NASA JOHNSON SPACE CENTER ORION ORAL HISTORY PROJECT
EDITED ORAL HISTORY TRANSCRIPT

MARK A. KIRASICH
INTERVIEWED BY SANDRA JOHNSON
HOUSTON, TEXAS – AUGUST 8, 2016

JOHNSON: Today is August 8th, 2016. This oral history interview with Mark Kirasich is being conducted for the Johnson Space Center Orion Oral History Project in Houston, Texas. The interviewer is Sandra Johnson, assisted by Jennifer Ross-Nazzal. I want to thank you again for joining us again today. When we ended the last interview, you mentioned that you wanted to talk about that multicenter aspect of Orion and that management model. So if you want to start there.

KIRASICH: Sure. Thank you for reminding me of that. In the beginning one of the Agency policy mandates that we had was that the Agency wanted Orion to be a multicenter program. The Agency didn't want all the work consolidated at one Center. The phrase at the time was "10 healthy Centers." We were going to support work at all the Centers. That was an early challenge to us to form a geographically distributed team. We visited a number of Centers, for example [NASA] Ames [Research Center, Moffett Field, California], and found out the specialties and the skills and the areas where Ames is really good, and then we went to [NASA] Langley [Research Center, Hampton, Virginia], and to [NASA] Glenn [Research Center, Cleveland, Ohio]. What we found, while at Johnson we were still quite busy flying the Space Shuttle and the [International] Space Station [ISS], the other Centers turned out to have some highly qualified people and excess capacity that we were able to take advantage of. Everywhere we went, we were offered the "best" that the Center had available, and the people at these other

Centers were very excited to have the opportunity to work on NASA's new spacecraft Project.

To be successful, we had to put some effort into setting up a multicenter management team, and we created our business rhythms, which included Daily Tagups, Strategic Councils and visits to the Centers where Orion was being done. I think it paid dividends early on, because we literally did get the best and the brightest technical people that the Agency had available to solve some of our key challenging areas.

In 2010 when the Project was proposed to be canceled, it turned out that this also helped, because we had a constituency if you will. We had a lot of people who were interested in seeing the program succeed. It was good for us both in the good times and the challenging times, because people from around the Agency helped us work through the difficult period after February 2010.

JOHNSON: How long did it take to set up that multicenter way of doing it?

KIRASICH: I would say that the concept of how we wanted to divide the work probably took two or three months. What we did was, for example, we took work and we parceled it out to other Centers, I guess I would say along two different lines. One was functional work, like entry, descent, and landing. The Langley Research Center and Ames actually have a lot of expertise. For example Langley has a lot of expertise with regard to landing loads, when a spacecraft hits water or the ground. Ames has a lot of expertise in thermal protection systems. Where there was expertise, then we would move functional work packages.

The next thing we did, we took the spacecraft at the time, which was a Crew Module, a Service Module, and a Launch Abort System, and we made Johnson Space Center the manager

of the Crew Module, we moved management of the Service Module to Glenn, and we gave Langley the responsibility for the Launch Abort System product team. We also divided work amongst project teams.

I think that division of big work packages came together fairly quickly. That was the quick part. The part that took longer was melding the cultures from all these various Centers, because we were marrying a human spaceflight culture with cultures at aeronautic centers and research centers and science centers. Especially in the early years we had a number of—we used to call them Strategic Management Councils, retreats where we would get the management team together. First of all, we would get to know each other, because many of us had never worked together. We would get to know each other, and we would work through the cultural differences.

Then we established business rhythms. We have a daily status telecon where we talk to everybody from the remote Centers and we get together monthly and quarterly. So we set up business rhythms to allow the interactions to manage the program.

JOHNSON: Do you feel like this was very successful and it had benefits beyond just the obvious benefits at the beginning? What would some of those other benefits be?

KIRASICH: Again, the earliest benefits, at a time when JSC had three major programs, the Shuttle Program, the ISS Program, the Constellation Program as well as standing up this new hardware development project, Orion CEV [Crew Exploration Vehicle], and when you went to these other Centers there wasn't as much work, and everybody everywhere we went wanted to be a part of Orion. We had the best and brightest, most talented people available in the Agency to solve

some of these big hard problems for us. Thermal protection system. Our launch abort system solid rocket motors. Our landing system. We were really able to attract the best and the brightest people.

