

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

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INTERVIEWED BY REBECCA HACKLER
HOUSTON, TEXAS – 26 NOVEMBER 2012

HACKLER: Today is November 26, 2012. This oral history interview is being conducted with Dennis Stone at the NASA Johnson Space Center in Houston, Texas, for the Commercial Crew & Cargo Program Office History Project. Interviewer is Rebecca Hackler, assisted by Rebecca Wright.

We'd like to begin today by asking you about your early involvement with the COTS [Commercial Orbital Transportation Systems] program. When we talked to Alan [J.] Lindenmoyer, he mentioned that he knew that you had an interest in commercial spaceflight and developing those opportunities. Could you talk about how you became interested in that area, and how you used your knowledge and experience in forming this new program?

STONE: I've been with NASA for 27 years, but even before I joined NASA I was following commercial spaceflight. It's always been a great interest of mine, and I really think it's the future. Following the frontier model, as we moved to the West and the explorers explored, the settlers followed. Pretty soon Fort Pitt turned into Pittsburgh [Pennsylvania] and so on. That's the model of our country, of our society. Space is that next frontier, and I've always believed that as NASA moved further and further out there, the rest of society should follow. The beginning of that would be some small commercial ventures that would work with NASA, and eventually spin off on their own and blossom.

Low-Earth orbit is that first place. One might argue the frontier is way beyond that; we've been going up and down for 50 years. I've always believed that there are markets in low-Earth orbit—whether in microgravity or tourism or all these other things—that NASA could stimulate for the good of the nation, and also NASA could use.

So when I heard that NASA might be buying services for cargo and crew to the [International] Space Station, I found out that Alan was going to lead that effort and went to talk to him. I knew him, but he never knew my commercial space background. I shared some of that with him. He said, “We have a business committee. You might be good to chair the business committee.” We agreed that would make sense.

Through the business committee leadership role, I was to apply my understanding of the commercial space industry, from the startups to the more experienced players, and the potential markets. All of these came into play when we did our two cycles of investment on COTS. But I knew there was a lot we didn't know, and that's why we brought on a venture capitalist.

HACKLER: When you talk about the business committee, do you mean on the Participant Evaluation Panel?

STONE: Yes.

HACKLER: Can you talk a little bit more about how the decision to work with the venture capitalist came about? What was your role in the [December 2005] Request for Proposal [RFP] for Venture Capitalist [Consulting] Services?

STONE: In that very first conversation with Alan, I said, “So we’re investing, right?”

He said, “Yes.”

I said, “Well, we need to think like an investor. What do you think about bringing on a venture capitalist?”

He thought about it for a few seconds and said, “Sure.” That was it. I then found Alan Marty, who we brought in on a temporary basis. He had an existing contract through the NASA Ames Research Center [Moffett Field, California]. Then when we needed more support we did a full-up competition and he won.

The idea was we are the government. We don’t know much about investing, and here we have to invest. This was new for NASA, so a VC [venture capitalist] would instill an investor mindset across the team. We wanted someone who not only could help us think like an investor, but also help us through the process. Alan Lindenmoyer was able to get Alan Marty cleared to be a member of our team during the evaluations, and he stayed and helped us during the early execution.

HACKLER: Once you started working with Alan Marty, what sort of advice did he give you? Any specific guidelines on how to transition to this investor mindset?

STONE: First we worked with him to figure out what proposal content we needed from the COTS bidders. He recommended that we ask companies for a business plan, which we did. So instead of using a typical NASA RFP, begin with a standard business plan content. Then we added, subtracted as need be. Of course we also asked for the technical data for the technical committee, but for the business committee we tried to keep it very high level.

His guidance was that the business plan is just the foot in the door, a screening device. He recommended that a focus be to evaluate the people, the management team, which is the essential ingredient of any business plan. The best way to do that, he said, is face to face, eyeball to eyeball. Ask the tough questions, watch them squirm, see how they interact and perform. That is the key second step, that the screen of the business plan is followed by due diligence, where we go kick the tires and have face-to-face discussion.

If a company proposed to provide skin in the game, in other words their investment alongside our investment, we had to evaluate what was the likelihood that they would be able to obtain that private capital. That's where Alan Marty really helped, because he was able to help us understand how to look at the various sources of financing, from the bank loan to private equity to cash flow. If it's a public company, how would they commit in their corporate structure to the investment? If it's a private company, how solid were their investors' commitments? If they depended on future revenue, how certain was it? Do they have experience doing this type of deal before? We learned a lot under his tutelage.

