INTERVIEW WITH

Chris Scolese

BY DON COHEN

Shortly after he took on the job of Chief Engineer, Chris Scolese talked with Don Cohen about leadership, learning, and NASA's new mission.

COHEN: How do you see the role of the chief engineer at this moment in NASA's history?

SCOLESE: The job that Mike Griffin asked me to do is to bring excellence in engineering to this Agency. I believe we have great engineers, scientists, and practitioners here. One part of my job will be channeling the talent we've got to deliver the new products that we need: a CEV (Crew Exploration Vehicle); a launch vehicle to get us to the Moon and ultimately to Mars; and robotic missions to scout areas where we want to put humans down and to find resources so they can live as much off the land as possible.

COHEN: Do you think it's important to retain the knowledge of older engineers soon retiring from NASA to accomplish this mission?

SCOLESE: Absolutely. In some ways, our human space flight goals are a case of back to the future. We need to learn from the experience of the people that helped us with the shuttle and Apollo so that we have the best possible chance of delivering the vehicles we need. That's going to mean not only looking at people we have currently working in the Agency but talking to people who worked at NASA or in industry and are now retired. A lot of people have been writing books about the Apollo era lately, but there's no

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substitute for talking to the practitioners and finding out what the reality was when they were building the lunar module or the capsule.

COHEN: It's hard to capture that knowledge.

SCOLESE: It is, and as you get further from the experience, you tend to remember the good things and overlook the bad. NASA has to become a learning organization. One of the things I want to see us do is get lessons learned out as quickly as possible. We need to do this for our successes as well as our failures. We need to sit down for an after-action review after a mission is launched, catalogue the lessons of that experience, and make them immediately available.

COHEN: After-action reviews seem to work well when they're a standard part of every project. If they're voluntary, people will always be too busy to do them.

SCOLESE: When I went to Goddard, they were required after a mission was launched and checked out. And after every mishap or significant close call, we had an after-action review.

COHEN: So you think learning from mistakes is important?

SCOLESE: We lost some of our luster because of Columbia and the Mars '98 failures. But, as we learned from Mars '98, we can come back stronger when we apply the lessons learned from failure. My job is to take those lessons and produce the successes we need in the future. It's not going to mean we won't have failures, but we want to make sure they are few and far between, and we don't ever want to have a Columbia again. We want to develop a test program that tells us what the limits are so we don't put a crew at risk, so we don't lose a mission. Part of what we learned from Mars '98 is that engineering rigor, discipline, and rigorous review processes give you the highest probability of mission success. We have to apply the same lessons on the human space flight side. We haven't designed a human spacecraft in thirty years. We haven't flown a new human spacecraft in ten or twenty years, depending on whether you include the replacement orbiter for Challenger. We've got to reenergize our talent and go back and get the talent that helped us design and test the shuttle and Apollo. We also need new capabilities.

COHEN: For instance?

SCOLESE: Having a long-term program means we've got to bring in talents that are not traditional to the Agency. We know that many of these new systems are going to last ten, twenty, or thirty years. We have to look at maintainability, supportability, and logistics so they will still be viable thirty years from now. We're going to have to maintain the knowledge that it took to design those systems so we know how to operate and adapt them. The shuttle was designed thirty years ago by a lot of smart people, most of them now gone from the Agency. Many decisions they made that may not seem to make sense today made sense then, but if you don't have the knowledge that allows you to say, "Oh, that's why," you run into issues. The same is true of the expendable launch vehicles. The Delta II is a wonderful vehicle. Had we known it was going to be around for fifty years, we probably would have thought about it differently. Today, we know that what we design will be around for twenty or thirty years, so we can start thinking differently now. That's a new capability for NASA.

COHEN: Does the new mission focus mean hard choices for NASA? For instance, backing away from programs it has supported in the past?

SCOLESE: We certainly have to make hard choices, but I'm not sure the new vision has as much impact on that as other factors. Instead of eliminating capabilities, we will be focusing capabilities. You'll see that all the letters of "NASA" apply. Landing on the Moon is one thing, and we've done it with robotic spacecraft and human spacecraft. So we have some experience there. Mars is different. It has an atmosphere—thinner than Earth's, a different composition, but an atmosphere. That means landing will be a different process. NASA successfully landed on Mars five times, in some cases with powered descent and in some cases using parachutes and balloons. Now we're talking about larger spacecraft to send humans there, so we're going to have to understand the Martian atmosphere a lot better. If our folks working on hypersonic aircraft and aerodynamic shapes can come up with the capabilities that allow us to have a wider range of entry conditions, that makes the job of landing there that much easier. We can use the atmosphere to slow down. For instance, we can use parachutes. Again, most of our knowledge of parachutes comes from the aeronautics folks. If we understand Earth's atmosphere, to a certain extent we can extrapolate that knowledge to Mars. The better we understand the chemistry and physics of the atmosphere, the more likely we're going to be able to land on Mars safely. Understanding the constituent parts of the atmosphere may provide capabilities for robotic air-breathing engines. Also, robotic spacecraft that go in long before humans get there can find not only good landing sites but also resources. Where might there be water? Where might there be heavy concentrations of oxygen-bearing minerals? Where might there be potentials for getting fuel? If we find an area that has water or ice, we can convert that to hydrogen and oxygen, and we've got fuel. If we find carbon dioxide and bring some hydrogen with us, we can make methane. Now we have methane and oxygen: fuel. We can breathe oxygen that we find.

