



**Dr. Gary Denman
1991-1995**

Interview: January 17, 2006

Interviewer: Please tell us your name and describe your tenure at DARPA

Denman: I'm Gary Denman, and I went to DARPA in 1990 as Deputy Director, became Director in '91, and left in '95.

I: What was going on in the world when you came into DARPA?

Denman: There were two things happening on a global scale. One, the Cold War was ending, which set the agenda to quite a degree for the Department of Defense and for DARPA during my tenure. And two, the First Gulf War was just in the early days of my tenure, and from a lessons-learned point of view, that set part of the agenda for the Agency.

I: How did you come to be part of DARPA?

Denman: I came through a little different path than many Directors. I worked for the Air Force for many years in the technology business, ending up as the Technical Director of all the Air Force laboratories at Wright-Patterson Air Force Base in Ohio. At the Air Force labs, it really was not as much about managing a large budget as it was managing people and many different technologies across a spectrum—of jet engines, materials and manufacturing, avionics, and aircraft structures. And then my good friend Vic Reis, the DARPA Director at the time, twisted my arm to be the Deputy Director of DARPA, and I finally agreed. Actually, I wasn't reluctant. I knew DARPA. I was always impressed with DARPA and took the opportunity to come to the "big city," as they say.

I: Why? What was there about DARPA that impressed you?

Denman: DARPA has the ultimate mystique in the technology business. It's the number-one game in town, so to speak, if you're in the technology business—certainly, in the defense technology business. So, I wasn't going to turn down

that opportunity.

I: From Deputy, how did you become Director?

Denman: A year after I got there Vic was promoted, as I used to tell him. He, perhaps, had different views of that. Anyway, he was promoted to the DDR&E, Director of Defense Research and Engineering, which is a level above DARPA in the Pentagon, and when he left I was fortunate enough to become the Director.

I: So, they didn't do a search?

Denman: There was a lot of competition, a number of people were lobbying the powers-that-be in the Pentagon, and we all have our friends. And, of course, my good friend, Vic Reis, helped a lot, and some others I knew. As they say, I pulled a few thorns out of people's paws over the years and that always helps. Anyway, I was fortunate to win the battle of the Directorship, so to speak.

I: Each Director brings a unique technical expertise, a unique management style. What was your style?

Denman: I think the thing I brought was the experience all those years of managing technology in a government laboratory environment. In that process, I had developed very good relationships with industry, and that's extremely important in a DARPA environment because DARPA has no laboratories. Everything is done by outside agents—usually industry, or universities, and sometimes government laboratories. So, I had that background of 25 years of managing technology focused on Air Force needs, and I thought I knew how to do that. And also managing people. DARPA, like any organization, is about managing people, and DARPA has some of the best and brightest. They're also sometimes not the easiest people to manage because most of them are smarter than I am (chuckles)—but you never let them know that. (Laughs.)

I: What did you see?

Denman: DARPA is a fantastic organization. It's because of the people. But, there were also tensions at DARPA. Some of those tensions are natural. There is competition for the budget between the various offices in DARPA and various program managers. You have to manage that in a positive way, but there will always be tension in that environment.

There is also a tension I thought was a little overboard. It had to do with the question: How do you invest our money? Do you invest it in the basic technology game, or do you invest in doing expensive, large demonstrations of technology—building airplanes, or whatever it might be? Doing a demonstration took a great deal of money, and the more technology-oriented people always had "one more thing" they wanted to do that the budget wouldn't sustain. So, the tension at times got a little out of control, and I had to manage that pretty carefully to keep it in balance, but also keep everybody moving forward.

I: The peace dividend?

Denman: Yes. And amazingly, during that time, the DARPA budget was going

up. But at the same time, what is called the “acquisition budget”—that is, the ability of the Pentagon to buy new ships, airplanes, tanks, whatever—was going down; going down fairly rapidly, actually.

So, the question was: What’s the outlet for all the DARPA inventions, so to speak, when you can’t build as many things as the military was accustomed to building? And that created some challenges. In fact, I’ll never forget one very senior military person, to be unnamed, who told me one day—he said, “You know what I don’t need from you is another miracle that I can’t afford.”

So, you know, that stuck with me. He was saying, “Look, I’ve got to make sure that what we’re doing can be affordable in this environment of the peace dividend”—to use your term. And that set the tone for a lot of things I did. I got into worrying directly about the affordability of technology. How do we make things less expensive for the military? And that was a unique question for DARPA during my tenure.

I: What mechanisms did you have to put in place? New funding mechanisms?

Denman: Yes, but that didn’t make things less expensive for the military to buy. It just made the technology easier to put under contract, but didn’t make it less expensive. And so what I focused on was how do we use technology to try to get things more affordable for the Defense Department? And one example—I’ll tell a little story on myself here.

Texas Instruments had an idea to make infrared sensors, which are very important to the military, very important to law enforcement, and a lot of applications. Their idea was to make them without having to cool the sensor to low temperatures which is very costly and unreliable. So I seized upon that as a way to reduce the cost of infrared systems, by developing this un-cooled, infrared detector set.

Well, the story on myself is: I was picked up at Dulles Airport one night in this big van that had a large, flat-panel display in front of the windshield. We turned off the headlights, and I drove to Washington with no headlights in the middle of the night just using this un-cooled, infrared detector to see with. Fortunately, we did not get stopped by the police. That was a very fortunate evening.

That’s an example of how you can take technology not just to make a better infrared sensor, but to make it more affordable. And we picked a number of projects with this objective. The way you do that is to challenge the program managers to come up with ideas with this objective: “Let’s not only make it better, let’s make it cheaper.”

I: One of the things that you had to kind of impress on people

Denman: Yes, absolutely, and it was all shaped by the end of the Cold War, the reductions in the acquisition budget so we couldn’t buy as much. Even though our budget at DARPA was going up, the overall budget was going down, and I felt that was an important, new strategic direction that DARPA should take.

