

***INCIDENTAL PAPER***

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**Seminar on Command, Control,  
Communications, and Intelligence**

**A Major Contractor's View of C<sup>3</sup>I  
Richard D. DeLauer**

**Guest Presentations, Spring 1981**

William O. Baker; John H. Cushman; Richard D. DeLauer;  
B. R. Inman; James M. Osborne; David C. Richardson;  
Charles Rose; Charles W. Snodgrass

**December 1981**

# ***Program on Information Resources Policy***



***Center for Information Policy Research***



***Harvard University***

The Program on Information Resources Policy is jointly sponsored by  
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Information Resources Policy, Harvard University, Maxwell Dworkin 125,  
33 Oxford Street, Cambridge MA 02138. (617) 495-4114

E-mail: [pirp@deas.harvard.edu](mailto:pirp@deas.harvard.edu) URL: <http://www.pirp.harvard.edu>  
I-81-9

## A MAJOR CONTRACTOR'S VIEW of C<sup>3</sup>I

**Richard D. DeLauer**

**Executive Vice President, TRW, Inc.**

Since Dr. DeLauer made the remarks that follow, he has become Undersecretary of Defense for Research and Engineering. He speaks here, though, from the point of view of industry, based on a 23-year career at TRW seeing the C<sup>3</sup>I business as one of the west coast's principal suppliers of military systems to the Armed Services. Visitors during Dr. DeLauer's presentation, and participants in what became an energetic three- (four-, five-) way discussion, were Robert R. Everett, President of the MITRE Corporation, and MITRE's Chief Management Scientist, Dr. Norman Waks.

**DeLauer.** I see some familiar faces in the room. I'm glad they're here. They have had a lot more experience in much of the acquisition of command and control systems, intelligence systems, than I have. It is a new avocation for me over the last seven or eight years, worrying about the question of C<sup>3</sup>I systems. I've really been in the missile business, before that in the weapons business, before that in the air-launched missile business, and before that, of all things, in the airship and airplane business. So I'm really an aeronautical engineer who has, for a period of time, moved into the question of command, control and communications, primarily because of the way we evolved at TRW. We began primarily with advanced computer technology, but we moved into the satellite business, and then into beginning the large complex command system for the original Minuteman weapons system. Next came classified intelligence systems, since many of them were tied to the satellite business. As a consequence of trying to lead that group of people, I got involved in the question of C<sup>3</sup>I. Then I served, with Bob Everett, as a member of the Defense Science Board management panel that looked at the acquisition process both

broadly and very narrowly. The DSB's 1978 study led to a lot of recommendations that were candidates for implementation in the last administration.

That's a disclaimer about my expertise. From now on you'll find that I may be in error, but never in doubt about my strong opinions on why things work and don't work. Before my nomination I had a little freedom about being a critic. Now I have to be more careful; it's going to be my job instead to go home and read the critique and do something about it. It's a sobering thought.

One thing about the C<sup>3</sup>I area: next to the strategic deterrent it's probably the one topic on which people hold the most divergent and violent opinions. Nobody is less than absolutely convinced that he understands the problems better than anybody else. We talk about command, control, communications, intelligence — for the mathematician that's a set of orthogonal issues in a big space that's undefined, the command space. Command is not a thing, it's not something you can go procure. At most it has the half-life of the individual commander, and that half-life is probably no more than three to four years, maybe only two years. Putting in the things that are needed to support his views on what the command function is may take a much longer period of time.

So how do you really get your hands on command? If you look at the organization chart of our national defense command structure, you will find in various places something called the Unified and Specified Commands. The Unified and Specified Commands are the brainchild of the JCS, and of the way the country wants to command its forces. But the Services — Army, Navy, Air Force and Marines — are not always in complete agreement that the way that the Unified and Specified Commander wants to run his operation is the way they would like to have it run, especially down at the service element level of the Unified Command. If you're in this business, you'll hear this is a real problem. For years and years we never had what is now loosely called the Worldwide Military Command and Control System (the WWMCCS). Why? Because nobody wanted to face the issue of who was going to be the commander. The top job, of course, is the President, he's the National Command Authority, nobody argues with his prerogative in that job, but what has been markedly absent is, "How's he going to do it?" One of the things we have discussed over the years is the difficulty of getting the President even to sit down to practice. I guess President Carter was the first president ever to visit the National Command Post and sit down where he was supposed to sit and at least be briefed on what it all means. President Nixon never did, Johnson never did, and some of the security advisors, like Kissinger, never went down there. And yet the President was the number one man in charge and always has been.

So it has been a very tough "roles and missions" philosophical problem: how do you acquire the capability to handle this critical issue when the players won't tell you what they would like, yet the implementers decide they have to implement it anyway because someone told them to do it? They get a lot of money to buy things, though, and so when they do buy them, chances are about one in five that the results will really be useful.

