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COMMERCIAL CREW & CARGO PROGRAM OFFICE
ORAL HISTORY TRANSCRIPT

PETER CAPOZZOLI
INTERVIEWED BY REBECCA WRIGHT
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[The opinions given in this transcript are the opinions of the person interviewed and do not necessarily reflect the official opinions of SpaceX.]

WRIGHT: Today is January 16, 2013. This oral history interview is being conducted with Pete Capozzoli at the Headquarters of the Space Exploration Technologies Corp., or SpaceX, in Hawthorne, California, for the NASA Commercial Crew & Cargo Program Office History Project. Interviewer is Rebecca Wright, with Rebecca Hackler. Thanks again for coming in and, for the record, congratulations on your new baby.

CAPOZZOLI: Thank you. Thank you for having me.

WRIGHT: We appreciate you coming in to talk to us. Can you share with us briefly your background before coming to SpaceX, and then your role here?

CAPOZZOLI: Sure. I had always had a strong interest in space and space industry, but after graduating engineering school, I found I didn't want to work for the big bureaucratic companies that were dominating the industry. I went and worked for some consulting firms doing technology and product development, and then onto strategy consulting. After finding that not very fulfilling, I turned back to space. I went back to graduate school, MIT [Massachusetts

Institute of Technology, Cambridge], to pursue a Master's in aerospace engineering and an MBA [Master of Business Administration], with the express purpose of doing something entrepreneurial in space. While I was there I heard about SpaceX, and it seemed like a perfect fit. So immediately before here, I was at grad school.

Here at SpaceX, I'm the Senior Mission Manager for COTS [Commercial Orbital Transportation Services] and CRS, the Commercial Resupply Services. In that role, I'm the primary point of contact with NASA for all programmatic issues, and I'm sort of the overall project coordinator for the missions.

WRIGHT: Why did they put you in that role, with your background?

CAPOZZOLI: I think my background ended up being really a perfect fit. I had been in customer interfacing roles in the consulting industry, and had done business and strategy work, which is just part of the job. It's very much a management job. I had also developed new technologies and new products, and understood what that took to get big, complex systems into a final ready state. I was able to talk to the customer and manage the project on that side, as well as talk internally to the technical folks, and be respected and knowledgeable about what they were doing.

WRIGHT: You really are kind of the middle man.

CAPOZZOLI: I'm very much a middle man.

WRIGHT: Share with us what was going on when you walked in the door as far as the COTS program. Had you already received the knowledge that SpaceX had been awarded a Space Act Agreement?

CAPOZZOLI: I joined the company October 2006, and we had just received the COTS award. When I joined, my immediate assignments were commercial satellite missions. For two years I worked on those missions and was only loosely involved in the COTS program. Then we won the CRS contract, and I was made the mission manager for that program.

That was in 2008, and over the next year my experience working with NASA for the commercial cargo missions—SpaceX senior management had referred the responsibility of COTS to me as folks either moved on or didn't work out at SpaceX. I was able to leverage the experience I already had from CRS onto COTS and see it through to the end.

WRIGHT: The commercial satellite missions that you were working on, that was kind of an industry-to-industry relationship. Is it safe to say this might have been your first industry-to-federal institution relationship that you had to work with?

CAPOZZOLI: Certainly my first industry-to-NASA institution. I had worked with some other federal bodies, FAA [Federal Aviation Administration] in my time here, and some of the energy industries in a past career, but this is my most intense involvement with a government agency.

WRIGHT: Share with us some of the first conversations you had with NASA, and how that relationship began to grow. Especially since for NASA this was a different way of doing business, with commercial partners.

CAPOZZOLI: Very much. The early conversations that I was part of were very encouraging, with NASA telling us that they wanted to do things differently, more streamlined, more commercial, and wanted to give us a lot of leeway in the way we did things. I was excited, and I remained excited to work on the programs. I think they've done a great job in that.