I: The Gulf War had come and gone. Did that change the menu you were also

seeking?

Denman: Well, it did to a degree. Certainly, we didn't need as much anti-submarine warfare as we needed when our primary concern was the Soviet Union. But on the other hand, we knew, for example, that Iran was buying very quiet submarines from certain parties, and we had to make sure that we had the same technology but modified for a new threat. So, we had to reshape much of what we were doing, and doing less of that. I also knew that sooner or later, we were going to reduce our nuclear arsenal, thus we didn't need to work on large rockets or rocket technology, and that sort of thing. With the end of the Cold War, it was clear there was going to be further nuclear arms reductions, and we weren't going to have to build the next generation of ballistic missile. So, things like that we shifted away from.

It was also clear that after the Gulf War, things were not finished in the Middle East. I mean it was just obvious that we needed to consider that question, and that shaped our thinking. I wish it had shaped it more than it did given the events of the last five years, but it did shape our thinking to some degree in terms of what now has come to be called "asymmetric warfare" associated with the war on terror. We did some things, however, in retrospect. I wish we would have done more. But I didn't have that perfect crystal ball.

I: Did you see the globalization of technologies as a particular challenge?

Denman: Absolutely, and it came mainly in the form not only of leveled playing fields in terms of who has the best technology, but also in terms of how much technology production was moving offshore, and continued to move offshore. We had to always ask ourselves, "How are we going to build this if we can invent it?" "How is it going to get manufactured in the United States versus the Far East or wherever?" And that was always a serious challenge, especially for electronics.

I: How do you protect yourself from something like that?

Denman: Well, you can't, but you try to the extent you can. I think it mainly comes down to finding an industry partner that's willing to take on the production of new technology and widgets. And, of course, we didn't move 100 percent of our electronics manufacturing overseas, but we were losing the edge in terms of the latest manufacturing technology. In fact, that led DARPA and the Congress, to a large degree, and with the industry to form something called **SEMATECH**, or "semiconductor technology." It was a consortium of industry that DARPA funneled at a significant level to work on the next generation of the tools for manufacturing microelectronics.

The industry matched the funding; it was a co-funded-partnership with the industry—not just a single company, but it involved Intel and all the other chip producers at the time, as well as the chip equipment manufacturers. That was another approach to try to keep a leading edge, at least to some degree, here in the United States.

I: Was there a drive to make a link between university basic research and

industrial applied research?

Denman: There was some move in that regard, but, you know, when you're dealing with leading edge Company "A" it doesn't always want to share its leading edge with Company "B". Now, with universities you can get cooperation a lot easier, although there are always the "not invented here" type of problems. But, yes, we pushed on that where we could, but didn't overdo it because there's the practical reality of intellectual property.

I: Do you recall the Technology Thrusts you outlined?

Denman: Well, you don't walk into the office on the first day and say, "Write down the five things we're going to do, and that's all we're going to do," because you want to listen to the people who are really smarter than you. Like I say, you never let them know they're smarter than you are, but you want to make sure you listen to them; and not just the people at DARPA, but also industry and so forth.

So, it evolved over some time, but certainly, as I've already mentioned, I was very worried about this affordability question, so we started a lot of manufacturing technology-related things. SEMATECH was the biggest one of those that DARPA didn't start on its own, but it really latched onto it and ran with it.

The other areas I was very concerned with were the intelligence, surveillance, and reconnaissance kind of things. A military leader will tell you, "All I need is perfect information on the enemy, and I can take care of the problem."

Well, obviously, you never have perfect information, but DARPA can help make it better than it is. We focused a great deal on sensors and techniques to improve intelligence and reconnaissance for the battlefield as well as just for pure intelligence, for collecting information on potential adversaries. That was certainly a thrust that I heavily bought into.

A thrust that Vic Reis had kind of started in simulation was one that I carried through on, because I thought it was important stuff. In fact, if I could digress just for a second (and Vic may have mentioned this in his interview)—one of the things we did after the first Gulf War was to take a very classic tank battle that happened in the Iraqi desert and put it into simulation, so that troops in the future could not just *hear* about what happened there, but could *see* it. There weren't any film crews out filming the battle—it was called, The Battle of 73 Easting. Thus we gather detailed information and develop a simulation.

The result was very informative to me as well as to a lot of people at DARPA and the Army. We brought several tank crews that were involved in this conflict that went on for one whole night, basically. And you learn a great deal by *seeing* technology implemented and how it *really* works and how troops have to adapt to really make it work. The targeting systems and communication systems involved and other systems. It was incredibly informative and shaped a lot of my thinking as I spent my time at DARPA - and a lot of other people also. So, that was an outgrowth of the simulation technology DARPA had developed over several years.

I: Did the Services see this and say, "Wow"?

Denman: Yes, absolutely.

When we finished it and brought some of these crews back to view the result, they were amazed. In fact, one of them at the end said, "That's what happened." I mean, for them to have been there and to see it and think it real. This will be valuable to every foot soldier that goes into armor for years to come, because it really made you feel like you were there. It also taught you what to do and what not to do, because there were some tragedies on our side during that particular battle.

I: Did everybody see it?

Denman: I don't remember how high up it went, but I remember we had to reproduce a very large number of videotapes. A lot of people wanted to see it. I don't remember who actually saw it, but I didn't really have to force it on anybody. Word of mouth took care of that, I *know* the chief of the Army did see it, because I asked him. He was very excited about the product and the technology.

But it's just an example how you can take DARPA technology and make it happen. You know, really useful for something you never thought about, and that was capturing the real history of conflict. That was an exciting time.

I: There was the peace dividend, yet your DARPA budget was going up. How did that happen?