There was an incident during the 1973 crisis in Israel. At that time Jim Schlesinger was Secretary of Defense. He went down to the basement and everything was there, all ready

for him. It turned out, though, that he only wanted to know one thing: had the C-5s taken off from McGuire Air Force Base? Well, they didn't have that information there. Nobody ever thought that that was the kind of information this commander would need. Now the information was available, but how did they get it? They picked up the telephone and called Albuquerque, which is the Air Force's central control point for all aircraft in the world, and the Albuquerque guy said, "Oh yeah, the C-5s have left," gave him the time they had left, and said they were halfway to the Azores — and so they told the Secretary. But here was a whole big setup and the one little piece of information the commander wanted was not on hand.

So to get your arms around this is one of the toughest problems. There was an attempt to do something about this. As a consequence of the Defense Science Board Study in 1978, which strongly recommended a bigger role within the Joint Chiefs, they established a C<sup>3</sup> spot for a 3-star general. The fellow occupying it, Hill Dickinson, grew up in the communications business in the Army. He's having his problems now getting the Services to do their job. That's the next step. But for the moment let me beg the question of defining the command aspects, and get into the area of communications and then control, which starts involving technology.

**Oettinger.** Before you leave that, let me ask you: how much of this problem is specific to the military? I recollect being in a conference room with the Director of the Office of Manned Spaceflight, Brainerd Holmes, in the early 1960s. There was a similar problem, so somebody got on the phone and raised Wernher von Braun down at Huntsville in order to get the answer. The PERT charts and all the other stuff didn't show anything. (Granted, that's still a government agency.) Now, you've spent your life in the corporate world; do these problems arise there? Do they arise in different forms? Because executives and private secretaries tend to be in place longer than the military commanders, is the rotation problem not as great? Or is the problem the same, but not argued as much?

**DeLauer.** I think it doesn't have the same character, but that's because of the breadth of the issues and problems involved. Take the different kinds of control. In the corporate world there is more control than command. In the first place, most things in the corporate world are laid out, well, not on a very long range basis, but certainly for the near term, one to three years. There are forecasts and plans, and so forth. So the problem isn't so much planning, it's the subsequent control on which people's points of view differ. Harold Geneen ran a very taut ship at ITT. Everybody sat around a table at Park Avenue in a room ten times as big as this, and the charts flipped up on the board and they had to tell why their "P & L" for the month was a certain way. That was the way he controlled it. TRW is much looser, but it's getting tightened up now; as a matter of fact, that's one of the problems I had. It's getting to the point in the implementation of the control system where it is no problem at all to send a "P & L" report and the balance sheet directly from an operating division, using a machine-to-machine interface, right to corporate headquarters without anyone in the middle having anything to do with it. And that's what they want to do at TRW. I had a hell of a fight with them because that procedure eliminated two levels of management, the group executive and the sector executive, from review of the data during the submission.

**Oettinger.** So you've got the "skip echelon" problem there.

**DeLauer.** Right. It's a hell of a mess. The people in Cleveland want to get the report before it has had any massaging, and by God, like anything you'd like to do a little massaging and put a little judgment in it. But the people at the corporate headquarters keep saying, "We've got to have integrity in our system." There's a difference between merely smoothing the data and understanding it, and going back and saying, "Hey, wait!" It's like anything else coming off the computer — what went into the computer as assumptions for that particular month — and there are many decision issues. Do you set up an LIFO reserve this month, or the month following? Do you work your heart out to get the bills paid on the 30th of the month, and therefore cut your receivables down, so that your "return on assets employed" goes up, which is what you may want to do particularly if it's getting near compensation review time?

So if you are a general manager you badly need to be able to review and manage your enterprise. But there are conflicting points of view within many corporations — they don't want anybody doing that. Even though some middle management people are willing to go along with that, there are other things they should be doing. They are the heart and soul of the organization, they provide the morale (you don't do that with zeros and ones), they do most of the hiring and firing and staffing. That isn't done with a computer. It can tell you the requirements, but it can't tell you whether the youngster you're talking to is a whizbang who wants to come to work for you or is jumping from one job to another to another. It doesn't provide the marketing strength you need. And it certainly doesn't provide the judgment as to where you should be putting your resources. Now there are attempts to do even that. TRW has a top-down model that can forecast, for five years out, every single sector and every single division. The models are great as long as there's no instability in the system. Since they are really persistence models, as you go up, it keeps going up; as you go down, it keeps going down. But when you get the inflections and the second derivative isn't positive, or one way or another isn't stable, it's a mess, and that's where judgment comes in. There are some fundamental differences in people's points of view. I didn't come here to tell you my problems at TRW, but believe me a difference of opinion existed.