We went through a transition in 2010. A couple things happened. One, we were proposed to be canceled. Two, the budget was cut, so we had to be a lot more careful how we used our dollars. The third thing, when the Shuttle stopped flying, all of a sudden the excess capacity at the Johnson Space Center went away. All of a sudden we had capacity here. We had to downsize the program commensurate with our budget, but even then everybody in the Agency that was on the Orion team understood and supported it. We would go to the other Centers, and it was very very helpful to see their view of what was happening to us because it gave us a lot of good ideas about how to manage the program moving forward.

JOHNSON: Let's talk about the ESD, the Exploration Systems Development Division, and that cross-program system integration, and how that worked with that.

KIRASICH: In the Constellation Program, there was actually a major, relatively speaking, relative to ESD, large program office that integrated the efforts of the Orion spacecraft, the launch vehicle system, the ground operations team, and the flight operations team. Also we actually had a space suit project as well. There were five major development projects underneath the program.

In 2010 when the budgets were significantly reduced and also the way Congress allocated money—before, money was allocated to the Constellation Program and the Constellation Program would divide it amongst the development projects. In the new order after 2010 the

major funded line items were for the launch vehicle, SLS [Space Launch System], and for Orion. Initially the Ground [Systems Development and] Ops [Operations, GSDO] project was funded under something called 21st Century. Eventually that changed and now ground ops has their own allocation.

There were a couple things. At the time there was no funding for a large program office. Secondly, because we had had a large program office under Constellation, coming out of Constellation we wanted to try something different where the focus was put on the flight hardware development. We created a very small light touch integration effort that ESD, Exploration Systems Directorate at [NASA] Headquarters [Washington, DC], managed. It was not a large organization that managed every interaction among the programs. It was a smaller integration organization that managed the key touch points. Then the responsibility for program integration between the programs was put on us – each of the programs.

I'm responsible for reaching out to GSDO. I'm responsible for reaching out to the launch vehicle and make sure my project works with their development projects. It's not this top down integration. We pushed the responsibility down.

JOHNSON: That I would imagine makes things quicker, or it makes the process of making those decisions on the integration easier?

KIRASICH: I think most of us who had experienced both ends of the spectrum, if you will, saw it was much quicker. When we run into issues amongst programs we have to work it out. Sometimes it's hard because we trade tough issues that make it harder or easier for our partner programs, but we work through that. Yes, this approach still brings an efficiency to the process.

JOHNSON: One of the other things you mentioned during the last interview, the way you described the EFT-1 [Exploration Flight Test 1], the day of the flight, and you described it as an electric day. Talk about that day and your memories of that day.

KIRASICH: On our first launch attempt we had to scrub. There were a couple reasons. First of all there were some range violations. There was at least one boat in the area where the launch vehicle would fly over, so we had to pause and hold. Then there were some winds violations.

Then after holding and recycling the count several times, one of the valves on the launch vehicle got so cold because it was in their liquid cryogenic system, that we had to stop for the day because the valve wouldn't work anymore – it was required to close during ascent. That day I guess it was the first time we as this larger Orion team had been involved in such a large flight operations scenario together. We scrubbed and had to go home that night and we didn't really know when we were going to try again. We were told, "Well, we may try again tomorrow night." But we really didn't know how serious the valve problem was. We didn't know about this valve, how it would unstick itself. In a way, that first launch attempt was a stress reliever.

We came in the next night excited to be able to try again so soon. Everything about that night just went absolutely perfect. The people who had been involved for so long putting this together, it meant a lot to them. It seemed to us that the public in Florida, in the United States, around the world stopped for a brief moment to watch what we were doing – that Exploration Test Flight. Even though relatively speaking it was a short flight, only two orbits around the Earth it generated huge public interest. But the fact that it was testing out this spacecraft that is

going to carry humans, people, farther than we've ever been before, I think to me showed the passion that a lot of humans, a lot of people, around the world have in what we do.

I felt it. We felt it. The statistics from all sorts of Internet traffic and social media traffic, as well as traditional media traffic, was really incredible.

JOHNSON: Information gets disseminated so much differently now than it did during Apollo or the way it was beginning of Shuttle.

KIRASICH: That's for sure. We're lucky. In Orion we have a tiny but very talented and creative communications group that understood this and created really neat ways to get our story out. They focused on new social media techniques, and they really did a fantastic job putting Orion's story out in the new media.

JOHNSON: During that day of the launch, and then during the flight, where were you?

KIRASICH: In the Mission Management Team Room. We had a Mission Management Team Room and an Engineering Support Room in the Launch Control Center at the Cape [Canaveral, Florida]. Then we had the flight control team in Houston. I was with the mission management team. The mission management team was actually led by Lockheed Martin, our contractor for this flight, because NASA purchased data from this flight, we actually hired Lockheed to build the vehicle and fly the mission.