Our vision calls on us to provide economic opportunities and expand our knowledge of science. We're going to be looking at the earth to understand it better. We've just been through powerful hurricanes. If we can support our sister agencies—NOAA [National Oceanic and Atmospheric Administration] and USGS [U.S. Geological Service] and FEMA [Federal Emergency Management Agency]—we'll do that. But our prime focus will be on getting people on the Moon and Mars. Once we can leave Earth's orbit and start living out there, the beyond becomes very big. The whole solar system and universe are open to us. We're going to be looking for Earth-like planets. We're going to be looking at the fundamental physics of the universe.

COHEN: Are there problems of communication and maybe tensions or disconnections among groups—engineers, scientists, astronauts, bureaucrats—that need to be resolved to achieve these goals?

SCOLESE: A lot of what came out of the CAIB [Columbia Accident Investigation Board] report and the return-to-flight task group addressed exactly those issues. We didn't have the communications we needed to make the right decisions. Those barriers are being brought down. The NASA Engineering and Safety Center (NESC) is one example of doing that by bringing together the best engineering talent from around the Agency—not just from Ames or Glenn or Langley or Goddard or JPL or Johnson or Marshall or Kennedy. They are available as a resource to bring exactly the cross-fertilization and different views you're talking about. The Independent Technical Authority is addressing the question of who is responsible for the success of an element or of a system. That's part of what engineering excellence is about.

There's always some tension, frankly, and it's healthy. Do scientists talk to engineers? Of course. If they don't, they're not going to get what they want. Do engineers talk to scientists? Of course. If the scientists don't have good ideas, there are fewer missions to do. Scientists want to accomplish significant things. So does the bureaucracy. They set the goals and then the engineers and astronauts and resource people say, "We can go this far, but not that far." We don't want to lose that tension, but we do want to bring down the barriers of communication. That's part of my job. Engineering excellence always comes down to communication and the ability to work together.

COHEN: So maybe organizational skills are as important a part of achieving NASA's goals as technical skills.

SCOLESE: We definitely have to adjust our management and organizational philosophies to meet those challenges. And we should evaluate those techniques just as we evaluate technologies. When you have a new technology, you're skeptical, you worry about it, you check it, you modify it as you go along until it delivers what you expected. Or you adjust your expectations to what you can deliver. We need to do the same thing with our management systems. We haven't done that. We never look down the road and ask, "Is it giving us the value we expected in the beginning?" When we need a new engine, we develop a test program and look at every step along the way: Are the materials working? Are the temperatures what we predicted? Do our analytical models make sense? If not, what do we have to change? We should do the same thing for our management systems.

COHEN: What is it in your background that gave you the values and insights you're applying now?

SCOLESE: I was in the nuclear navy for about eight years, part of that time working for Admiral Rickover. That instilled a value in me that's absolutely important: being personally responsible for the success and safety of the mission. In the nuclear navy, when a new ship went to sea or you put new hardware on a ship, you went out with the crew. So you *really* want to make sure it works. Of course, you do anyway, but this dramatized the point. You never want to be in a situation where you'd say, "I wouldn't go out on it because it's unsafe." When I was a junior officer, I didn't have much responsibility, but I knew that what I did would have an impact. If we're going to have engineering excellence, technical excellence, and mission success, every single person has to realize that they are part of the team and their work is important to the success of the mission. Whether your work is sweeping the floor; washing windows; typing reports; or designing, testing, or flying the system, you're part of it. You're responsible for your job but also for problems you see. There was the case of a janitor who was sweeping up and noticed bolts lying on the floor. He reported it. I don't think those bolts had a direct impact on the mission, but they showed that people controlling the hardware weren't doing a good job.

COHEN: Is there a part of your experience that helped you recognize the importance of the human or social side of an organization?

SCOLESE: I think sports did it, to be honest with you. I wasn't a very good baseball player in Little League, but we had a coach who was just great. We were a bunch of misfits, but we all got along. The coach taught us what he could, and we probably won more games than we should have. I ended up being pretty good in track, but my first two years on the team were really frustrating. The coach didn't provide any organization. My last two years, with largely the same people and a different coach, were fantastic. We won various championships at the appropriate level. We went as high as we could possible go. I saw that building a team depended not only on the people on the team but also on the

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leadership, and that a well-functioning team can accomplish a lot more than the individuals themselves. Sometimes that involved personal sacrifice. The coach would say, "I know you can win this race, but I really need you to take at least a second or third place in another one." So you thought, "All right, I'm not going to get a gold medal this time." Sometimes you surprised yourself. The team ended up doing well as a result, and we all ended up doing well. Throughout my career, most of my supervisors have recognized the importance of good leadership and helped me to recognize it. In the navy and NASA, I was fortunate to have people who appreciated and understood that and served as mentors. And I had one really terrible person and saw how dysfunctional you could be when you don't recognize and utilize talents.

COHEN: I've been struck at how talented and enthusiastic most people at NASA are.

SCOLESE: In an organization like NASA, you find very few people who are poor performers, but you often find people who are in the wrong job. What we have to do as supervisors, leaders, and managers is find the right job for the person. When you do that, they usually excel. I've yet to find anybody in NASA who just comes in to sit at a desk. Everybody is motivated. They could make more money and have a more relaxed personal life in just about any other place. We build one-of-a-kind items so you never know what's going to happen tomorrow because you're pushing an envelope here. You don't have a blueprint to go back to and say, "We built the last car like this, so this car goes the same way." People here are motivated to do things that are hard. One of the great things about NASA is we're always doing something different and trying to do something better. We're not building the hundred-thousandth car. We work at the frontiers of technology and science and humankind. ●