HACKLER: One of the things Alan Marty recommended, as we've talked about before, was the book *The Innovator's Dilemma* [by Clayton M. Christensen]. Was there anything in that specifically that you applied? Do you feel that the COTS program fits into the model established in the book for disruptive technology?

STONE: Yes. Alan Marty said COTS was a disruptive technology—using the word technology broadly. It was a disruptive force to NASA. *The Innovator's Dilemma* shows that disruption isn't necessarily bad. It helps organizations understand how to embrace change and nurture it.

The book helps us realize that our program was a disruptive force within NASA: a new paradigm of investing in a small tiny program that was working with industry in a truly commercial fashion. It was valuable to think how the rest of the institution would look at us, how they would view COTS as either something to embrace or as a threat to the old way of doing business. It really helped as we were strategizing the program in the early days, in terms of realizing who we were, the environment that we were in, and how to deal with that environment.

For example, the book says to get away from the mother ship. You should go outside the gate, have your own cost structure, and innovate. So we requested offices outside the gate, but ended up here in [JSC] Building 1. It was worth a try. Certainly however, the book gave us context that I think was helpful.

HACKLER: Do you think that NASA's view of the COTS program has changed over time? You mentioned at the beginning it's new, it's disruptive. People don't know what to think about it. Has the perception of how people viewed it changed over the six years of the COTS program?

STONE: Yes, it's changed. I wouldn't say everyone has come around and said, "Oh wow, commercial space is great." I think there's still a lot of skepticism. Probably the greatest change has come in the last year when we've seen one of our two partners, SpaceX [Space Exploration Technologies Corp.], launch very successfully and get to the Station and back to Earth.

They've already had their first successful paid flight under the Commercial Resupply Services, or CRS, contract. I think that has swayed a lot of people. To put this in perspective, for \$800 million, we've developed two new medium-class launch vehicles and two new

automatic cargo carriers that can rendezvous and berth with the Space Station. That's a pretty good deal, an amazingly low cost.

Indeed, I think some people have been surprised at our success. Frankly, this is not an environment where we routinely use commercial space partnerships to address mainstream mission needs. This is something that we've never done at the Johnson Space Center on such a scale before. So as we got started there was a lot of skepticism, but now that we're near conclusion, I think people have realized commercial partnerships can be a very useful tool in getting our job done.

HACKLER: Going back to the beginning, you talked about how Alan Marty helped you with things like the face-to-face due diligence meetings, including financial milestones in the Space Act Agreements, having a portfolio of investment. When you were forming that portfolio, choosing which companies to fund, how did you make the fixed \$500 million COTS budget fit in with the milestone phasing those companies had proposed?

STONE: Here's how the evaluation basically was conducted. We would first evaluate companies separately against a set of criteria. We used colors from red to blue [lowest level of confidence to highest level of confidence] for both technical and business.

Then we would take the bluest ones, if you will, and start putting them together into candidate portfolios. We sought various capabilities: unpressurized cargo up, pressurized cargo up, pressurized cargo to Earth, and crew transportation. So as we evaluated various portfolios, we looked at the coverage of these capabilities.

We also examined whether the portfolio of companies could fit in our budget and the phasing of that budget. In some cases we had to go back and negotiate the timing or value of milestones considering fiscal year boundaries.

HACKLER: One of the partners from the first selection, Rocketplane Kistler [RpK]—their Space Act Agreement was terminated because they could not meet their financial milestones. Could you talk a little bit about what sort of efforts were made to help them meet those milestones? Working with NASA, if I understand correctly, Alan Marty tried to help them a little bit as well. Why was the decision made to eventually terminate, from your business-side perspective?

STONE: First let's go back to the idea of a financial milestone. In general, the COTS agreements had milestones where they would design a little, build a little, test a little, fly a little, and get paid a little. Most of the milestones of all our partners fell in that category. But as a result of the diligence we did, if we felt there might be a risk, we could negotiate in a milestone to protect NASA.

