



Victor Reis
1990-1991

Interview: January 17, 2007

Interviewer: Please tell us your name and the dates of your tenure.

Reis: My name is Victor Reis. Dates of the tenure—that's a little harder. I went there in the fall of 1989. I was the Deputy Director for a few months. I went in as Deputy Director. I was Acting Director for about six or eight months and then I became the Director. I was the Director until Thanksgiving of 1991.

I: What was the world like back then? What was going on?

Reis: Well, I think the big thing was the end of the Cold War. That was the dominant situation when I first got to DARPA. And then the Gulf War started, those were the major historical situations. With the end of the Cold War—what do you do with a DARPA? This was the big issue. Then during the Gulf War we had to mobilize very, very quickly. And then after the Gulf War the question was, "Do you go back to what you were doing at the end of the Cold War, or is there a new series of national security situations?" So, it was a time of considerable turmoil, and part of it was what is the role of DARPA?

Craig Fields, the Director before me, was very interested in moving DARPA into the civilian-military interface. This was the reason why he got fired and I found myself Director.

I: *Why DARPA* - seems to be a reoccurring theme. Tell me more about that.

Reis: Right. I'd been working with DARPA in one role or another, primarily as a contractor, but also on some various advisory groups for well over 20 years. Craig Fields asked me to come in to be the Deputy Director. Craig had been at DARPA himself for many years and wanted someone as his Deputy Director who had more of a relationship with the Defense Department and I'd done a lot of work with the Defense Department.

So, he felt that we'd work together as a very good team, where he would

concentrate on the technology, and I would concentrate on the applications, particularly for the Defense Department. So one of the first things I did when I became the Deputy Director is to visit a number of my friends who were in the Pentagon. I remember specifically talking to General Lee Butler, who was the J-5, the plans group. He had been working for the Chairman and for Dick Cheney—looking at this whole question of what is the role of the Defense Department at the end of the Cold War. And I said, “I’m at DARPA now. What would you like us to be working on?” And he said, “Look. We don’t need anymore wonderful new weapons, because we’re not in an arms race with the Soviets. “So, instead of inventing new wonderful widgets,” which DARPA was frequently known for, “we should really think about how to bring the cost down, and use the technology to lower the cost of acquisition.” He said he thought that reducing costs would be the most important thing DARPA could do. And that’s not getting out of the technology business in any way, concentrating on those things that could bring the cost of the weapons down.

I: That’s a *real* rethinking, isn’t it?

Reis: Yeah, it really was. And, in a sense, I think that was also consistent with the way Fields was thinking. What *is* our national security threat?

Craig felt in many respects—and I’m sure he’ll tell you all about this, that the threat was going to be economic and, in fact, might come from places like Japan, as opposed to Russia. So, how do we deal with that? He felt that the thrust was going to be in things like, high-definition television, advanced electronics, and advanced computing. And it was important for DARPA to stay ahead in those sorts of things. In other words, the interaction between the commercial world and the military world was going to get more and more blurred as time goes on. So, it was important for the nation to stay ahead in the commercial world, as well as in the national security world.

I: So he was merging the relationship that DARPA had with industry?

Reis: That’s right.

One of the things Craig did was actually start to invest in some companies, and that’s, I think, where the powers-that-be in the Defense Department, Don Atwood who was then the Deputy Secretary of Defense said, “Hey, we don’t do that. We don’t invest specifically in companies.” But the truth is DARPA had invested, if you will, not necessarily in companies, but in universities, for quite some time.

I: If the contracts were signed through different agencies within the Services, isn’t that, in effect, investing in companies? I’m not sure I understand the difference.

Reis: Well, “invest” in the sense of taking an equity position. You know, literally—being on the board, or, being in an advisory position. And that’s always been an issue within DARPA, especially in dealing with startup companies, which is part of a DARPA role. If you wanted to carry that financial analogy that much further, you can think of the Defense Department as having a technology

portfolio. And, you know, at one end, the technology portfolio would be involved in maintaining infrastructures, like municipal bonds, or something like that. At the other end, DARPA represented IPOs; let's take a certain part of our portfolio and invest in high-risk, high-payoff—that sort of thing.

I: I think it was called "other transactions."

Reis: Yeah. Dr. Raymond Colladay was the Director just before Craig, and Craig was one of Ray's Deputy Directors. I'd gotten to know Ray because when I worked in the White House at one time, Ray was at NASA, and Ray worked for me on a big study on the future of aeronautics. Ray was the aeronautics person from NASA. So, when Ray became the Director, he asked me to help. So, I worked on a number of programs with Ray, prior to my becoming the Deputy Director.

I: Was there a corresponding attempt to transition some of the DARPA programs to industry as well as to the Services?