Particularly the COTS program, giving us the freedom to develop how we see appropriate, while of course meeting all of their requirements and standards. SpaceX is seeing a streamlined version of how I think NASA typically works, but it's still very big and very bureaucratic compared to what a lot of other folks—at least the early folks at SpaceX—are used to dealing with. That's been a personal challenge for me.

WRIGHT: Can you give us some examples of items that you found that fell into that category?

CAPOZZOLI: Most of it tends to be around documentation and updates in status, whereas a lot of folks, including myself here, really just want to get the job done. That's the right thing to do, and do it correctly. Having us spend a lot of time documenting what we've done so that other people can review is something we needed to come to terms with. We understand why, but it's not the way we'd prefer to spend our time.

WRIGHT: Working in a NASA environment, I know there's a definite structure of how the documentation proceeds. Without divulging internal secrets, can you give us an example—I'm sure you have to keep some documentation to show how you got from Point A to Point C. What is it that you do here that is a contrast to NASA's method?

CAPOZZOLI: I think SpaceX actually does a very good job of documenting in our way, which is very much electronic. I think we've grown and matured, and in part that was NASA's influence. I think we would've gotten there organically anyways, but NASA pushed us to do it sooner rather than later. I've always been comfortable with how SpaceX did things and documented, particularly on our launch procedures. We're very very good there, but I can also see how it didn't lend itself well to what NASA was used to.

WRIGHT: Talk to us some about the milestone procedures. The whole process of the milestones being set up as part of the agreement, SpaceX moving toward those milestones, and how you brought that to fruition in order to get payment.

CAPOZZOLI: Certainly under CRS—that's my primary role, and when it came to COTS I took it over halfway through. I think the key that we've learned over time is really setting expectations about what these milestones are. Even though they're written down on the contact, they're still very subject to interpretation. For example, the CDR, Critical Design Review—there may only be a few bullets in the contract that say what that CDR should be. SpaceX may interpret it one way, and NASA would probably expect a lot more, especially in the realm of documentation and maybe a more final state of your design.

That was the challenge moving forward, and always working back and forth, hand in hand with NASA. I talked to them every single day, and I think that's helped a lot. When we get to the review, generally it goes very very well, but inevitably we've missed a few things that NASA had expected but weren't written down or explicitly discussed ahead of time. We'd go back, and we'd usually address those items to NASA's satisfaction, and then that usually leads to a closeout of the review. We've passed the review for the contract, and we receive a payment, which is always a good thing for a commercial company.

WRIGHT: When NASA set up the COTS program office, they assigned a project executive to come work with SpaceX. In your case it was Mike [Michael J.] Horkachuck. How did that method of communication work for SpaceX?

CAPOZZOLI: I think that setup worked very well. I worked very closely with Mike Horkachuck. He's done a great job of keeping the giant NASA bureaucracy at bay, and calling in key experts to attend our design reviews and participate in the overall development and progress of the contract. I think also in terms of milestones and deliverables, he and Alan [J.] Lindenmoyer [Commercial Crew and Cargo Program Manager] have been very firm but very fair, and always looking to see whether or not SpaceX met the intent.

Maybe the requirement was to do a particular test, and SpaceX did two tests that we thought were sufficient, whereas NASA said, "Well, we might've liked to see four tests." If that was the case, we would discuss that. If we could say the two met everything you really need to see, then they would agree and we'd move on. If they really said, "No, we need to see these

other items as well," then SpaceX would go back and do those, both for our own benefit and to satisfy the contract and the relationship.

WRIGHT: What other kind of outside help or discussions did you have with other realms of the NASA environment?

CAPOZZOLI: The technical folks were doing that, but I do know that we worked very closely with NASA to develop our heat shield, and do heat shield testing at NASA Ames [Research Center, Moffett Field, California]. NASA was very willing and very open to lend their expertise wherever we asked, and often offered up places where they thought they could help. Again, I think Mike Horkachuck was a big help in that regard, because he had a really good feel for where NASA could be helpful, and where maybe they want to just leave us to work it out on our own.