In this case RpK had a lot of money to raise. It was good that they planned to contribute that much, but it was also a risk. We wanted to not only incentivize them, but also give ourselves an off-ramp. So we came up with the idea of the financial milestone, which not only would pay a little if they raised that much money, but would allow us to exit if they didn't.

If you look at the history of the COTS program you'll see a lot of slip in SpaceX or Orbital [Sciences Corporation] milestones. But in every case, there was clear understanding of the reasons and very visible evidence of them making continued progress toward completion of

their Space Act Agreement. Resources haven't been a major issue, rather a technical glitch or schedule glitch that is typical of a development program of this size.

In RpK's case though, we began to see that because of various reasons related to the financial markets, they were having trouble with their capital raise. That started to first manifest itself in some of the technical work, because they were starting to run a little dry of resources. Then the financial milestone itself was missed. So just like our other partners, we gave them a lot of time and we gave them some help.

In fact Alan Marty and I were both on Wall Street [New York City, New York financial district] for meetings with RpK and its investors. We went there to demonstrate that NASA was committed to COTS. NASA was interested in purchasing cargo transportation services in the future because we had a Space Station to support and the Shuttle was going to go away. We were there to show NASA was really committed. We hoped that helped, but it didn't help them enough.

HACKLER: You said you had meetings on Wall Street. What type of meetings did you have? Were they with investors?

STONE: We met, if I recall, with their investment banker, because they were the interface with the investment world. They wanted to be able to tell investors, "We met with NASA. They picked these guys because they really believe in this company." RpK had a great technical design. It was completely reusable, so it really could have been a game changer in the future of spaceflight. They gave it a real fighting chance and we did our best to support them.

HACKLER: Was there a particular moment when you knew that the finances weren't going to be viable and you knew it was time to terminate?

STONE: There was. There was a particular investor, a large pension fund if I recall. They were seriously looking at the deal, then they started to pull away. I think that may have been the straw that broke the camel's back.

HACKLER: After the agreement with RpK was terminated, COTS decided to pursue a second round of selection to use the remaining funds and give those to another commercial partner. Were there any particular lessons learned in the Round 2 selection that you had applied from what you learned the first round with RpK?

STONE: We pretty much used a cookie cutter during the second competition, namely the same approach from the first. We used basically the same team, and we actually streamlined it a little bit. Fewer people, but we pretty much the same process. It worked really well. In fact we did it in record time. If you look at the Announcement of COTS 2, it was very similar to COTS 1. We were really pleased with how well the first round went. By keeping the same people, including Alan Marty, we were able to execute the second round of competition really quickly.

In both COTS rounds, since we weren't under the FAR, the Federal Acquisition Regulation, we could pick and choose what elements of a traditional procurement we wanted to have. We chose to go into a bunker, we chose to follow certain Source [Evaluation] Board-like procedures.

HACKLER: The other thing that we understand you worked on—NASA also had partnerships with other companies through unfunded Space Act Agreements. Can you talk a little bit about your involvement with those aspects of the COTS program?

STONE: I negotiated all the unfunded Space Act Agreements that we had. There were five partners, most of which had competed for the funded round. They wanted to stay in the game using their own money, and have some technical interchange with us. They still had milestones, they still were developing a launch vehicle, but they didn't have our money.

They knew that coming out of the COTS program there'd be a separate competition under the FAR for CRS. They wanted to compete in that. In fact one did quite well in that competition it turned out. They didn't win, but they came very close.

HACKLER: Was the process for selecting them similar to the funded agreements?

STONE: To become an unfunded partner, a company must have been developing a capability to carry cargo to low-Earth orbit. We knew all the companies and all were players in the ecosystem.

HACKLER: Was there any limit to the number of companies NASA could work with under that unfunded agreement?

STONE: Our help was limited by the technical resources that we had. They were each assigned to a project executive, so somebody was responsible for interfacing with each unfunded partner.

Somebody answered the phone if they called and arranged for help. But if the help they needed was too extensive, noting that the funded partners had priority, then we placed limits to how much we free help we could give them. But I don't recall it ever getting out of hand.

HACKLER: Was the help primarily in the form of phone calls, asking technical questions? Or were there a lot of onsite visits to those companies, or their representatives coming here to help them develop their vehicles?

STONE: I negotiated these agreements and got them approved. Then they were turned over to Mike [Michael J. Horkachuck] and Bruce [A. Manners] to manage. You might want to ask them how they went, but they were generally much lower key than the funded ones.