Mark [S.] Geyer and I, our Chief Engineer, Julie [A.] Kramer[-White], our Chief Safety Officer, John [K.] Trainor, members of our management team associated with recovery and

flight test, we were all together in the mission management team. As the day went on, we were joined by some of our Agency leaders, Bill [William C.] Hill, Bill [William H.] Gerstenmaier, Charlie [Charles F.] Bolden joined us in there.

We came in I believe a couple hours after midnight, and on the second attempt the count that day went flawlessly. We just sailed through all the points the day before we had issues with. Then for launch the building we were in, it's not like the Launch Control Center that we used for Shuttle flights and we'll use for SLS. It didn't have any windows, so we had to run out about 10 seconds prior to launch, to watch the launch, and we watched it until we couldn't see the rocket anymore, and then we came back in.

Then the flight really clicked off beautifully. All the events, all the things that we worked so hard for, the things that we were challenged by, that we were worried about and could go wrong – they all worked. For example our fairings. Really interesting story that we didn't fully appreciate at the time. The clocks in the room of course counted the actual time, the actual real time, the actual mission elapsed time. The video was about three, four, five, six seconds delayed. We got to the time where the fairings were supposed to deploy and they didn't deploy, so we began to wonder. We didn't realize there's a delay in the video. But of course three, four, five seconds later the fairings came off.

Everything went fantastic. The view as we went through apogee, the highest point, which was by the way the most energetic orbit that we've sent a spacecraft built for humans has been in a long long time, was fantastic, like the first views from our previous programs. Then the separation events coming home and the really neat video that we saw during entry and then the chase planes when they acquired the Orion spacecraft. It was just really neat to see it all come together, especially after what we the team had been through since 2010.

JOHNSON: There were really no big problems with the flight itself, but the uprighting system after landing was the only problem.

KIRASICH: Right. We had the uprighting system where I think three of the five bags had holes in them, we found out later. Somehow we generated a hole, so they didn't hold their inflation. That was the biggest thing that came from the flight in terms of things that we noticed during the flight that we had to improve for the next time. That was the biggest.

JOHNSON: Speaking of that, let's talk about lessons learned that you did learn from EFT-1 to apply to EM-1 [Exploration Mission 1].

KIRASICH: We knew we were going to learn technical things about the spacecraft. For example the heat shield. We learned that manufacturing a five-meter-large monolithic heat shield is very hard we had a hard time getting the structural material strength we needed and it cracked. We learned about the CMUS [Crew Module Uprighting System] bags that you just brought up. But more importantly, the things that really benefited the program the most, we learned how you build a new spacecraft from scratch for the first time. In the human spaceflight program we only do that once every 20 to 30 years or so. We learned, for example, how you go from design concepts to PowerPoint chart to engineering drawings. When you're trying to get out 1,000 drawings a month, how hard that is to get all the concurrences on it.

Then those drawings go out, and they get distributed to a supply base which included about 1,000 manufacturers from around the United States. All of those orders to all those

suppliers, whether they're for single sophisticated parts like a computer, for example, one computer includes 40,000 individual parts, or they're to manufacturers who provide us, click-bonds, which are relatively simple, lights or harnesses or connectors, all those things have to be tracked. We learned how to set up an organization that we called supplier management.

Then we learned about how to assemble the vehicle, how to keep the assembly facility clean. Then we learned about spacecraft testing and verification and flight ops [operations]. We learned the end-to-end process of what it takes to build a spacecraft. The first time through it, when you have a team of 5,000 people doing it, you don't have everybody all aligned in the same direction. There were a lot of these areas that there was plenty of room for improvement. At the end of the flight we sat down and we wrote these things down and we implemented lessons learned into our Exploration Mission 1 flight production. It's going dramatically smoother, better, more efficient. It doesn't take long. Our production metrics, our drawing release metrics are better. Our software development metrics are better. How we're managing the supplier base is better. Everything about the second time through is much better because we had the EFT-1 experience and learned how to do it as a team.

JOHNSON: What about some of the technology and the advances in technology now that Orion provides?

KIRASICH: Yes. There's a couple of different areas where Orion is pushing or taking advantage of the state of the art. Electronics is one of them. Everybody always grabs the latest and greatest in electronics technology. We have things like GPS [Global Positioning System] navigation where previous vehicles at least when they were designed and built didn't have GPS. For

example our entry, when we finally deployed our parachutes we were exactly where we needed to be. After you deploy the parachutes you're really at the mercy of the wind. But at the point we deployed the parachutes our spacecraft position was incredibly close to exactly where we were trying to hit.