WRIGHT: Talk to us about the decision to combine the C2 and 3 and to make it C2+ [COTS demonstration mission]. Were you involved in making that happen?

CAPOZZOLI: Yes, I was definitely involved. As you may know, the C2 was originally a flyby of the [International Space] Station, and the C3 was the actual "go up and berth the Station." As we got further and further along, we realized we were building three different versions of the capsule—the C1, the C2, and the C3—and having different versions incurs drawing change and cost and overhead. If everything went really well, why should we just come home? Both SpaceX and NASA have now wasted a whole launch, and they had a whole capsule.

First we made the decision to build only one more version of the capsule. We had the C1 version, and then we had the C2+ version, which is the full-up Dragon. Then, once that was decided, we started talking to the COTS office to see if they would be willing to combine the missions. That was a long, long discussion that I think ended up very well. What we agreed and showed we'd be able to do is complete all the objectives of the original C2 mission before ever trying to berth to Station in furtherance of the C3 mission.

If anything went wrong, we would come home and try again next time. If everything went really well, then let's give it a shot, might as well. I think that was good for everybody. Certainly it went the way we wanted it to, and it sped up the completion of the COTS program, so now we're into commercial missions sooner than we would've been otherwise.

WRIGHT: Tell us what you learned from doing that, and from the successful achievements that you've had over the last few months. How that is preparing you, with those lessons learned, that you're applying to the next launch, and to the next mission that's being planned toward the [International] Space Station? Are you fine tuning what you already knew, or where there some discoveries that you made that will make a big difference in how you do things in the future?

CAPOZZOLI: I think, somewhat surprisingly, we're mostly in the fine-tuning phase. At least from my perspective. Maybe some of the tech [technical] folks might think otherwise, or may have another idea. I think we're in the fine-tuning phase, because not only did they go well, but they went very much as expected. Some of the problems we saw, or even the single effects that we saw in our avionics were expected, and we were prepared to deal with them. Now I think we're in the process of making our procedures, especially our mission procedures, more robust

and refining our launch preparations. Getting into a real production flow in terms of building the capsules and launch vehicle.

WRIGHT: I'm going to ask Rebecca, do you have some questions?

HACKLER: I did have a few questions. You talked about how as you worked with NASA, you learned more about the types of documentation that you would need. What kinds of lessons learned did NASA share with you, some of their documentation from the past, that you were able to apply to your vehicles or processes?

CAPOZZOLI: NASA's been very open and willing to send us either examples or give us feedback. I think mostly what I came to appreciate was that there's so many people involved on the NASA side, that they really have to be able to pick up these documents with almost no background to what we're doing. That's a very general statement, but I've taken that approach to all the documentation. If someone's coming in, knows almost nothing about SpaceX or Dragon or cargo, let's build it so that they can follow this clearly. It's a lot more work up front for us, but it makes for a better document in the end.

HACKLER: SpaceX aims to be a very efficient, innovative company—and has been very successful in doing that—so you're able to get the best possible product without the unnecessary overhead. In working with NASA, you have had to add in some extra steps and documentation, some more bureaucratic processes. Do you feel that SpaceX is moving in a direction towards

taking on some of the characteristics of a more bureaucratic organization? How do you find the balance between those goals?

CAPOZZOLI: I think it's a challenge. I do see a lot more procedure here, a lot more overhead, a lot more bureaucracy than when I started. When I started, I was somewhere around the 150th employee, and now we're close to 3,000. I think probably just in the growth this would have happened, but working with an organization such as NASA and some of the other government organizations have really added quite a bit of overhead. For me personally, I think this is a great time for SpaceX to say, "What are the good parts and necessary parts?" and then really be careful about adding any more. Obviously we need to satisfy our customers, and we want to, but we should be careful.

I will add that NASA has generally been open to not just adding bureaucracy for the sake of it, as long as we point it out. It's easy for them to say, "This is the way we've done it, this is the way we have to do it," and SpaceX is fairly famous for saying, "Why?" Let's talk about what are you trying to get out of this, and is there an easier or a more streamlined way to do it? I think we'll just have to keep doing that and be very vigilant about it.