HACKLER: Did you have any role in writing the Space Act Agreements? Were the agreements similar to the funded ones, or just a loose collaboration?

STONE: They were patterned, if I recall, a lot on the funded ones. Since we weren't putting money in, there were a lot of clauses that didn't apply. We also used Space Act Agreement Maker, or SAAM, which is a tool that the Center has to get boilerplate language.

HACKLER: The other aspect of your work in the COTS program has been working with support contractors like Booz Allen Hamilton [Inc.] to help evaluate some of the companies' milestones. Can you talk a little bit about working with them and what their role was in supporting COTS?

STONE: We are a very small office. At our peak we had 13 civil servants in the program office. I think that may have been during the CCDev [Commercial Crew Development] time when we actually had seven commercial partners to manage in one year. Two COTS, five CCDev, not including the unfunded ones.

We've always been lean and mean, so there were times when help was essential. At Booz Allen they do special assessments and deliverables. They analyze requirement changes of the Space Station for their interface with the visiting vehicles. They helped us track schedules. They've also helped provide NASA with some insight into the partners when, for example, there's a major technical review such as a design review. NASA will write RIDs [review item discrepancies] during those partner reviews. Sometimes our Booz Allen folks would help track and facilitate our review of those RIDs before we presented them to the commercial partners.

We've always tried to maintain a bit of a firewall between the rest of NASA and our commercial partners, because we didn't want to overwhelm them with help. When a partner needed help from our COTS Advisory Team [CAT], we tried to arrange it, as it wasn't a major activity. When there was a milestone that we had to assess, then we initiated that call for help from our CATs. These NASA advisors review partner data and helped us determine whether they met the criteria in their Space Act Agreement.

HACKLER: Did you work with any other contractors, or was it primarily Booz Allen?

STONE: There were technical contractors on the CAT, but only Booz Allen and Alan Marty supported C3PO [Commercial Crew & Cargo Program Office] directly.

HACKLER: You also mentioned CCDev. You mentioned that one company that had an unfunded Space Act Agreement was more successful in later efforts. Did you see a lot of that, with help from the COTS program carrying over into the CCDev effort?

STONE: Yes, some of the CCDev partners were previously COTS competitors, some successful, some not. They wanted to take the first step into commercial crew. The first CCDev also allowed proposals from companies which may not have had a full system, but had a technology. Paragon [Space Development Corp.] had a life support system design that we funded under CCDev 1. Other companies just had the capsule, like [The] Boeing [Company]. Others just had the launch vehicle, like United Launch Alliance.

We used a very similar cookie cutter on CCDev 1 that we did on COTS 1 and COTS 2. We didn't have the venture capitalist with us at the time because it was a smaller activity. It was only \$50 million and just a one-year activity. It wasn't the full development cycle, so their financing wasn't as important. But we used a very similar Announcement, business plan and technical plan.

HACKLER: You've talked about how you're a big enthusiast of commercial spaceflight. What is the role you see for commercial spaceflight in the future? How do you see the COTS model that you've worked so hard to establish being utilized in the future?

STONE: When there's a mission need, program managers must consider whether we should develop a government-owned and government-operated solution. That is normally what we do.

Mercury, Gemini, Apollo, Skylab, the Space Shuttle, and Space Station were all systems developed through a contractor for NASA to own and operate.

The COTS/CRS model is a different approach. It is a two-step model of 1) development under a non-acquisition instrument such as an SAA [Space Act Agreement], followed by 2) procurement of services or data. Under this alternative approach, the system is owned and operated by a company, and we just buy the data or services which we need.

COTS was a step toward that. The service buy going on now is CRS. Actually, NASA has had some experience in this before. Once in the science world they wanted ocean surface data. Somebody discovered that the fisheries industry needed that data too. So instead of putting out the traditional RFP for a satellite, they put out an RFP for the data. The result is called SeaWiFS [Sea-viewing Wide Field-of-view Sensor], which was a very successful data purchase where NASA shared the cost with another industry, and maybe helped put some fish on our dinner table.