Reis: Well, there's always an interaction between DARPA and industry. Let me give an interesting example. One day, after I was the Director of DARPA a relatively short time, I got a call from the head of technology at DuPont up in Wilmington, and he said, "Would you come on up and we'll tell you what we're doing and what we're doing with you."

We had a relatively small contract. Maybe \$10 million with DuPont for some ceramic armor they were building for us. So, I go up to Wilmington and I'm met by this *enormous*, white limousine. And we then go over to the hotel in Wilmington, which was owned by DuPont. And there were all these executives who give the company overview and drive around. We have lunch, and they're all the vice presidents and whatever, and there's a note from the president saying he's really sorry he couldn't be there, you know, but he had to be out of the country or something like that. So I'm thinking, "What is this all about?" And, driving back to the station, I had a chance to talk in the limousine to Al McLaughlin who was their chief technical officer. I said, "What in the world were these people doing here? DuPont is a great big company."

"Oh," he said. "Look. What we do is we use DARPA because we only expect one out of 20 of our ideas to actually make it, but we have a lot of ideas coming. How do we know which ones are good or not? Well, we encourage people to apply for DARPA contracts. Then you do the sorting for us, because if they work out, and we win the contract, we'll invest more in those because the probability that those things are going to work out is higher."

So, you have this odd symbiotic relationship, really, between the industry that supports the military and basically DARPA's role in doing this. And I think this was particularly interesting because then the concern was, "How do I drive down costs?" You have to understand how industry does things a lot better, because frequently it's in the manufacturing, as well as just a new idea - a new way of doing something as well—both play.

I: So, DARPA was becoming science honesty broker to industry.

Reis: Yes. Right.

And it also had a strong international flavor. One of my people was looking at this and, this was why Craig was concerned with the Japanese. I mean, the Japanese were following things very well and it became clear that those small companies that DARPA would invest in, the Japanese would also invest in because they also wanted to stay on top of the technology.

And so, in a sense, DARPA was - getting back to the financial analogy - doing a startup business. And if you remember back in the early '90s that's when you began to see the growth of the Silicon Valley and all the things that went with that. DARPA was—I'm sure people have told you—very integral in getting a lot of that Silicon Valley stuff basically going at Stanford. And all the spin-offs that went with that were, in large measure, from DARPA or ARPA.

I: Did you see that freight train coming?

Reis: Becoming a Director?

No, not at all. As I mentioned earlier, I'd been working with DARPA for some years. In fact, I remember the first interaction I had with them. I'd gotten my Ph.D. from Princeton. I was in ROTC, and I connected up with NASA, at Ames Research Center, and stayed on after my Army career was over. I stayed there as a civil servant. The particular program I was working on was using ballistic ranges to fire very high-speed pellets and measuring the radiation. The purpose was to support probes into Mars but of course it had some relevance to ballistic missile defense.

I remember that Cliff McClain, the ARPA program manager in ballistic missile defense, who came and told us about what they were doing and that seemed to me a lot more socially useful than, say, going into Mars and Venus. And so I moved from NASA to General Motors, which also had a ballistic range, and DARPA was the sponsor. And then, throughout the next 20 or some years I was a DARPA contractor and I got to know the Directors themselves very well, and they would frequently have me do special projects for them. But one day, literally out of the blue, Craig Fields called me up and said, "Hey, I've just become the Director at DARPA. I'd like you to become the *Deputy Director* of DARPA."

I was working for SAIC at the time, and just getting out of the financial hole with kids in college and all that sort of stuff. And I said, "Gee"—I really wasn't interested terribly much, but I'd be glad to come in and help him. And then he pressed a little harder, and he says, "Well, suppose we make you an IPA?" which was the "Intergovernmental Personnel Act. And he said, "I have pressure to get someone who has good contacts with the Pentagon and with the Services." And he said, "We can arrange for you to go back to work for Lincoln Laboratory and then come to DARPA as a Deputy Director." So, he arranged for me to go back to work at Lincoln Laboratory for three months and then come to DARPA as an IPA to be the Deputy Director.

I: What happened when you became Director?

Reis: I had started out as the Deputy Director but within two or three months,

Craig got fired. So, I became the Acting Director. So I had to decide: what am I going to do? Shall I stay as Deputy Director? Should I try to become the Director? Should I go back to Lincoln Laboratory?" which was still my employer at the time. "Or, should I go to SAIC?" where I was working before?" And I just decided, "Well, why don't I see if I can become the Director?"

And, of course, the way you become the Director is you act as the Director. You don't try to maneuver very carefully. You say, "Well, if you do a good enough job you'll end up being the Director" and that's basically what happened.