HACKLER: We understand that at NASA you had two primary points of contact. Through the COTS office through Mike, and you also worked with the ISS [International Space Station] Program Office for the CRS contract. Were there any differences between working with those two organizations? Was there ever any conflict between trying to make sure all the parties' needs were satisfied?

CAPOZZOLI: We were working with the ISS office anyways under COTS because they owned the ISS interface, even though the COTS office managed the Space Act. At least we were already familiar with Kathy [Kathryn L.] Lueders and her team. Having CRS in parallel with COTS was very challenging for me personally, because now I was the primary point of contact for both parties.

I found that the COTS office seemed to me smaller and more streamlined. I'm not sure what was going on in the backend, but to me it was a little more streamlined, whereas the CRS office and the ISS office seemed a lot bigger, and I had a lot more folks to work with and satisfy. All the ISS integration activities went through that office as well, which was a massive amount of work. It was challenging, and a little different.

HACKLER: Because you are doing rocket science, as you started to build more hardware some of the milestones started to slip a little bit. Did you ever fear that NASA would terminate the Space Act Agreement because of those milestone slips?

CAPOZZOLI: I was never really worried about that. Even though things were taking longer, I personally thought the milestones were fairly aggressively scheduled anyways, and we were always making solid, consistent progress. I don't know the threshold by which NASA would've stuck by us, but it felt to me like we had the same common goal, for us to be successful both as a service to NASA and for us to be a successful private company. I never worried they were going to leave us or terminate.

HACKLER: You said you entered shortly after the first COTS award was announced. Did you have any involvement in any of the other proposals, the COTS Round 2, or the CCDev [Commercial Crew Development]?

CAPOZZOLI: No, I wasn't involved in those. I think my plate's full.

HACKLER: Thank you.

WRIGHT: How important do you think NASA's partnership with SpaceX impacted your progress in developing your technology?

CAPOZZOLI: I think it was critically important. They've been a partner with us for a long time, and I think we were able to draw on their expertise. Certainly, having the contract with known financial milestones helped us with the time we needed to develop our technology. Generally, just their support throughout the program has, I think, helped make SpaceX successful. Also, probably a more robust vehicle in the end by having to meet ISS integration requirements and other things along the way. I think we probably ended up with a better vehicle because of it.

WRIGHT: I understand that there was never a question that although you didn't have to, your vehicle was going to the Station [to demonstrate its cargo capabilities]. When you were doing all of the work for it, you were making sure that it met all those requirements to be able to berth at the Station.

CAPOZZOLI: Yes, absolutely. I think that really came handed down from our CEO [Chief Executive Officer], Elon Musk, who's always said, "We're doing manned spaceflight, we're going to Station, we're going to Mars, we're going to carry crew, so do it right from the beginning." I think that was a good choice.

WRIGHT: Provides that vision?

CAPOZZOLI: It does, and it forced us to work out problems and create solutions earlier than maybe we would've otherwise.

WRIGHT: Tell us where you were when Dragon and the Station came together [successful C2+ mission].

CAPOZZOLI: I was in our Mission Control. At that point I didn't have a role anymore. It was well under the control of the Mission Operations team, but I was there watching. The moment that Dragon was grappled by the Station, that was quite emotional. That was four years of long hours and stress and wondering if we were going to get there.

With the C1 launch, we had shown we could bring a capsule back to Earth, so that was piece number one. Now, at that very moment of the grapple, we showed that we could build a vehicle capable of navigating and being berthed to the Station. That was the second and final piece. Now we're a full-fledged space company, and we can only be successful from here I think. That was a great day. That was my best day at SpaceX, for sure.

WRIGHT: I bet it was. What was the biggest challenge that you encountered during those years, those four long years?