Denman: Well, it's in the budget wars of Washington; it's not a game for the faint-hearted (chuckles). But, I think DARPA had a better story than most of the other people managing technology, and both the Department as well as the Congress had confidence in DARPA. I think it's as simple as that. I mean I could go through war stories of how it really got there, but there was a lot of trust in DARPA—not just in me because I was there, but in DARPA, its legacy, and its people. I mean, it really had the reputation of being a point of collection of some of the best and brightest people and it made things happen.

You know, there's no magic formula to that, but you do have to get in there and mix it up a bit in the budget wars. But, anyway, we were successful. I can't tell you exactly why, but we were successful in increasing the budget.

That's not the objective you start out with. You start out with ideas and say, "I really need to get this funded somehow." You don't just stand up and say, "I need more money." You really have to take ideas forward and effectively articulate the idea.

I: Your tenure occupied a really interesting political landscape.

Denman: Yes. I was there during most of what we've talked about in terms of the end of the Cold War, the peace dividend, but also I went through a change of administration, from the first Bush Presidency to President Clinton, and all of that ripples down into the Defense Department and so forth. And that's an interesting social phenomenon, as well.

I was not a political appointee. I was one of the few career civil servants

who were put in the DARPA job. There had been others, so, I wasn't automatically thrown out at the change of the President, but I could've been asked to take another position, of course, but I survived that transition, and then the whole new set of people coming into the Pentagon, which was a challenge, as well as exciting. And some very smart people came in, particularly Bill Perry, who eventually became the Secretary. I have enormous respect for and really enjoyed working with him during the transition, as well as when we moved forward.

I: So, the congressional landscape was really interesting. What was that like for you?

Denman: Well, I went through two transitions there, actually. When I became Director, it was the Bush 1 administration and Democratic Congress, that were, for the most part, very supportive of DARPA. So, it was a matter of taking the right ideas and presenting them in ways they could understand. Doing the technology business, you tell people what you did for them in the past—the recent past—tell them what you're doing for them today, and give them promises of what you'll do for them tomorrow.

And through my whole career that seemed to work, and that's always the approach I took to dealing with Congress. I would usually have to testify, somewhere between two and four times each budget cycle. When the presidency changed to Clinton and still a Democratic Congress, there wasn't much of a transition there with the Congress. But then the next transition was in '94, the transition to a Republican Congress, and that was a little more challenging.

We all lived through that, and you know that if it was the prior Congress' idea, it isn't going to float very well with the new Congress. We had to work our way through that. And we kept growing the budget, so I guess we were successful, but it was challenging.

I: Was there earmarking in your day?

Denman: Sometimes. There was earmarking of the budget going on in 1796, because I personally reviewed the appropriations bill from 1796, and it was a lot worse than it is today. So, the answer is, "yes" (chuckles), but at least they weren't setting my salary. That's what they did in 1796. They would say, "We want you to buy the horseshoes from this company, and we'll pay you so many dollars a year as a civil servant to do our bidding." You know, that's a little scarier than it is (chuckles) today.

But, yes. There was a lot of earmarking—whatever term you want to apply to that—and I got into a lot of trouble sometimes over that. If it was clear the earmark was for something that either already had been discarded by every scientist you could think of, or if it just had no hope of working, then I would take it on. We would inform the Department as well as the Congressional people involved that we're just not going to execute the program. It's bad government. That was a phrase I used a lot—"bad government."

A few times I was almost run over, but I guess I'm still here, so I didn't get run over. But that took more of my time than I think it needed to, but it's a fact of life. You know, you just have to live with it and try to do the right thing. That's all you can do.

I: What was your relationship with the Services?

Denman: That's an area where because of my background from the DOD laboratories I thought that the relationship with the laboratories needed to be improved considerably. And the reason is that DARPA, when I was there, only had 200 program managers to manage a couple of billion dollars—more than that, actually, in some years. And it's very challenging; you can't run every project day on a day-to-day basis with just 200 people, or even with the support contractors that surround DARPA. Nor did we have the contracting staff to put all that money under contract, so we relied on outside agencies. We called them "DARPA agents."—was the term that was applied. And the DOD laboratories were a very important part of that, so I put some energy into building better relationships with the leadership of the DOD laboratories. It was easy for me with the Air Force because I'd been there, but I also needed to do it with the Army and Navy. And we did okay with that. There was always some tension because they wished they had my budget to do it themselves, but I think we did okay.

I: Well that's a built-in tension

Denman: Of course.

I: You mean, they would've been asking, "Why DARPA?"

Denman: I don't think so. I mean it was what it was, and "you play the cards you're dealt," as they say. And from my Air Force days I had good friends in the Army and Navy labs, and, you know, built on those relationships. So, it's about relationships, and we just worked the problem. And at the end of the day, if you let them put their hands on the rudder, so to speak, they were happy. You never let them get full control of it, though. That was the DARPA program managers' job—to always have a firm hand on the program.

I: Did you find yourself in the position of "science honesty broker" to the Pentagon?

Denman: Well, yes, to a degree. I, or some of my people, got called into the Pentagon when there was a serious problem with some development going on in one of the Services. Usually you only sent senior people into those environments, because you knew you may have to stick a fork into somebody (chuckles) and tell the truth, you know.

I would just tell the people who were going over to "just tell it like you see it. Don't pull any punches. Tell it like it is."

And so in that way we *were* the science advisor to some degree, to the larger Pentagon, but it didn't happen every day. But it happened enough that I had to get my people, or I went myself when I knew it was really heavy-duty

political. But you just tell the truth. Tell it like you see it. And sometimes it made some people very unhappy, but that's the role DARPA had to play.

I: And has always played?

Denman: Yes, it always has.

I: Do any projects stand out in particular?