But it was kind of a wrenching time, and I remember waking up at 4:30 and then I was getting up at 2:30 in the morning. The thing that made a difference at the time was the Department of Defense was going in for Total Quality Management (TQM) stuff. And the Under Secretary was a fellow named John Betti, who had come from Ford, and TQM was what he was going to do. So, I said to myself, "Hey, I'm going to learn this, because Betti's going to be the person who is going to be selecting the next Director at DARPA. So, if I could get DARPA moving in that direction, I think that would help." Besides, I wasn't going to become the Director based on my skill at doing quantum mechanics, or management, because in truth, I'd never really managed anything big at *all* before. I'd always been an analyst who pretty much worked by myself. And suddenly, you're in charge of running this organization. I had done some strategic planning, but that didn't mean you were actually running an organization.

So, I took the TQM stuff very seriously. I got all the Deming tapes, actually watched them all, and tried to see how I could then use them to help organize DARPA. And then fit DARPA into this new defense world, which, we discussed earlier, it was going to be very, very different. And use this whole idea of quality as the paradigm—I said, "Okay, I'm going to use TQM as a way to lead DARPA in a way that was different, perhaps, than other people have been able to do before." And that's essentially what happened. Then after about six months or so, they decided to name me the Director.

I: Was it the Under Secretary who made the call?

Reis: It was the Under Secretary and the Deputy Secretary and to some degree the Secretary as well—I mean, Cheney, Atwood, and John Betti. You never know with those things. It turns out that it's really the Deputy Secretary or the Under Secretary that you deal with. At least that's what I felt comfortable with. And since Betti was big into Quality, I became big into Quality as well. But then I used TQM because I found it actually quite useful in terms of organizing. I sent everybody to Quality school, from literally the guy who carries the mail around to the office directors. And then I subsequently reorganized DARPA to fit the new approach.

I: Can you tell us, how close was DARPA to being shown the door?

Reis: Well, I don't think it was. There was talk like that and the question was, what do you do with a DARPA? But you know everybody likes DARPA.

Everybody likes DARPA. And it's leadership-oriented and it's pretty high-profile when it wants to be. So, I don't think there was any question about DARPA disappearing.

There was a question about what DARPA's role might be and how one would organize it to make it change, but it never occurred to me that DARPA wasn't going to exist. There was always a concern about size of the budget—was it going to be bigger or smaller—basically that sort of thing. And there's always that kind of chatter, but it never really occurred to me that it was going to go away.

It occurred to me, "What am I going to do?" because this organization is so small, and, of course, the way it's positioned, it's responsive to leadership. And most of the DARPA Directors, if not all of them, recognize that, in terms of what they could do. I mean, they could really make a difference in some sense if they wanted to.

I: Well, I like the idea that TQM saved DARPA.

Reis: I think it did. I mean it certainly was a peculiar situation. One is you have an Under Secretary who said, "Do TQM." You had Vic Reis coming in who'd never run anything large at all. But, after all, systems analysis was basically my job, and strategic planning was a way of doing systems; a way of quantifying what you're doing. Well, that just fit in very kind of naturally for me as a perspective. I felt I could use TQM to get a hold of this organization.

I certainly wasn't in any way the scientist that, say, Craig Fields, or George Heilmeier, or Charlie Herzfeld, or some of the other Directors who were really first-rate scientists were. I was a systems analyst, and so you take the approach to asking, "How do I integrate this? What's really important here during this change?"

And Deming and TQM *force* you to think about what you do and force you to put numbers on things; to analyze what it is that this organization does. And, fundamentally, what DARPA does is put money on new technology and make decisions.

I remember talking to one of the office directors, and I said, "Well, what do you do?"

He said, "Well, I do radars here. We invent radars."

And I said, "Well, show me the radar. Where in this building do we make the *radar*?"

He says, "Well, actually, we don't make them here." All he did was help the radar community move in new directions.

People actually thought they were building stuff, and they weren't. What they were doing was making decisions, putting dollars on it, and putting programs together. TQM forces you to say, "Well, what am I doing? How am I doing it? How well am I doing it?" And, "How do I measure what I'm basically getting to happen?"

I: Did you encounter any kind of resistance?

Reis: Oh, sure. Sure.

There was a fair amount of resistance from people who had come here because DARPA's, in large measure, a group of free spirits. That's why they went to DARPA. They didn't go there to think of themselves collectively as doing anything. They came there because they were going to personally make a major change, and they had four or five years to do it, and, by God, they were going to do it. And they looked upon the person in the next desk or office as a rival, not necessarily as a team member. And so that was the challenge.

So, I was challenged. I think when any DARPA Director comes in; he's challenged to *some* degree. And some of them like a George Heilmeier and Craig Fields; their brains were so good, that they—(chuckles)—knew the science better than the people who worked for them. But I was a systems guy, and I knew how these things played together probably better than they did.

DARPA is a leadership organization. How do you, in fact, provide the DARPA managers with that leadership? And that's what TQM does for you. If you think about it, it says, "Look, everybody is a customer, a supplier now." If the people working at DARPA are my customers, what do I give them? And the answer is I've got to make decisions, and I've got to give them a leadership role, and I've got to help provide them with a direction.