The use of lightweight materials in the spacecraft. Composites, high strength metallic alloys, it allows us to build a stronger, more capable spacecraft for less mass. Another couple of key technologies involve crew safety. Our Launch Abort System, the system that will pull the crew away from an emergency from either the pad or during ascent, it takes advantage of a technology that was developed by the Strategic Defense Initiative, SDI. It's a steerable attitude control motor, solid rocket-based, that can actually point the abort system and control your direction during abort. This technology expands the envelope of survivable abort conditions to a much larger envelope than for example the Apollo spacecraft abort system had.

Similarly we are developing what's called an Amine Swingbed. It's a catalyst bed that removes carbon dioxide from air and then bakes it out overboard so it's a very efficient way of removing carbon dioxide from the air, so another example of a new technology that we put in the spacecraft.

JOHNSON: Also as people like to point out, the Space Shuttle was built and operated with 1980s computers and technology. Orion from what I've read is more easily upgradable than Shuttle was?

KIRASICH: What we did was our computers are a Honeywell product and it's based on the computer and the architecture that Honeywell sells to Boeing, one of their aircraft programs.

Whereas Shuttle computers had a limited base outside of the Shuttle Program that used those specific computers, Orion is able to benefit from this larger install base of our electronics and our computers specifically. As the aircraft industry upgrades its computers and takes advantage of evolving technology over the years we'll be able to benefit more easily from that than if we were the only ones or if we were one of a smaller install base that uses this particular computer, this family of electronics.

JOHNSON: You were mentioning some of the pluses of having that multicenter organization. Now of course we have European Space Agency [ESA] partners. It's the first time that NASA has joined with anyone outside the U.S. to actually build from the beginning this spacecraft. Talk about how that works and the differences in communication and the differences in the way you may work with them or the similarities as you would with the different Centers.

KIRASICH: What you find, there's commonality in working with a different Center, in that it's always different. In fact we sometimes tell a joke. I talked about how we move work packages to different Centers. We moved the work package for the ESA integration to the Glenn Research Center. The Glenn Research Center manages our work to interface with ESA.

If you think about it a little bit, they not only have to communicate with the Europeans and work through the language and the cultural differences, but then they have to work with us at Johnson Space Center. We have a cultural difference with Glenn and Glenn has some cultural differences with the Europeans. Glenn actually has to marry up the two cultural differences in addition to integrating a complex space vehicle.

What you find when you work with—whether it's another Center or another partner—sometimes I call it culture. People are what their experiences have taught them, and their value systems are based on that. The Europeans have been very successful, they've built a lot of very capable spacecraft. The ESA Service Module has actually leveraged a lot of design from the Automated Transfer Vehicle, which flew to the Space Station a number of times and proved the autonomous rendezvous and docking techniques. It was very successful.

The Europeans have clearly proven many times that they are capable of building outstanding high quality space products. But they have sometimes I will call it different approaches, different engineering standards, different cultures. What we have to do is work through those. That's one of the biggest challenges of working with ESA.

It was really no different than—it's a little bit different shape and size, but when we first brought Lockheed Martin, our prime contractor, on board, Lockheed Martin had not built a human spacecraft before. So we had culture differences we had to work through with Lockheed. We find the same thing with the Europeans. A big part of the challenge is not only to get the technical designs to match up and the connectors to align, but to get the people to align and to work through problems, because many times what they say is true and correct but we don't understand what they're saying. You have to work through it.

JOHNSON: You mentioned with the multicenter that it was a policy mandate from the Agency to spread that around. Where did the decision and the agreement to do this partnership with ESA come from?

KIRASICH: We were asked, sometime after 2011 or so, by Headquarters, by the Human Exploration and Operations Directorate, to conduct a feasibility study of having the Europeans contribute some element to Orion. At the time there was no specific mandate for ESA to provide a Service Module or this component or that component. The Europeans were interested in becoming involved in our exploration program. We generally—when I say we, the Human Exploration and Operations Mission Directorate—were interested in having an international partner.

We had to work through a number of constraints to identify the work package that the Europeans would do. There were several drivers to that. One was the amount of financial contribution that the Europeans could afford. It was based on the offset available in the Space Station CSOC cost, Common Space Operations Costs, so how much value was left that the Europeans owed the international partnership via that CSOC agreement. We had to find things that fit that value.