Denman: I do remember—I think it was an Army program that was being unsuccessful, and it had to do with sensors and finding targets. They had done two things: put the requirements beyond reach and they had picked a sensor technology that was unproven. And I went to that meeting, because this was an important project with a large budget. My view was they were spending 80 percent of their money on a 5 percent problem. It was one target that they were never going to ever see with the selected sensor. They were spending all their effort on trying to get 1 percent of the targets. Also, the sensor was never going to work. Can't produce it. The chemistry's too hard.

And there were some very angry people (chuckles) after, but you were responsible for telling it straight. We had done our homework before we went to the meeting and I took a sensor expert with me to explain the details.

I: You've been in that situation a few times.

Denman: Yes, but you know, you must tell it like you see it, that's what the senior leadership of the Pentagon wants from DARPA.

I: What was the transition from Bush 1 to Clinton like? How did your relationships change?

Denman: Well, I did know some of the people coming in. I knew Bill Perry slightly, not well. I certainly didn't consider him a close friend or anything. Some of the new leaders I didn't know. John Deutsch came in as the Undersecretary and later became the Deputy Secretary. I didn't know John at all. I went to see some of the people before they were in place, to get their views on, "What do you think DARPA should be doing? What is DARPA? What do you think it should focus on?"

Some just said, "Keep doing what you're doing. The reputation's so great." Others said, "I'm not sure why you're into a certain technology, but, you know, we can talk about it when we get there."

So, I think reaching out was important. It's about relationships as much as anything.

Bill Perry already knew DARPA, knew it well. Didn't have to educate him about DARPA, and his direction to me was—and I've never forgotten was, "You just need to make sure you're working on the hard problems. DARPA's there to solve the hard problems for the military—not science, in general but technology for the military. Don't pick the low-hanging fruit. Pick the tough problems. You'll fail a lot, but that's where we need DARPA to be," and that's where my mind already was so we communicated very well. And I always carried that with me—that DARPA's there to work on the hard problems not the easy ones. And I think

that's helped me through hard discussions inside of DARPA, as well. I would tell program managers, "Hey, this is a good idea, but you're solving an easy problem. It's not about working on - I don't mean by working on hard technologies that are difficult to do, but find technology that'll solve hard military problems. That's why we're here."

I: Can you give me an example?

Denman: Well, I think I'll go back to the sensor business to support intelligence and targeting—really a hard problem. When you're going to attack a target, there's always somebody that has to say, "That's the right target," whether it's the pilot in the airplane, or the commander on the ground. "You've got the right target." And that's a gut-wrenching decision for a lot of people, particularly if you're in an urban area. You know, as we all know, the military has made mistakes sometimes on targeting.

So, that's what I consider the hard problem—being able to provide the kind of information that's distilled to the point where a human can interpret what he's looking at and increase the confidence that he's looking at what he *wants* to look at, whether he's there to just find it, or whether he's there to do damage to it, or whatever. But, you know, sometimes that's called "target recognition technology." So, it involves sensors and software and computers and it's an integration problem to a degree. So, that's one we worked very hard on, and it still isn't totally solved. I'm sure the current DARPA people are still working on it, to improve upon it.

I: Have they conquered some of the problems in command-and-control?

Denman: Yes, we worked a lot of command-and-control things, and it's improved. That's one of those problems that you can always improve and improve and improve. You just try to make significant steps forward on it because it's a very hard problem to get perfect command-and-control, or perfect intelligence, or a perfect picture of the target, so to speak.

I: To shorten that distance between information and decision making.

Denman: Yes.

And we did work a lot on that- of trying to cut those timelines from what's called "sensor-to-shooter." But we did work a lot on that, and I'm sure they're *still* working on that. I think it's down now to the timeline of a human being making the decision. I think we're getting the information there a lot quicker than ever before, so now it's the human having to distill it and make a decision. "Yes. You have authority to do whatever you're going to do." And it might not involve large scale operations or might involve using Special Forces.

I: What about TRP?

Denman: Oh, yes. Do we have to?

I: Where did the idea come from?

Denman: Well, it all stems back to the end of the Cold War and the reduction of

our acquisition dollars. And the question is then, "Well, how can we better exploit our commercial industrial base to solve military problems and also get it to flow the other direction to help the economy?" So, break down the barriers between military and commercial products—hence, the buzzword "dual-use" became a popular term.

DARPA was not the flag bearer initially for this idea of dual use. I did find some staff on the Hill who were creating the idea, and this was under Bush 1 and the Democratic Congress late in his term—last year of his term. The Congress put together an appropriation with, I don't remember exactly, \$300 million, or some number like that. A lot of money. This was for one year. I mean \$300 million in one year that was supposed to continue on to further years. So, it was a big program. Carved up into a lot of pieces. I can't even remember. Maybe conveniently don't want to remember all the pieces, because it was difficult. Then the Bush 1 administration and the Pentagon did not want to execute that program. When President Clinton came in...

I: Did it come out of the Democratic Congress?

Denman: Some Executive Branch, but mainly Congress. Two or three senators were the prime architects, supported by some staff people that really passionately believed in the idea of dual use. How to get the defense business helping the economy, how to get the core industrial capability helping defense—and they were passionate about it. I don't question their motives because they, you know, had sound motives. There's nothing wrong with the concept.

But it was a political minefield because it smacked, to one party, of industrial policy mucking with civilian industry. And we don't do that, you know. So, there were a lot of philosophical differences between the two parties. I mean political parties.

The Republican side at that time refused to execute this program. The money never came to DARPA. And then the elections. President Clinton took office and within a few weeks, and I don't know how it happened, The White House discovers this money. They were looking for things that they could jump-start that he didn't have to wait for the next budget cycle. They told the Pentagon, "We have it. Go." (Chuckles.)

