They knew this was going to be a different way of doing business, and were very supportive of it and complimentary of NASA for developing this new way of investing. That's what we did, that's how we structured it. That was the basis of our commercial partnerships.

We should talk about the proposals we received, how we ended up with the company portfolio, and then how would we execute the program. One of the two companies we ended up doing business with was SpaceX, who recently completed their Agreement, with a perfect ending. Then we have Orbital [Sciences Corporation], who's about to complete their demonstration.

The other part of COTS is how we executed our program in a very very streamlined fashion. For example, we allocated only 3 percent of our entire \$500 million budget for program operations. That's \$15 million out of \$500 million. The rest, all \$485 million, went to the commercial partners. 3 percent program overhead never been done. It's typically 10 percent to 15 percent or more for a large program with this amount of money.

So we said we're going to do this with a very small team, which we did. We typically had ten people in the program office, and then we had another group of experts that we could reach back when needed. We funded six to ten a year. That's how we did it, a very small group. This allowed efficiencies in program management that were never achieved before.

We did have one of the companies that didn't make it, RpK, so we should discuss the circumstances around that. That's probably enough for today, do you think?

WRIGHT: I think so, it's a good stopping spot.

[End of interview]