What I couldn't do, which is what Heilmeier could've done, and Craig would've done, was really help them from a scientific perspective, from a technical perspective. Because they were that good. I didn't know quantum computing. And a lot of DARPA was developing very basic, very important technology, much of which I had never really encountered during the 20 years I'd been working for DARPA because I'd been working a lot from the applications sort of perspective. It was a question of how you pull all that together. That was important.

So, from my perspective, the hard part was, well, how do you integrate this? DARPA goes all the way from quantum computing to RPVs [Remotely Piloted Vehicles], and satellites and - RPVs and satellites I understood, how do you pull all that together? And I felt that Total Quality was the approach that, one, made some sense from a systematic perspective; and, two, to be honest, it was also being pushed by the guy who was probably going to decide whether I was going to be the Director. And, if I could show him, look, I can use TQM at DARPA, which is not a place you would ordinarily think of using TQM, then I'd be more likely to get the job.

I: Was the country anticipating reaping the benefits of the peace dividend?

Reis: Yep. Right.

I: What kind of budgetary constraints were you anticipating?

Reis: Well, it looked like the budgets were going to basically go down, but in truth, our budget actually went up. It was kind of interesting, and part of it was that there were a number of large programs that were being killed at the time. Now, in the Defense Department, they completely kill a program, they almost always continue the R&D. What better place to continue the R&D than DARPA?

The comptroller of DARPA had come over from the Defense Department,

and knew the DoD system very well. He looked like an accountant. He'd been there for some time and didn't quite fit the DARPA mold but he really did the financial stuff very well. Among other things, he would discover when a program was going to be killed and he was able to then be first in line to get that R&D money. So while there was a lot of talk about financial pressure I didn't feel any.

I: So, it was backwards transitioning.

Reis: Well, it's backwards - things are changing, okay? Who do you look to change? Well, you look for the technology organization to be at the front of it. So, you don't want to be cutting back on that. And, you know, Cheney understood that. Atwood understood that. And Betti understood that as well. In times that are changing you don't cut back your change organization. That's where you want to be investing.

I: Does change become the constant, then?

Reis: DARPA is a change organization. I think change *is* the constant in a place like DARPA—absolutely. Change and leadership, remember, go together. If you're on a constant path, management is what you need, but if you're going to change, you got to have somebody who can visualize where you want to be and move in that way.

I can remember very clearly, by the way, getting back to your early statement, talking with Fields about this before I came to DARPA. And he said to me, "Do you know anything about Franz Liszt the composer?" He says, "Well, Liszt started changing his music at some stage, and when people said, 'What are you trying to do?' he said, 'I want to throw a javelin into the future.'" And then Fields said, "That's what I think DARPA's role should be."

And, you know, as far as I was concerned, that was it. The concept of DARPA is that you're throwing a javelin into the future and you're going to hit something. It is really what DARPA's basically all about. And I still remember the feeling: that's what I want to spend my life doing.

I: When you look at the project portfolio and the TQM approach, did it help you weed out some projects?

Reis: Yeah.

I: How did that process work?

Reis: Well, you know, it certainly helped us weed out projects, and, in fact, Craig had already started this. He called them "shooting stars" and "fallen angels," and he said, "We've got to start thinking about how to separate these in terms of where we're going." The question now is, "Okay, how do you do this with TQM?" The first thing I did is send everybody to TQM school so they understand the basics. Let's try to get everybody on the same page. Then I reorganized. Let me give an example.

There was a Manufacturing Office but it was completely disconnected from the rest of the organization. The Congress had said, "We want the Department of Defense more involved in manufacturing. Let's start a

Manufacturing Office. Let's give it to DARPA." But it didn't integrate into DARPA as a whole.

Well, this guy who was head of the Manufacturing Office wanted to build workstations. Well, that's what the commercial sector was doing. That wasn't something DARPA could really basically contribute to, particularly. So, I eliminated the Manufacturing Office, but integrated manufacturing into the other offices.

I did a couple of other things. One sounded pretty simple, but it turned out to be, I think, a little more profound. The way the system had been set up, before the money could be released, there had to be something called a DARPA Order, and only the Director of DARPA could approve them. Once he signed a DARPA Order it went to the comptrollers over in the Defense Department and the money was released. And when I got to be the Director, boy, there was a pile of DARPA orders, waiting to be signed. And each DARPA Order came with all the backup material. I realized there was no way I could read all this material.