So, it was all thrown to DARPA, and we had, I don't know, short time, three or four months, to get this program organized, vetted, and across to the Pentagon, information out to industry and the road trips that we had to make *and* to explain this whole concept to both sides of industry; defense and state government.

What I insisted upon was we want the requirement, the need, be defined by the defense side and the technology - if there is any- be brought from the civil side. This may sound easy, but, believe me, since these two never meet—the military industrial base and the civilian industrial base don't meet very often, it's a very challenging problem. And then you pile the political differences on top of that, and it took an enormous amount of my time to launch it.

I: How was it supposed to work?

Denman: Well, it was supposed to be a—find projects of sound technology that can be brought either from civilian industry to defense industry, or vice versa, that you can exploit defense technology in the civil sector. And do projects, demonstration projects.

One good example, which was probably the largest program we ever funded, was in composite-materials technology—the kind of things golf club shafts and tennis rackets are made of but also used extensively in aerospace products.

Composite materials weren't very deep into the commercial engine business, so we had a project to try to make very large front ends of engines, called "fans," out of composites to help both the military and civilian engines. It increases the efficiency of the engine. It makes the engine lighter—a lot of very positive things. Very difficult to solve the bird-strike problem because composites tend to be a lot more brittle than metal. So, if a bird strikes the front of an engine it'll bend, and composites might break. So, those kinds of problems you had to work on.

That's one example, and it went all the way down to very small projects of the same kind of concepts. So, that's how it was intended to work. And we worked hard to try to make it work. There were a lot of very good projects started under the program.

Then you fast-forward to the change of the Congress, and now I find myself having to be the advocate (chuckles) of these projects to the Congress, and that was even harder. (Chuckles.) But the program sort of died of its own primarily because of industrial policy issues. Now, there're still some remnants of the project and it is still going on under a dual-use banner, but not so much at DARPA.

I: Didn't a similar project like this end up with a previous Director being fired for exploring that avenue?

Denman: Well, the idea of, or, the issue of getting too close to civilian industry and trying to shape it to the point where it can support military smacks of industrial policy that, I think, a previous Director got into some difficulties over. Because he believed we needed to pull technology out of civilian industry to help military, and I never had any trouble with the idea. I think some of what was attempted to execute got a little close to the bone of causing civilian industry to complain, and you know the rest of the story.

I: Does this go back the expense of some of the technologies coming out of DARPA?

Denman: Well, this whole area of trying to work what—I use the term "affordable weapons" —was something my good friend Larry Lynn didn't always agree with. And he became Director and he decided to reduce investments in that area.

You know, the one thing about DARPA is the Director is king. And I don't mean that in an authoritarian way. I mean it as the Director has the responsibility to do what he thinks DARPA needs to do at the time. And I don't think you'll find many organizations in the government that are that way. The Director is given

enormous latitude by the Secretary of Defense and sometimes the Secretary has to protect the Director. Sometimes he can do that. Sometimes he's unsuccessful in doing that, as in the case we were just talking about. But I always felt that I needed to do what I thought was the right thing; shape the program the way I thought it needed to be shaped. That didn't mean that I managed every program, but in terms of the investments and the plans and so forth, it's the Director's decision.

I: This goes back to the problem the Services were having with acquisition, doesn't it?

Denman: Yes. Exactly.

Larry didn't feel DARPA should be so deep into the manufacturing side of industry; that it should be focused just on new technology coming forward, and figure out later how to make it affordable. But it's just a different point of view. I never had any problem with Larry over that issue.

I: Tell me about Global Hawk. Was there a problem with the program?

Denman: Well, not a problem.

Global Hawk was done late in my term as Director, and it was one of the things I'm most proud of. So, I don't have any problem with it.

I have some problems with what happened to Global Hawk after I left, but, well, I don't talk about those. Those are the next administration. Well, I'll talk a little about it.

Global Hawk is a large surveillance aircraft. And I told you earlier that I thought surveillance and intelligence was one of the most important things we could do for asymmetric warfare, and that sort of thing. That came to fruition in a very long-endurance, unmanned aircraft called Global Hawk, which was a hard sell to the Air Force, and probably wouldn't have happened if I had not had a good friend who I'd previously worked for, a general officer who was running Air Combat Command. And I went to see him and told him what I wanted to do. And he said, "I'll tell you what I'll do. I'll stand up a UAV squadron. Only going to have two people in it, but formally, on paper, there will be a squadron that can accept Global Hawk when you're done."

And that's what really got it to take off, because you've got a customer now, and it was a large DARPA investment that's going to do a demonstration program. I had to agree to transition it to the Air Force sooner than I wanted to, and that was, in hindsight, probably an error. It diverged from one of the objectives I put on that program that I don't want this to exceed \$10 million in production. Well, that number is three or four, fivefold now, and that's what I don't like. I think we could have had a lot more of them a lot sooner, and they'd be darkening the sky over Baghdad today, if you will. But they're not because there are only two or three of them out there today

I: What was the Air Force's hesitancy?

Denman: Well, their hesitancy was twofold. You have to appreciate the culture of the Air Force. It's white-scarf fighter pilots. And you're going to tell them

they're not going to put a man in the airplane anymore? What's *wrong* with you? You know, it was just counterculture. And, Mike Low —was the general's name— saw the future; that we've got to go there because we can't have pilots sitting in an aircraft that's just flying around for 36 hours at a time. We would have to give them a new body when they tried to crawl out of the cockpit. And, of course, they can't stay awake for that long, anyway.

So, you know, it's still a good program. Don't agree with what was done to it afterwards, but it's not my call. I wasn't there, didn't have to make those decisions. I know why those decisions were made, and I've talked to the Air Force about it, but, anyway, it's still a good program, and we're going to have a lot of them soon. They're just going to cost a lot more than I think they should have. But they'll do a lot more.