I hope that program managers of the future will look at the COTS model and realize they have a choice. If their mission is to seek gravity waves, there's probably not going to be other markets so a government-owned solution makes more sense for the taxpayer. But on the other hand, as I mentioned in a recent speech at NewSpace [2012 Conference], if their mission is to transport cargo to the surface of Mars, there might very well be non-government markets for that in the next decade or two. It's difficult because there may not be objective market projects. But if other customers are plausible, then we should consider being an investor and customer, instead of owner of the system.

It frankly didn't take any more money to do it the COTS way than the traditional way. In fact some have said that we actually saved money. So I think that NASA should always consider

buying a commercial service or data where there's a reasonable chance that there will be other customers.

There's a team that [NASA] Deputy Administrator Lori [B.] Garver has stood up, which Alan [Lindenmoyer] and I are on, to look at the COTS model and other models and see how NASA could use such models in the future. We're trying to give future programs the benefit of our lessons learned and tools to help them. COTS/CRS I think has given them some top cover so they won't be the first kid on their block to try this. We've tried it, it works, so it's okay for them to consider it.

HACKLER: One of the goals of COTS was to help develop new markets for commercial spaceflight. Now that COTS is transitioning into the [Commercial] Resupply Services phase, have you seen a lot of new markets developing? Do you see any companies that are able to say, "Yes, I want to buy this service"?

STONE: While we had project executives working with each of these companies, I worked on issues that transcended the partners. One of those was the ecosystem in which they had to exist and grow. I have a chart showing the COTS partner, investors, government regulators, other markets, and insurance, all of which affect the partner. We tried to stay in communication with these nutrients in the Petri dishes, such as explaining the COTS commitment of NASA to investors or insurers, or ask the FAA [Federal Aviation Administration] to prepare for licensing COTS launches.

Most of my ecosystem effort has been in the market development because our goal is to not be the only customer of COTS. The gold ring is to see other customers for this to share

costs. That would be good for NASA and good for the nation. As far as the launch vehicles of our partners are concerned, for example, you can see the SpaceX launch manifest on their website, showing who they've already sold Falcon 9 [rocket] flights to. They're already doing a nice job of leveraging our mutual investment in their COTS system to launch satellites for commercial and sovereign customers. I expect Orbital will do the same with Antares [rocket].

As far as the COTS cargo carriers, we don't yet know if there will be non-NASA markets. SpaceX is offering a configuration called DragonLab, a LEO [low-Earth orbit] free flier which does not visit the Space Station. It orbits Earth at whatever altitude, inclination, duration, etc. that the customer or customers want, and returns to Earth with their payloads. If there is an opportunity for the COTS partners to carry some cargo to the Station that is not paid for by NASA, then that will open this market at low marginal cost.

I've spent some time looking at the market for microgravity. I think it's potentially huge, considering the value it offers to the biotech [biotechnology] pharma [pharmaceutical] industry, as well some other industries. I think NASA has done a lot over the last 50 years to demonstrate the value, but we need to do a little better job of communicating that value—and the new flight opportunities because of COTS and the Space Station—to go there and discover new drugs and do other really important commercial research. The jury is still out on whether there'll be a market for the cargo carriers, but I'm optimistic.

HACKLER: At this point I wanted to ask Rebecca Wright if she had any questions.

WRIGHT: A few, and I want to go back to the beginning. You talked about how the selection of the management team was the key. What kind of attributes were you looking for when you were

selecting those first partners? Since, as we know, they didn't have any proven capabilities, this was all going to be new.

STONE: We had to understand first of all what was the task at hand. For example, if they were going to build a system completely in-house with very few suppliers, did they have the right kind of skills? Had they ever done that kind of thing before? If they were going to, on the other hand, hire some big seasoned aerospace companies to do that job for them, great, but how are you going to manage them? Have you ever had experience as a small company managing a big company? How did that work, and how are you going to do it here?

If they already had the money, then their CFO [Chief Financial Officer] was not that critical to their financing. On the other hand, if they must raise a lot of money, has your CEO [Chief Executive Officer] and CFO ever done that before, or anything even close? What's your experience, and how many successful investment raises have you had?

You look at the job at hand, look at the people to do that job, and identify any mismatches. There was a case where we said one person has too many jobs at this company, and they hired somebody to help round them out. There was another case where the CFO did not have the experience to do the work that was proposed. We flagged that as a major issue before we picked them. We said, "You're going to have to find somebody with more experience to do that."