So, I told the office directors, "I'm going to give you 24-hour service. Everything you give me I am going to sign within 24 hours. I'm only going to read the front page, because I don't have time to read to the back page." Part of the job of DARPA was to give money to technology. And if you're not giving the money, you're not doing the job. But I said, "Then you're responsible for the quality of the work." Well, at that point, one of the office Directors completely froze. He was using the Director for his quality control. Okay? He didn't feel comfortable with signing off on it. So his whole organization stopped, compared to the other organizations. So, that was an opportunity to use quality methods. I moved him back to where he was comfortable and appointed another person as the office head. She later became the Director of the National Institute of Standards and Technology (NIST).

The second thing was to change the way we decided to select new programs. What we did was we spent two days with all the Office Directors. Every program was briefed and then every program was pairwise voted on. So everybody voted right then. Everybody got a chance to vote. So as a result, in a very short time, you were able to rank order every single DARPA program. And then, depending upon the total DARPA budget, that's where we drew the line. Each office director had one favorite program below the line, and I allowed them to keep one each.

It wasn't just somebody's judgment, it was the collective judgment. So, everybody participated. Everybody understood the process. I didn't vote at all. My job was just to make sure the process was taken care of.

I: Harold Brown had a saying, "You hire good people. You let 'em do good projects. You correct the science, and then I'll sign the check."

Reis: Right.

And it depends on the individual. I mean take George Heilmeier. George felt in large measure that part of his role was to help, help tutor, you know, help his program managers become better scientists, become better men. That was the way he did it.

In my care, these guys knew more about their subject than I did. I wasn't about to tell them how to do it, but then, on the other hand, I think I could integrate the whole picture better.

I: What was the relationship with the Services?

Reis: Yeah. I discovered that the DARPA I thought I knew from before was very different from the DARPA that existed when I was put in charge. I had a window into DARPA leadership. I had worked with Heilmeyer. I'd worked with Colladay and worked with a number of these folks directly. But nonetheless, it was basically different when you are at the top.

The relationship to the Services had to do with a direct, personal relationship with the Director of DARPA and the head of research operations for each of the Services. It could be, in some cases, the CNO, the Chief of Naval Operations, or his R&D Admiral. We would cut some deals, just go over on a handshake; paperwork followed later. Frequently these projects were classified, so I'm not going to discuss them with you, but some very important sort of classified projects were started that way, for example, some Stealth areas. They just felt, for some reason or other, that they didn't want to run it through their R&D systems. You had to move a lot quicker than their normal system would. About 30 percent or so of what DARPA was doing—at least when I was there—was based on that kind of an agreement.

So I got to know these people pretty quickly. They said, "Look, here's something important that we need to get going ..." and I said, "We can do that." Usually part of the deal was they would provide you with the program manager and frequently they would help you do the contracting. They might produce some of the funding.

But when the program was finished, and assuming it worked, the program manager and his office would then move back into the service. That's how you did the tech transfer into the Services. It was basically this handshake agreement.

I: It seems by this point, DARPA and the Services were cooperating on programs. Had the Services come to the understanding that DARPA did have a role because they were flexible?

Reis: Indeed, you know, you probably want to talk to some of the earlier Directors who put that into being, but I didn't find any problem. In fact, it was usually the other way around. I mean, it was how to be selective because there were more projects there than we could really accommodate. And at least in the two years I was there, it worked out quite well.

I: Is there an ebb and flow in DARPA's connection to Presidential issues?

Reis: Yeah.

You know, Charlie Herzfeld felt that DARPA worked on Presidential issues. And the truth is I didn't see that. What I saw was it really was the Secretary of Defense, the Deputy and Under Secretary of Defense, and the Chairman—or the heads of the Services that were the primary customers. I got

to know Chairman Powell him quite well. Got to know Cheney, too. But most of the interaction was at the Deputy Secretary and Under Secretary level.

I think probably when DARPA started at Eisenhower's initiative, it was sort of presidential. But I think by the time I got there, it was not presidential. And the key, though, I think, at DARPA is to keep it up at a high enough level, which really means the Secretary or the Deputy Secretary, so that they know what it is you're doing. The service chiefs, or their chief R&D person—these are the people you deal with.

I didn't have any communication problems at all. The reason Fields hired me on as the Deputy is that these were people I knew, so that part worked out. How to integrate DARPA was the issue that I had to deal with when I became the Director.

I: (I had heard) "Weinberger didn't know zip about science." That had to be hell for Cooper. (Laughs.)

Reis: Right.

Well, you know, I was actually kind of fortunate there, because Cheney, who was the Secretary at the time, was actually pretty good at understanding R&D. And Atwood was, you know, an MIT graduate, been involved at General Motors, and John Betti was a good engineer—solid engineer, you know. So they knew what they wanted from a DARPA for the most part. I mean I had no problems with them.

In fact, when they finally named me the Director, I went through the interview chain, and it all went pretty quickly. And so when Atwood told me I was selected I said, "What do you want?" and he said "You can do whatever you want, just stay out of the newspapers." And I said, "Now, those are the kind of instructions I can handle."