Then there were of course European preferences. They needed to provide something big and visible and not piece parts scattered all over the vehicle. They had technical expertises, for example there were really interested in automated rendezvous, but we didn't need that initially and had our own mature team in this area. We, NASA, had a desire to make sure the interface between what NASA and Lockheed would build to and what the Europeans would build was relatively clean and easily definable. That's how we settled on what we now call the ESA Service Module. It's really the lower half of what used to be called the Service Module proper. Then we have an adapter that Lockheed builds that goes on top of the ESA Service Module to complete the Service Module. This Crew Module Adapter then mates to the Crew Module via a much more complex set of interfaces including separation bolts and a separating umbilical.

That was really key. It really did dramatically simplify the interfaces because now what the Europeans provide bolts on and stays connected to a NASA/Lockheed-produced piece. The actual dynamic piece and the pieces that have to separate in flight are actually both built by NASA/Lockheed. It simplified the interface and it fit the budget profile. It certainly supports the ESA desire to have something really big and important part of the spacecraft, because it's really a critical part. The ESA half generates all of our electrical power, stores our major consumables and provides propulsive capability to do the exploration missions. We can't explore without the ESA Service Module, ESA is in our critical path.

JOHNSON: Of course because of schedules and timelines, does it make it any more difficult to work with someone outside the United States as far as keeping on schedule to get things done?

KIRASICH: Since it's another partner and it's a partner that it's not like having a NASA Center down the road, it's far away, time differences, native language differences, and as I mentioned before, engineering culture differences, it takes more effort to integrate our international team. But we also benefit from this. We increase the resource pool available to Orion and for human exploration. We also provide value to the country in increasing good, stable relationships with our partners.

I don't know that that in and of itself drives schedule appreciably. I do know that when ESA joined, we formally added them in 2013, we were well on our way to building our first flight test. ESA was just starting to design their first entry, so they started out development maturity-wise, behind us. We had been at it a number of years. We had an EFT-1 spacecraft that we were ready to fly.

I would say not because they're slow, not because they're incapable, but because they started out behind us, they have been playing catch-up with us. As I mentioned we learned a lot about production on EFT-1. So generally speaking our production process the second time around is a little faster and has fewer problems than when ESA is doing things for the first time around.

There is that difference. It is not because the Europeans don't know what they're doing. They just started out from a different point when they joined the program.

JOHNSON: I've heard it mentioned before in some of these interviews, that by bringing in the partners from other Centers and the European partners, if things change with the change in administration, the President, it makes it more difficult if you have European partners to cancel something and start over again. Do you feel that bringing in these different Centers and bringing in European partners might help?

KIRASICH: Bringing in international partners and having an international partnership makes the program stronger, makes it more appealing to future policy makers. When you look at our national leaders and what they'll be concerned with, it's the nation's security, our standing in the world and how well we get along with other countries and work together. This is an example of our country working with other countries in a really cooperative fashion. This partnership makes the program more attractive to new political leaders coming in, in that it's a demonstration of our country working together with others on a really hard complex program. Hopefully they will see value in this, and then this provides another reason for them to want this program to continue.

JOHNSON: Looking over your time with Orion, is there anything you would think of or point to as your most significant challenge?

KIRASICH: We talked early on about change a lot. We had a lot of change in the beginning. I would say probably two things. The most significant event no doubt was responding to being proposed to be cancelled in February 2010. Hopefully I will only live through one of those in my career, because that was very very hard individually and for the whole team to work through that. We talked about it the first time we were together.

After that I would say second thing that surprised me, because I'd always come from mature programs, but when you're early in the development stage, your program exists only on paper and on PowerPoint charts. It's very easy to change, and it's very easy to be critical of a PowerPoint chart. You have to be conscientious and focused to limit the change, because you can always go back and spend another couple months making a new set of charts. You have to be conscientious and transition your program from out of this paper stage into a detailed design phase and ultimately produce flight hardware. The early days where we were in a lot of that PowerPoint engineering was quite challenging, and we had to break through that.

JOHNSON: What would you consider your most significant contribution?

KIRASICH: I would say there are probably two things that are memorable to me and important to me. First off, it was bringing a production schedule-focused emphasis to the program, especially on our way towards EFT-1, when we were really struggling getting parts to the Cape and building the vehicle for the first time.

Secondly, I do remember early on I feel like I contributed in establishing this multicenter organization, because in the early days again to make those personal ties, to establish those business rhythms took effort. I think those are the things that I remember most about my tenure here on Orion.

JOHNSON: Was there anything that we haven't talked about that you wanted to mention? I imagine you have lots of stories and anecdotes. Any memories that we haven't talked about that you'd like to?

KIRASICH: I'm sure I will think of something, but for now you've exhausted me. But if anything comes to me I can send you a note.

JOHNSON: Okay. We appreciate it. Thank you very much.

KIRASICH: Good.

[End of interview]