The competition was the U-2, and the Global Hawk was going to put the U-2 out of business. And there was a high degree of U-2 advocates that didn't want to see that happen. So, it was a pretty heavy-duty contest over this, but I, fortunately, had a four-star general who helped me solve those problems.

I: This gives us a glimpse of some of the hard work the Directors had to do.

Denman: Absolutely. It's a big part of the job of Director to, on one side, have the relationships with the Services that are your customers, and at the same time get them to share your vision of the future. They're usually fighting today's war, and you're trying to fight tomorrow's and the future war, so to speak. So, that's a challenging problem—to get them to share your vision. I remember I was able to develop that relation with Gordon Solomon, who at the time I was there was the Chief of Staff of the Army, and we did a lot of good things with him. He tried to get me to do something that maybe in hindsight I wish I had done—to find a solution to the Katushka rockets being fired into Israel, because he had just come back from a trip from Israel and wanted to help them solve that problem. But I looked at it as “a bridge too far.” I mean it's like trying to grab a bullet in midair—you don't know where it's coming from or when it's coming. So, I didn't bite on that one. Maybe I should've.

But, Gordon and I were able to talk about those things, and he certainly shared my vision of the future. So, we were able to do a lot of things for the Army.

I: You had to eliminate some projects. How did that process work?

Denman: Well, you know, in the technology business it's *easy* to get into something. It's a heck of a lot harder to get *out* of something. You have to get out of things that aren't going well, that are not being successful. And when you're taking the kind of risks that DARPA takes in programs you're going to have a lot of failures, and the challenge is to recognize those early and get out of them. Take the money and invest it elsewhere.

The second thing you can do is grow the budget, which was happening under my term as Director, so I didn't have as much pressure. It's actually a bad thing. You want that pressure to get out of the things that aren't going well. That's always one of the most challenging things because some people get

personally wedded to programs, and you've sold the programs to people, and you've said, "Yes, this is really going to work," and now you've got to go tell them, "Well, it didn't work." So, even for the Director, he's got to eat a little crow to get out of things. And nobody likes to eat crow. It doesn't taste very well (chuckles). But that's what you have to do. It comes with the territory. And that's the way you find the money to go do other things, as well as grow the budget. And you grow the budget by doing good things, so, at least that's what I've always believed. If you're doing good stuff, the budget will follow—not vice versa.

I: The Director has to walk the fine line of making room for new people.

Denman: Yes.

I: So, how does that work?

Denman: Finding the best and brightest—which is a buzzword I used to use a lot—was exactly what we were trying to do at DARPA. And at the same time, you've got some people that have been there too long—at least slowing down, lost the fervor, whatever—and they're government employees. That's a challenge.

The good news is there's a small minority of those kinds of people that you really say you'd rather they go. I was successful. With some of them, I would go out and find them a good job. Say, "Hey, I got an opening over at Naval Research Laboratory. Why don't you go over and do that for a while? If you want to come back to DARPA later, why, we can talk about it." You know, that kind of thing, rather than trying to damage their career by saying, "You're not cuttin' it."

Whereas, in any other organization they might've been way up in the shining star kind of thing, but at DARPA they've lost their fervor, or were off in directions they weren't really qualified to run.

But that was not a big problem for me. I tried to replace people sometimes. The harder problem—*much* harder problem was—I'll use an example: Go find the best and brightest software engineer and get him to come here for one-fourth the salary he's being paid in industry. It doesn't work.

There was a little-used process called IDA, and I wish I could tell you what that stands for. It's another three-letter acronym in the government, and the government has six million of those. I can't remember what it stands for. But it's the idea where you can go find an individual—they have to be a nonprofit, or quasi-government, or university. It can't be an industry that you would want to do business with. I couldn't go find the best and brightest at Lockheed. Had to be from Lincoln Labs, or had to be from a university, or other Lincoln Lab-type organization—Sandia—or all the DOD national labs. And it was sort of an experimental thing that Congress had authorized, that DOD wasn't very keen on implementing. I managed to convince the right people at the Pentagon that DARPA really needs this and it's restricted. You can only do it for two and extend it to four years. Perfect. It's just the right amount of time you would want to have the people stay at DARPA.

So, I exploited that as much as I could. I would get pushed back on a lot by the personnel people in the Pentagon, but I would go to the guy at the top and say, "Hey, call off the dogs. We need this. We got to have this," and they let me go beyond the edge (chuckles) of what it was intended for. It wasn't intended to staff an organization. It's intended to bring in an isolated person you really had to have. I was staffing the Agency with these people. And, by the way, they were above and beyond my ceiling on manpower, too, so (chuckles) I made a lot of use of that, and it was pretty successful.

And I understand today that Dr. Tether has some special authorities in experimental personnel areas, that he may be taking a different approach because he has another tool. But that's what I did. And you just got to slug it out, but it's very hard. Finding the - I use the term "best and brightest" is difficult. But, fortunately, I had this tool, and it worked pretty well.

I: Can you give us a summary of the challenge?

Denman: You mean on the personnel side, or just in general?

I: In general.

Denman: Okay. If I had to list the top three of what I consider my challenges, one was certainly the personnel—finding really smart people who could make things happen at DARPA. And it takes not only technical prowess, but it takes a different kind of person that's a risk taker. Those two don't come in a package terribly often. I mean a real scientist sometimes isn't a big risk taker. When I say "risk," I don't mean technical risk; I mean a career risk of sticking your neck out and saying, "I'm going to make this happen," when you *know* that it's going to be very difficult to make that happen.

So, that was challenge number one. And I spent a lot of time on that, and got a lot of help from my people, you know—from the middle management at DARPA—to make that happen. I didn't personally go out and find these people; they did.

Probably the second challenge for me, not coming from a political background, was some of these things going on with the Congress, which were a little out of my territory. I have people that helped me try to keep me out of trouble. I didn't always stay out of trouble, but that was a challenge for me personally.