I: Now, in terms of advanced projects—what were the issues?

Reis: You know, the big thing was really in the supercomputing and information business. And that was an area I knew little about; I just hadn't been involved. I'd been involved with missiles, airplanes and submarines—the military systems perspective. I knew DARPA was involved in the computing business just by anecdote, but I had never interfaced with the Information Technology Office. And when I got there, the place was in complete revolt. Yet, I realized after a short period of time that the most important thing that DARPA could be doing—was in the information technology area.

And that's really where the guts of DARPA was, and as I thought about what the future was, in terms of what DARPA could do, it was to bring advanced information technology into the military. And, of course, it gets you right at the military-commercial interface question.

What DARPA was working on then—and this had dated back to Cooper, and really I give Bob a lot of credit, you know, for getting this one started—was the idea of parallel processing. I don't know if you've had a chance to talk to Bob Kahn who's the one who started that. I mean this really began the Internet, you know and the whole idea of packet switching and getting computers to talk to

each other and how the computer will interface with people...That was an eye-opener for me, and it didn't take me too long to realize, "Okay. What is the area that I'm really going to concentrate on?" The idea of information technology is the thing that will make the most difference. And, in many respects, that was the technical area that I knew the least about.

I feel that was the one area we made the most progress on and where we made the most impact. The reason I feel this is that after I was director at DARPA, I moved up to become the Director, Defense Research and Engineering (DDR&E), a political appointment. And then when the administration changed, I stayed on for three or four months, and then I moved to the Department of Energy, where I started the stockpile stewardship program. The basis of that program was really the DARPA computing technology; I was able to actually apply the same technology we had pushed at DARPA.

The Defense Department hadn't picked up on massively parallel computing that quickly, but I was able to pick it up, and push it when I was in the Department of Energy. I brought one of my program managers over from DARPA to run the program, so we essentially used a lot of the same technology and many of the same techniques in the Department of Energy that I'd learned at DARPA.

I: Modeling and simulation as an example of that kind of computer technology. Why don't you tell that story?

Reis: Well, part of the issue was not just fast computers, but also, how do we get those computers to interface with people? How do we use that technology to do their jobs? And, one of the applications of packet switching was a program called SIMNET, Simulation Networking, which was primarily designed as a training tool in large measure for the Army where you could simulate both sides of a battle.

People sat in what looked like little tanks but they were really interactive workstations. They could look out and see the terrain and people, or other tanks, or other things coming at them and with them on a landscape. And so you can sit in a room not unlike this one and play a whole battle out and help learn how to operate on a battlefield. Interestingly, the program manager for this, a fellow named Jack Thorpe, who was an Air Force colonel, had a background growing up in Hollywood. Right?

This was an area I felt was really important, because it took this technology right down into the soldier's hands—something really very, very practical.

Well, right in the middle of my tour as Director, the Gulf War started, and one of the things that DARPA did during the Gulf War with respect to simulation is interesting.

Even before the war was over, Jack came to me and said, "Instead of doing these mock battles, let's see if we can simulate a real battle." Jack had read a report where a U.S. cavalry troop had rolled into one of the major Iraqi training grounds where they'd run into a large Iraqi armored unit and they completely won the contest.

So, we sent a group over there, and they were able to basically simulate the battle and the conditions. We learned, for example, that one reason we did so well was our soldiers were able to wear infrared goggles. It was so dusty but the Americans could see through the dust the Iraqis couldn't.

So, not only did we build the simulation of the battle, when it was all done, I said, "Why don't we make a little documentary about how we did all this?" We did. And I then took it and showed it to Cheney and showed it to Powell and used it for various congressional hearings. Looking at it you really got a sense of how this technology that we're talking about, that seemed so abstract, could actually be used in very practical military situations.

I remember when I showed it to Dick Cheney, he said, "If we'd had that before," he said, "I could have taken that, shown that to Hussein, and he probably wouldn't have attacked Kuwait."

Now, I mean he was smiling when he said it, but he was able to pick up, I think, that this use of technology was important, and that it allowed us to simulate actual battlefield experience in training. So it was really a very interesting experience.

The other thing we did in the Gulf War worth mentioning is after the war started, one of our vehicles was shot by one of our own missiles. So, I got a little note from Mike Carnes, who was then the Director of Operations in the Pentagon. He said, "We need a solution to this IFF [Identification Friend or Foe] problem for some 20,000 ground vehicles in two weeks. We expect to have air cover. And, money no object." So I called in my Chief Scientist, Doc Dougherty, an Air Force colonel, and said, "Okay. Go to it."

Okay. Within a couple days, he had put together a design using a blinking infrared source, a battery, and a transistor. You'd stick it on a tank with a sort of super Velcro, which DARPA had also developed. It was sort of clunky, but it worked.