Each case was different. We had to be careful because we wanted to allow startups. We didn't limit it to startups, but we didn't want to preclude them. We carefully walked that fine line when we wrote the Announcement and when we did the evaluation. If the people were all green, that's not good. But a startup can have a lot of seasoned people who've had long careers

in aerospace which was okay. We had to look at the startups especially carefully and not penalize the company for lack of corporate experience.

WRIGHT: Was it a plus or a minus that they had someone on their management team that had worked with NASA before? Did you view that as a plus because they would understand, or were you looking for people that maybe didn't have preconceived notions of how to work with NASA because you were not going to be working with NASA as you had been before?

STONE: We didn't use that as a criterion explicitly. But they had to have the skills to execute their plan, so we reviewed their technical management's credentials to do the job at hand. Space experience, not necessarily experience working with NASA, would increase our confidence that they could implement the technical said of their business.

WRIGHT: It's true there are other space companies in the world. You've talked to us about how your organization was so lean and mean, because that's how COTS was developed, to have few people but to do a lot. Could you share with us a fuller picture of the organization? Of course we know Alan was tapped to lead the group, and you mentioned that you were leading the business committee, and that there was a technical committee. Can you go from there what the rest of the organization was, and what those responsibilities were of your teams?

STONE: During each competition there's a separate organization set up that only lives during that competition. So we had a program office, and then the competition team. Some people were on

both. During the competitions Alan [Lindenmoyer] chaired the PEP, the Participant Evaluation Panel, which was equivalent to a Source Evaluation Board.

During the first COTS competition, we had three committees. We had a business committee which I chaired, a technical committee which Valin [B.] Thorn chaired, and a finance committee consisting of budget experts. In the second investment round, we collapsed the business and finance committees into one. During COTS [Round] 1, the program was collated with the competition team. During COTS [Round] 2, we had an ongoing program. SpaceX was busy executing, and so the people who were working with SpaceX did not support Round 2. They really were parallel efforts.

WRIGHT: You created a new model to not do NASA business as usual, so I'm curious about how you set that up.

STONE: We have project executives and a few key supporting functions in the Commercial Crew & Cargo Program Office. I do program integration, which covers everything that is not specific to a single partner, such as managing our support contractor, reporting to the Center or [NASA] Headquarters [Washington, DC], public outreach, etc. We have a safety rep [representative] who participates in partner insight activities. We have a budget rep and procurement rep and legal rep, and that's it.

WRIGHT: You refer to your companies as an ecosystem, and I think that's really interesting. You mentioned too that you knew all these companies and that you developed a relationship with them. Can you fill in the background? How did you pull these folks in? Did they start looking

for you once the word got out, or did you start looking for them to build this network of companies so that they would know what was going on here at the office?

STONE: What timeframe? Are you asking after they've won, or before they won?

WRIGHT: Before. We all know that the word got out, but how did it all start to move its way into these separate little companies, or people who had concepts of companies, to become part of what you refer to as your ecosystem?

STONE: By ecosystem I mean all of the things they need to be successful that are outside COTS, like investment, regulation, insurance, other customers, suppliers. Once we picked winners, we could go out and start talking to potential customers of microgravity and so on. We knew general investors in the space business, we knew the insurance people in the space business, of course the FAA space office [Office of Commercial Space Transportation]. If you want to go back before the COTS award, I knew a lot of the players in the commercial space industry from my experience.

When Mike [Michael D.] Griffin [NASA Administrator] first came on board, he started speaking about this commercial way of doing business. There was a speech he gave to the Space Transportation Association in [June] 2005. Industry had been lobbying Congress to go do this. "Give us a chance, let us try this," they said. "This is the perfect situation to carry low-value cargo to the Space Station. You've got other ways if we fail: [Constellation Program] Orion [Crew Exploration Vehicle] and the International Partners."

Once the program had started and we were ready to engage industry, we used transitional procurement-type practices. We had a formal industry day and we issued a formal Announcement when we were seeking proposals.

WRIGHT: Have you found that there have been new members that have come into the ecosystem? For instance, you said investors—I always think of the phrase “cottage industries.” They start popping up because now this new concept is turning into a reality. Have you met new people that have come into this realm because they want to be a part of it? Do you see more startups or more investors that are interested now that you’ve been doing this for five or six years?