CAPOZZOLI: We had challenges all over the place developing new technology, but more than anything it was trying to keep a schedule. I think we did something unprecedented with the number of people we had and the timeframe we did it. It was a team effort across the board with a lot of smart people, good team players working really really hard, and all in it together. I think that was a challenge, just the pace at which we did it and solved problems along the way.

WRIGHT: So much was going on at such an intense pace—how was communication shared with your team, and with your NASA partner?

CAPOZZOLI: I think communication was a challenge, to keep it up to date as quickly as possible. We tried to send over information as fast as we got it, whether it was an email, a phone call, a test report, test results. It was, "Let's keep them informed as much as possible, as quickly as possible," so that everyone was on the same page. There was no one way, and there was no easy way. It was just talking to them a lot.

WRIGHT: That's interesting, because you mentioned that so much was based on electronic documentation. So it was also almost like an electronic network that was constantly moving between you and your partners and your teammates.

CAPOZZOLI: Oh yes, very much.

WRIGHT: Before we close, is there anything else that you can think of that you'd like to share with us about your experiences working with this? Or for where you're going next, based on what you've learned through these experiences?

CAPOZZOLI: No, it's been just an amazing experience. I've really been honored to be a part of it, to be able to see the second half of COTS all the way through to the end, and be managing the CRS contracts from the very beginning. I'd say when Dragon was grappled to Station, that was my best day at SpaceX.

My proudest accomplishment was the first CRS mission, because that was, for me, the one I saw from the very beginning and worked with the ISS office. We really brought cargo to the crew, ice cream included. That was a good mission, and I think we're well poised for the next 11 under that contract. I'm not involved in the crew work, at least not yet, but that'll be really exciting. I think the sky's the limit, literally for SpaceX and the partnership with NASA.

WRIGHT: Did you have dealings with the [ISS] International Partners too?

CAPOZZOLI: I worked with them primarily through either the Safety Review Panels or the IMMT, the ISS Mission Management Team. Those are formal meetings that were held just before the mission and during the mission. When we did have some anomalies during the mission we would get questions from the partners, and we addressed them and had good answers. It was never an issue. I think they have seemed very supportive along the way. Our

interface with them was more limited. NASA really handled that interface primarily, except during real-time operations.

WRIGHT: Rebecca, do you have any more?

HACKLER: You talked about SpaceX being well poised at this point as a result of the partnership with NASA. Do you have any involvement working with other commercial opportunities that have become available as a result of the partnership? New customers that you work with, or business you've been able to gain?

CAPOZZOLI: That's not what I'm working on. I know our successes have certainly made us a more viable entity in the marketplace, and our business development folks are actively working. We've signed a ton of contracts, but that's not where I'm focused right now. I'm focused on executing the missions at hand.

WRIGHT: Do you see the cargo evolving, different levels of intensity about what's going to be coming up and what's going down?

CAPOZZOLI: Yes, I think so. I think the demo [demonstration] mission, the C2+ mission was very limited cargo. And even on this last CRS-1 mission NASA didn't put on their most important cargo. I think we'll get more important cargo the more we show we're reliable, adding in more capabilities at NASA's request. We'll be able to fly mice, and that'll be our first live transport. That'll come up in a few missions.

We're adding in more powered cargo so we can do more science, which is obviously of great interest to the whole community. What you'll start to see is cargo in the trunk, the part in the back that's exposed to space. We'll have our first external cargo flying up on this next mission. It's a pretty simple piece of hardware. If it didn't work, I don't think NASA would care too much. We'll start to see real science payloads going in the trunk there, more and more important payloads. It'll continue to evolve and get pretty exciting.

Every cargo mission's very different, especially what's going in the trunk. We can fly up to three of these science payloads. Each one's really a small satellite, and if you add in the pressurized cargo, we also have the capability to have some small satellites deploy. You could have a mission that is five, six, seven different customers and satellites. It's complex and exciting.

WRIGHT: No kidding. It seems easy, but it's not like loading the trunk of your car, is it? Well, thank you. We appreciate you coming in just for us.

CAPOZZOLI: Sure. It was fun, thanks.

[End of interview]