There was a DARPA project which was sort of a huge electronic catalogue, which allowed you to do the ordering for you. Remember, we were worrying about how to do manufacturing better. Supply is a big problem. They discovered the only place they had that many transistors was in the United Kingdom. They sent them over to the U.S. There was a 24-hour delay getting it through Customs.

In the meantime, we found a small company up in New Hampshire that still had a number of ladies, literally, who knew how to solder and put these things together and they sent them to Saudi Arabia, and installed them.

After the war ended, this note arrived from Colin Powell—handwritten—thanking me and Dougherty for doing this. This came in the mail the same day I got notice from the I.G. [Inspector General] that we were being investigated because someone had complained that we had not gone normal contracting procedures. But we had essentially went through the entire production cycle, testing cycle, did the whole thing in ten days straight from the initial request. It was DARPA at its very practical best. And it worked.

I: That's a great story.

Reis: It was a wonderful story, including the I.G.; I.G. said I didn't really break any laws because there was a war on.

I: You were there during this shift from "monolithic adversaries" to this different kind of adversary. How can DARPA face this new definition of threat?

Reis: Yeah.

I: What do you see there?

Reis: One of the things that DARPA has done off and on was to look into the interplay between technology and the social sciences. You know, they dabbled a little bit here and there, but there was never any sustained view on what to do. DARPA did not get into psychological warfare when I was there.

There's an area I think, that DARPA might play a role. You now have the interface between not just technology in military operations, but you've got cultural interface, too. It seems to me that that's an edge where technology can help. It isn't just technology improving traditional military operations, because military operations are going to be different.

DARPA has always participated in helping the intelligence community. But to think of intelligence in a broader sense, not just finding out specific technical things, but what's really happening, and how do you understand? I think if I were the Director of DARPA now, I'd be thinking about how to do that.

When I was at DARPA, some of the areas—for example, automatic translation—helped some. But what you're really concerned about is a deeper meaning; the interface, between human technology, and varying cultures. Not necessarily waiting until the bomb is there and you're trying to explode the but also how to think about avoiding those situations in the first place.

I haven't really had a chance to talk to Tony much about what they're doing, since I've been pretty busy doing something similar for the Department of Energy since I left DARPA.

I: Looking back at your tenure with DARPA, what are you most proud of?

Reis: Well, I think a couple things moving DARPA, for instance, changing the leadership perspective in terms of what the organization was doing—Craig had started that, but I think we were able to move it along. At the same time, we also developed very good working relationships with the Services. In large measure, that was driven by the war. When you're in a war situation, all the bureaucratic interface just falls away instantly, and then you're in the afterglow of that for basically some time. I think that was very good.

Technically, I think the part that we were able to do was really push very hard on simulation and the high-performance computing; which I would not have said going into DARPA. I was able to then really exploit the high performance computing when I moved to the Department of Energy and was able to reinvigorate the entire U.S. supercomputing industry. I mean *really* big-time.

That's another story, but the germ of all that occurred when I went to DARPA. I didn't get to change it much when I was at DARPA, but I could see how you *could* change it. And then, when I had the opportunity to actually

change it by putting the big bucks into supercomputing, I was basically able to do it.

And, again, the other thing was the way we were able to respond during the Gulf War. I mean, after all, many of the technologies that made that war so successful, J-STARS and Stealth for example, were really DARPA, but that was just riding on what had been done by previous administrations. I think that's about it.

I: Are there any regrets?

Reis: Well, I was only there two years, essentially. Maybe a little bit more. DARPA's a five-year organization. And I'd gotten a few things started and I'd made some organizational changes. So, I mean the only regret, in some sense, is that I wasn't able to stay a little bit longer. I didn't leave because I wanted to; I got moved to the DDR&E job, and Atwood and Don Yockey the then Under Secretary, —couldn't understand why I didn't leap at this idea of getting a promotion to become DDR&E. It was a senate confirmed position. I had an enormous office in the Pentagon, and would get to go to all these important meetings. But it wasn't half as much fun. And I kind of resisted it for some time. But, there was no way of actually refusing. Not when they're saying, "We really want you to do it." Of course, you do it.

So, my only regret, really, was that I wasn't able to stay at DARPA longer.

Gary Denman, who was my Deputy at DARPA, became the Director during that time. And I think Larry Lynn became the Director subsequent to that, when I was working in the Department of Energy. And I don't think the Department of Defense necessarily was able to exploit the high-performance computing work, which they might have been able had I stayed on. But, you know, different Directors do things somewhat differently. And I was able to exploit it, basically, in a different way in the Department of Energy, so in that respect I don't have any regrets.

You know, I think Fields, if he had had the opportunity to stay longer, I think he might've also taken DARPA in different ways, which would've been very interesting, as well.