STONE: Yes. We get communications from small companies which want to play a role, which is good. As I say, suppliers are definitely a part of the ecosystem. When you step back from COTS, you see there’s really quite a renaissance of commercial space going on. For example, in space tourism, there are suborbital companies. In orbital tourism, there’s an existing market through Russia [Russian Federal Space Agency (Roscosmos)], but America may grab some of that market share once U.S. commercial crew capability is operational.

Other signs of the growth of commercial space in the U.S. include the Commercial Spaceflight Federation. Several dramatically growing conferences focus on commercial space, like the NewSpace Conference of the Space Frontier Foundation and the ISPCS [International Symposium for Personal and Commercial Spaceflight] in [Las Cruces] New Mexico. The ISDC [International Space Development Conference] is another one that the National Space Society runs.

I remember—this is going way back—30 years ago there'd be 20 people in a little rented room at some hotel wearing T-shirts, shorts, and carrying business plans in their back pockets. Some of these turned into the companies we see today, some didn't. What a change from today. Commercial space has grown in legitimacy and its ability to actually build things. SpaceX didn't even exist until 2002.

WRIGHT: You've explained that there was a lot of thought process and a lot of work put into setting up the PEP and the evaluation criteria. When you were put into the position of having to do the second round, why didn't you just go back and choose one of the companies that maybe was the third or the fourth runnerup when you evaluated the first group?

STONE: That's a good question. A year and a half had expired. Markets change, particularly financial markets. Technologies change. So we decided to put out a new Announcement. Some companies sent a similar proposal as they sent before, while others changed theirs. We also had some completely new participants. We believe that this was the most fair approach.

WRIGHT: What were some of the questions that the companies asked you during these rounds of evaluations? Maybe were there some questions they asked that surprised you? Or were you pretty much prepared for whatever they were asking?

STONE: We were doing the asking. I wouldn't say we wouldn't allow questions, but they were under the spotlight.

WRIGHT: I'm just curious if they asked how much oversight you were going to have, in the sense of if you saw them getting overwhelmed or they were struggling to meet their milestones, there might have been suggestions or recommendations from NASA. Were they very receptive of the help that you were offering? Or did they want to be given the time to figure this out on their own because it's their product and their company?

STONE: We seldom initiated help; we generally waited for them to ask. During major design reviews, when you write a comment on a design, a formal comment to be dispositioned by a board, in essence that's help too. It says, "We don't think your design is going to work," or, "It doesn't meet a requirement." That's help.

We had insight, not oversight. Even though we were small, each of the project executives had a deputy. They would go to many partner meetings and reviews and were generally welcome to sit in. We would get a lot of insight that way. If we saw a problem coming and we thought we had some advice, I doubt we would just hide it. Bruce and Mike could give you a better handle on that.

WRIGHT: You were helping to put the concepts in place originally—do you feel, as you've come through these last six years, that you truly were partners in this effort? Or did you find that NASA was in somewhat of a traditional role of overseer and provider of funds?

STONE: Definitely we were partners. It worked out pretty close to the way we had envisioned. We're very happy with the results of COTS. In a traditional NASA program, there is change traffic and other ways in which contractor revenue can increase. We had none of that. This was

fixed price. This was a company-owned-and-operated system. They were solely responsible, except at the interface with the Space Station where we were jointly responsible for the integration. Otherwise this was their baby. Our partners knew that if we were ever going to put our cargo on it then they had to be responsive, so the incentives were built in. We didn't want or need to treat them like a traditional contractor. That isn't the model.

WRIGHT: Were you involved with the ISS [International Space Station] interfacing, doing any of the work on that relationship when that began?

STONE: Not really, Valin started that. Mike Horkachuck would be a really good one because SpaceX went through that. The Station Program too could provide input on that, as well as [Assistant Project Executives] Warren [P. Ruemmele] and Kevin [M. Meehan].

WRIGHT: The last question for me at the moment—CRS is not from this office. Were you involved in how the continuation of the concepts moved on? Did you think when you first started out that this office would be finishing what you started for all of the efforts with the commercial side?

STONE: Early on it was clear that it was Station's requirement and Station's money, so it would be better for Station to manage it. At the same time we were funding the partners and their integration work, Station was funding its integration side, so we had to work very closely with them. Kathy [Kathryn L.] Lueders runs the Transportation [Integration] Office of the Space

Station. We worked closely with them in the early days to understanding needs, which translated into our four capability goals A, B, C and D.