On the program side - besides the TRP, which had its set of challenges more back on the congressional interface side - but the technical challenge was really this whole business of we no longer had a reliable enemy, and what should DARPA be? So, I come back to the end of the Cold War, and that occupied a lot of my time outside of the office. I mean my wife would look at me and say, "What are you thinking about?" (Chuckles.) And usually, it was that subject: Where should we go? Where should DARPA go? It wasn't obvious. It was definitely a challenge from an intellectual perspective, and we did what we thought was the right thing to do. And at the end of the day, that's what you have to do.

I: What *can* DARPA be doing?

Denman: Well, in today's context the adversary is obviously the, you know, using the inside-the-beltway buzzword, the "Global War on Terror." And I think there are a lot of things, and DARPA is doing a lot of things right, but I'm not going to try to tell the current Director what he should do, because, as I just described, the Director is king, okay. And, you know, I'd give him any advice he wants from me, but I think it comes down to you've got to know and understand your enemy.

You know, we spent 50 years trying to know and understand the Soviet Union. We're at this for five, eight, ten years at the most, of trying to get inside the mind, the loop, the behavior of the enemy, and being able to predict him. I'm not recommending DARPA restart the Mind Meld (chuckles) program. I'll leave that to "Star Trek." But, what I mean is understand behavior and develop solutions, or develop counters to that behavior and stay in front of it. And I think that's where the focus is today in DARPA, but I'll let Dr. Tether tell you about that.

It's a lot easier to be ten years removed, and I can talk about things that back then I couldn't talk about. So, he'll have a lot of things he won't be able to talk about.

I: Were there any projects fast-tracked?

Denman: Yes, I'll give you one example. I've got to make sure I get this right.

It was Somalia when we had peacekeepers there, and they were running over mines in their Humvees, and soldiers were losing their legs and feet, and so forth. And Gordon Sullivan, the Chief of Staff of the Army, called me and said, "You got to help me with this."

We had been doing some lightweight armor, and one of the problems is you can't just throw half-inch-thick steel plates on a Humvee. The chassis would break down. I mean it'd be way too heavy. But we were doing some lightweight armor, and actually, our target was the Humvee. So, we'd actually made panels and add-on kits, and we told the Army what we had, and they said, "How many can you get to us, and when?"

And the next day I picked up the phone to the contractor and said, "I'm giving you a letter—verbal contract today. I don't know how many we're going to buy, but it'll be in the thousands, and I want you to start getting ready to produce those today—not tomorrow, not waiting for any lawyers or—I want you to start today."

And I had the authority to do that.

And we got kits over there. Hopefully, saved some of the troops. That was a rewarding experience.

I: You had the authority to say, "Here's a project we need. I'll write the check this afternoon."

Denman: Yes. I mean it isn't quite the way it works, but I had the authority. I had the authority. So does any Director of DARPA, because he's an agency head, and that has special meaning in the contracting world. I mean, obviously, we've got to quickly follow that up with paper. The next step was a letter contract, and then the next step was an actual contract. But, Directors have the

authority to do that.

You know, if you misuse it you can get in a lot of trouble, but it's intended for just the kind of situation I just described.

We had a few other things that happened that... I'm hesitating, because I'm not sure I can talk about it, so I'd better not. But, yes. Other things happened that were fast-track in the context of solving an immediate military problem.

On the technology side you never want to over-fund a technology. You'd just be wasting money. You'd probably help its doom and failure. So, you know, you can fast-track things and get it moving as quickly as you can, but you don't want to just start throwing money at a particularly good, interesting technology. I never wanted to do that.

I: How did the balance between basic and applied research work?

Denman: I think I mentioned when we first started this interview that *that* was one of the tensions at DARPA—the tension between those who want to focus on technology and those who want to do big demonstration projects. And actually, there was probably more tension in the Agency just before I arrived between two Deputy Directors at the time who were at loggerheads over that question.

So, you get the people in the room. And we used to have some lively discussions at budget time on that question. Somebody had this great idea to build an airplane that would fly backwards, or fly itself, or, you know, some wild scheme. And a guy says, "But" (chuckles) "I've got this infrared sensor that if I can just do this and get another..."—you know—"50 million on this, we can really make something happen."

And those are hard calls, but there was never any blood on the floor—not literally, I mean. (Chuckles.) You might have thought there was going to be blood on the floor, but you just slug it out. I didn't do that in the privacy of my office. I did that in open meetings. But at the end of the meeting, I'd say, "Here's where we're going." Or, I'd need to go think about it and tell them later.

I: It takes the ability to integrate the small, insignificant project into the bigger picture—something as simple as a ball bearing...

Denman: I think I know what you mean. You know, you take on some technologies that are just kind of neat, and you don't know where they're going to end up. You don't know that the ball bearing's going to save the world, so to speak.

One of those that I was really enamored with was something called MEMS, which is Micro Electrical Mechanical Systems—another three-letter, Washington acronym. But, one of the projects was to come up with a new way to display things with a chip. I mean, MEMS is like a computer chip, only it will do mechanical things. It'll jump, you know. You know, you could... I'm not going to explain the technology. But you can do mechanical things with a microchip.

Well, one of the ideas was to put a million mirrors on a microchip, and you can display images with high brightness. Well, the latest commercial TV technology that's now in stores is called DLP—digital light processing. Now, I don't know where they came up with the name but it's the mirror we worked on

12 years ago, that we started and didn't have a clue where it was going. I mean I knew what I was interested in. I was interested in very bright displays, say, in a cockpit. You have multiple displays in cockpits, and sometimes they're really hard to read. If you get sun coming from the back of you they just sort of wash out. But with this thing, you could turn up the knob to a point where it would almost blind you. But it became a new TV technology, and it's out there and very affordable, very competitive with other displays.