I: The safeguarding of the nuclear stockpile—you became your own transition device in a way.

Reis: I'll give you a little bit of history, just to follow up.

As I mentioned earlier, I became the DDR&E and led an effort to develop a total DoD R&D strategy, and an implementation plan.

Well, then Bush One lost the election. Clinton came in and appointed to the DoD a number people that I know- Bill Perry became Deputy Secretary, and John Deutsch Under Secretary, and they asked me if I would stay on for a while. I was Acting Under Secretary for a short period until Deutsch came on; until they could get somebody else to be the DDR&E.

In the meantime, I was asked to take a job in the Department of Energy, as the Assistant Secretary of Energy for defense programs, which meant responsibility for the weapons complex. At the time, the big issue there was,

"Shall we maintain nuclear weapons testing?" And, they decided to stop the testing. So I put together a program called "Stockpile Stewardship," which meant "how do we maintain these nuclear weapons without testing?"

Well, nuclear testing was fundamental to the way people had operated. All of a sudden, we're stopping testing; how do you do that? Well, you can start by really understanding what happens in a nuclear explosion, using big-time simulation and big-time computing. So we put together a program called Science-based Stockpile Stewardship. And we were able to specifically say, "How much computing do we need?" We knew that the people who actually designed the current weapons would be retired by the year 2005. So, we wanted to get it done by then.

We knew that the small changes to the weapons would be significant. So this allowed us to determine what size computer we were going to need and how fast it had to run. So, we put together a program called the Advance Strategic Concepts Initiative, and it required an increase of maybe three orders of magnitude and about ten years. Can we basically do this? Can you write the software to make this happen?" And using my DARPA experience, I felt this is going to require some large companies to be involved. DARPA traditionally had worked with very small companies and then grew them. So, I had to get some large companies involved.

I went to talk to Harold Brown, a former Secretary of Defense, who at the time was on the board of IBM and he said maybe IBM might be convinced. So I went to IBM and talked to their Chairman Lou Gerstner and he signed on- IBM would compete. He said, "This will be our Apollo shot."

To run the computer program, I hired Gil Weigand, from DARPA.

So, I essentially embedded a DARPA program, with a DARPA program manager, into the DoE. We embedded the DARPA culture into a laboratory culture which was not used to working that way. And, we met our goals. Not only IBM, but several other companies, as well. You know, we're over 100 teraflops now. It was expensive, but the U.S. is now at *the* very top. If you look at the top ten computers in the world they're all U.S. computers, mostly working at the DoE laboratories

I: Just two more questions. Did you work with the JASONS?

Reis: Yeah, I did work with JASONS. You know, JASONS didn't have a clue about Total Quality. They thought I was probably nuts—they didn't quite get it. I should point out that when I started, we also had the JASONS look at the computing, and they said, "You can't do it. It's too hard." We went ahead and did it anyway.

I had worked with JASONS in the past. The JASONS were fun to talk to, and they provided a lot of intellectual back and forth. They also threw great parties, and it was good sort of intellectual gossip. But I can't say they actually helped substantively in anything during the time I was at DARPA.

I: Any really big experiments take place while you were at DARPA?

Reis: Right. I actually helped get some big experiments going before I went to

work as DARPA Director. I was always at the big-experiment end so that part as DARPA Director came easily.

We did the small rockets, satellites, and air, land and sea vehicles and so on. That's where I was coming from—the big-experiment side of DARPA. The part I didn't see until I got to DARPA was how they integrated basic science into the big experiments. These not two parts of DARPA.

What I brought to this was, "How is it pulled together?"—the play back and forth. The hook I found was in the information technology, which was not part of my background in the first place—how important a part it played and I think still plays today. That's DARPA's basic strength; you don't have it in the Services because information technology moves so quickly.

I: The key to DARPA's future?

Reis: Well, you know, I think the model is a leadership organization. You've got to work on the front-end problems, and they've got to be big enough. I think that is the key. You know, when General Marshall started the project planning staff at the State Department with George Kennan he said, "Just one thing. Avoid trivia," which I think would be appropriate to DARPA as well—avoid trivia. If it isn't working, if it ain't gonna' make a big difference, don't do it. That's the two-word advice I'd give any Director of DARPA.

Another thing that is important, and that seems to hold true, is that the Directors of DARPA over time have all been qualified. Some of them did a better job than others. Some didn't do so good a job... Regardless of the party, if you look at their résumés, every one of them brought some serious technical ability to the position. I think that's very, very important. You know, the job is never given away as a campaign reward. It's never been, "Hey, we've got this guy who worked in the campaign. What are we going to do with him? Well, let's give him the DARPA job." That has never happened, and so whoever the Director is, you know it's a person who is really qualified to do the job.

I: Dr. Reis, thank you.

Reis: Okay.