ISS helped develop a draft of an IRD, Interface Requirements Document, which went out with our Announcement. As time moved on, that IRD became more mature. Having two real designs, sometimes requirements evolve because of unforeseen integration issues. As SpaceX has shown with its successful COTS demo [demonstration] and first CRS flight, the ISS visiting vehicle process worked well.

WRIGHT: You're very positive when you talk about the program, a true believer. Is there anything that you feel like you wish you could have done differently, or some expectation that didn't get fulfilled? Is there any disappointment in this whole effort that you have seen as you worked through the process?

STONE: I think it's worked amazingly well. I would have liked to do more on market development. SpaceX still has not sold a single DragonLab mission. I can't prove that if we worked harder on that and helped educate the biotech industry that there'd be enough to fill a flight, but the fact that we haven't supported this too much might be a factor. That's something we can still do. In fact, in the commercial space study we're doing right now, we're looking at whether it is appropriate for NASA to do more to stimulate demand for space applications.

We had a failure of investment in an early COTS partner. Could we have done more? Perhaps. A stronger customer base can lead to greater investor confidence.

WRIGHT: Can you narrow down what the key to the success of this whole concept has been? Is it just the simplicity?

STONE: Top cover was critical. When COTS started we had a NASA Administrator who said, "Go do it." He said, "Here's \$500 million. I want this fenced, I don't want anybody to touch it." He told our lawyers, "Find a way to use Space Act Agreements to fund them." With his support, everything fell into place on NASA's side of the partnership. That was essential, particularly the first time an organization like this tries something disruptive, something so new.

In the future I'm hopeful that we don't sit around and wait for the Administrator to make these decisions. Instead, I hope that program managers and mission directorates realize that they have a choice now, that they can innovate and use these new ways of doing business to their advantage. There's precedent now.

Earlier in my NASA career, I studied data and service buys and why some agencies choose one versus the other. I briefed the AA [Associate Administrator] for Exploration. His name was Michael Griffin. He was very interested in these experiences of other agencies in using private-sector partnerships to fill mission need efficiently. Years later I saw Dr. Griffin at a conference and said, "Do you remember that briefing I gave you about buying services instead of systems?" He said, "No." Darn. So I figured, great minds think alike. He's a smart guy.

When COTS was started, NASA saw cargo to ISS as a good opportunity to buy services. We allocated the money and said, "Let's see what they can do." Today some folks may have been surprised at our success, pleasantly or not. But we were successful. Now I think that the trade space has been opened by the COTS program.

WRIGHT: Well, thanks.

HACKLER: I do have one more quick question. You talked about the Round 1 and Round 2 selections. In Round 1 you had a separate business and finance committee, then you consolidated them. Could you explain what the difference was between the business and finance aspects?

STONE: Yes. Our traditional budget and cost estimators would look at a proposal and try to estimate the cost. In a typical SEB [Source Evaluation Board] there's a cost volume you ask for, work breakdown structure to many levels, with detail on labor and suppliers. We didn't ask for that. Our main concern wasn't the cost per se, it was whether they had enough money to do the job.

We asked for some cost data. Primarily using the technical data, our cost team used NASA cost-estimating models to estimate how much we think the system will cost. We then compared our estimates to theirs as a confidence factor, and used them as a source of questions during our due diligence. If they had good answers, that was fine. If they didn't, well, maybe they needed to raise a little more money than planned to, which could translate into a financial weakness. They may have said they needed to raise X, but if we really thought they needed to raise 3X that could be a problem. So the cost assessment was often translated into financial findings such as, "We have low confidence that this participant will raise the money required to develop and demonstrate its proposed COTS system." We reflected this in the second round when the business and cost functions become one integrated team.

HACKLER: All right. Thank you very much for your time today.

WRIGHT: Have anything you can think of that we might want to cover?

STONE: This has been a great experience for me personally. I really have enjoyed the chance to be part of something that's so cutting edge, where NASA is benefiting from the commercial space industry and helping to nurture it too. This is a great experience. I've learned a lot, and I hope others can learn too how we do this.

WRIGHT: We do too, so we may be back.

STONE: I hope, I would expect that you will be.

[End of interview]