I: An example of transition into civilian use.

Denman: Yes, but it's called "serendipity." No, it's called an industrial customer with a vision—that's what it's called. But whether DARPA funds that or not is more of a political question than a DARPA policy question.

I: What role does serendipity play?

Denman: I love it. (Chuckles.) I love serendipity. I mean it. You know, a lot of people would say, "Well, I had that in the back of my head when we started this," but, it's really new, and you just don't know where it's going. Bright people will find new uses for something really new and call it serendipity. But it doesn't just fall off the turnip truck. I mean (chuckles) commercial industry knows what a customer needs, is exposed to a technology and says, "Hmm. I may be able to do that," even though nobody intended it originally to be for that use. It's serendipity, and I love it. (Chuckles.)

I don't think anybody at DARPA—when they were doing ARPA Net in the first year or two—had any clue it would change our whole society worldwide. If you put yourself back in 1960, when the best you could do was go to the library and get an encyclopedia, or whatever —then today's access to information is *astounding*. And that started with two or three engineers at DARPA saying, "Hmm. Got this idea." But they thought it would just be a neat tool for researchers to collaborate. That's why it was started. And they never had any idea that it would become the Worldwide Web—never a clue that that's where it was going to go. Is that serendipity? Or, what is it? I don't know.

I: Just the way things go.

Denman: The way things go.

I: When you left DARPA, what were your feelings?

Denman: Oh, it was very mixed emotions. It was almost like one day I kind of had this thought run through my head that, "You know, maybe I've been here long enough." Whether I was feeling stale, or I don't know what, but then that festered a little bit. "Yes, I think it is time to move on." And so I just told everybody I was going to leave and picked the date, and Larry Lynn came to be Director.

I: You picked your own exit time?

Denman: Yes. And it wasn't any event. It was just that four to five years is... well, it's an individual thing. You know, if you've still got the fight in you—I just

felt it kind of leaving me. I guess I'd have to say that during my whole career, I change jobs every four to five years. Go on to something new—a new challenge. It was probably more personal and didn't have anything to do with what was happening at DARPA. It was still exciting.

But then when I finally made the decision, I thought to myself, "What have I *done*? This is the best (chuckles) job in the *world*. Why am I leaving this job?" But—I'm going to follow through.

I: A fairly tranquil period in DARPA?

Denman: A fairly tranquil period?

I: Was it?

Denman: It didn't *feel* like (chuckles) it was tranquil when I was there. I mean there was always a new challenge. Whether it was figuring out what to do with the end of the Cold War or figuring out the TRP. I mean (chuckles), I'll tell you—it took all *my* energy.

But I had great people. I mean, the people at DARA are just fantastic. Support people, program managers just want to make it happen. You know, like the people that supported this project, it couldn't have been better.

I: And the key is to a successful DARPA in the future?

Denman: Well, I think it's just what we've been talking about. Probably the key to it is that the Secretary of Defense already realizes, no matter *whom* he is, how valuable DARPA is to the Department of Defense—and to the country. I always felt that I had his cover, even when I was going to screw up. That has to be there. Otherwise, if people get crucified for every mistake, the Agency will become timid. Then you've lost it.

So, it really starts with the Secretary of Defense and the Director to feel the freedom to make the right things happen.

I: Did the ideas and the issues come out of the Secretary's office or the White House? Where did the ideas come from?

Denman: Oh, they rarely came out of the Secretary's office. I mean I got very broad direction, rarely a specific program direction. And if I did, I knew why, and it was a political thing. But it was pretty rare that it came from the Secretary. I mean, about 10 percent of the budget—or probably more like 5 percent—was earmarked from Congress for projects.

Now, I have to admit that I always knew there were some of my program managers over there selling a project that I wasn't funding. So, some of the earmarks I recognized where they came from, but I never broke anybody's legs over it. (Chuckles.)

I: Kneecaps, but no broken legs.

Denman: A few kneecaps, but no legs—right. (Chuckles.)

So, earmarks—some of them are good, and some of them aren't too good.

I: Were there some things you regret?

Denman: Well, I sort of mentioned one, and it's more hindsight that creates the regret. I wish I had had a better crystal ball to see the terror issue exploding the way it has because, I think if DARPA had started working on things in the early '90s, we might be in a better position today to handle this. So, that's a regret in a sort of hindsight kind of way.

Oh, I'm sure if I really thought about it, there would be some regrets, but none of them big enough to pop up. I mean it was a great job, an absolutely a great job. I loved it, and I think every Director probably says that—that it's the best job in town if you're in the technology business.

I: What jumps out as something you're most proud of?

Denman: Well, maybe it's because it was the last big project I did, but this Global Hawk thing is going to have a major impact on our ability to know what the bad guy is trying to do. It'll be a big information overload, and we got to figure out how to handle that. I mean, because these things can sweep up enough information in 30 hours to choke a horse. It's going to choke the communications systems, the command-and-control systems. So, I know people are working on that pretty hard, to be able to handle that.

I'm also proud of some of the smaller projects I mentioned—the MEMS and the digital light processing TV sets that are now here. But that whole area a lot of people thought was off in the clouds somewhere, and there are a lot of things that have come out of that or are continuing to come out of that. I mean the little, bitty accelerometers and just all sorts of things that are going to allow you to do things that just couldn't be done unless you had this little, bitty accelerometers that knew you just wiggled your toe, okay?

So, there are quite a few of those things. And, again, I didn't start it. Vic Reis was there at the beginning, and I followed through. This SEMATECH thing had a lot to do with the fact that we still have a vital semiconductor industry to support defense. It wasn't necessarily an invention of DARPA, but I think we managed it right, I guess is what I'm trying to say.

There are probably some other ones, but I'm not here to beat my drum.

I: Anything else?

Denman: You've been a great interviewer.