I think a diversified corporation has to decide on its level of aggregation, and that ought to be decided upon, not by the economic units in it, but pretty much by the marketplace it serves and the environment in which it operates. There's a hell of a lot of difference between what we had to do on the west coast to plan our future, which was high technology, and the guys in Cleveland on the automobile side who were worried about a completely different set of problems — such as worldwide sourcing of passenger cars — and the solutions are completely different. No one guy sitting at the top is going to have close enough touch with the substance of the business to make those decisions.

**McLaughlin.** Given that, does a corporation attempt to enhance its early warning system? Presumably one can massage the data only so much each month before there are serious disguised problems that will eventually start to crop up in one system or another. Is there early warning value?

**DeLauer.** Well yes, I think that's the value of the top-down forecast for major economic units. It's to see whether or not there are any really big error functions in there, and then go to work on those. That's essentially how I managed the sector. The sector had its forecast and all the divisions in turn forecasted their operation. Significantly, it turned out that the high technology part, what you would call essentially systems and energy — the TRW Defense and Space Systems Group (SSG) — was a one billion dollar single profit center. Which is unusual in the corporate world. And therein we had another problem. The guys at the corporate level thought that that was too big a unit.

Now let me tell you, having a billion dollar single profit center gives the general manager an awful lot of opportunities. We were just talking about that in the case of AT&T, and the whole question of deregulation. If you have a reasonable level of aggregation, good enlightened management can, within its economic framework, do good or evil. It can protect the losers too long, when they should probably be snipped off. But it certainly can nurture and bring along embryo businesses which, if narrowly examined, would have to be chopped out. And we did that. It's a great case history, somebody either at Stanford or here ought to write the case history of SSG.\* It was a very interesting economic development: a group starting out with one activity, a little sheltered, particularly in having to 'fess up to modern accounting rules based on everything that has evolved in 25 years of the SEC. But the thing was that for almost ten years they had a single overhead rate. Now this is very good, if the rate is reasonable, which it was, and if the element of it that contributed most to the sales carried an overhead rate of about two-thirds the organization's rate. That provides you with a lot of resources and opportunities to nurture a whole bunch of new businesses. And that went on for a long time. The ballistic missile business carried TRW for about 12 years; and then finally, the day I took over, the ACO came up and said, "We're not going to do this any more, we're going to start changing it." But for a while it was very successful.

**Student.** I was struck by what you were saying earlier about the skip-echelon aspect — that this might be a problem not only in the corporate but also in the defense area — and what you said about a top-down as opposed to a bottom-up system. It would seem, in looking at problems caused by technology, that you can have problems with too much decision coming from the top as well as not enough feedback from the bottom, and that there should be some meeting halfway — just as when you cited the technology causing the skip-echelon problem, eliminating those who should be mediators in the upward data flow.

**DeLauer.** Well the checks and balances of the middle echelon are certainly something I support and think we ought to have. We want to be sure everybody in the chain, at least

\*Somebody has. See Paul H. Thompson, "Case 4-3, TRW Systems Group," in Kotter, John P., Leonard A. Schlesinger and Vijay Sathe, *Organization*, Irwin, Homewood, Illinois, 1979, pp. 182-203. Also the following Harvard Business School Case Studies: "TRW Systems Group (A), (B) and (C)," 9-414-013 EA-A 550R, 9-414-014 EA-A 551R and 9-414-015 EA-A 552, Harvard University, Cambridge, MA, 1967. Available from Intercollegiate Case Clearing House, Soldiers Field Road, Boston, MA 02163.

somewhere along the line, has the same objectives in view, so that the judgments are being made on reasonably common ground. In the Department of Defense that is handled as kind of a carrot and stick process. To quote Bob Everett, "A lot of people can say no and stop something, but it's very hard to get people to say yes and make it go through. So the 'yes' decisions are generally a consensus." We once had to make a recommendation on an acquisition program and this whole question of advocacy and non-advocacy came up. Bob Everett's solution was included in our report: you make a decision and then take the advocates for another decision out and shoot them! Which is an honest solution to the problem, because as long as the non-advocates stick around, they create an impedance to getting the signal through — they can keep mucking it up.

**Student.** But if you have a system in which people know that if they don't advocate something they are going to be fired, don't they just respond by advocating something they really don't believe in?

**DeLauer.** We're never short of advocates. There are plenty of them. The problem is that when we finally make some general management decision, some of these advocacies aren't going to win. Some people inevitably say, "Okay, cheeri-aye-aye, we're going to follow this other path." Those guys never go away, and how do you rid the system of them in order to make the thing work? We tried everything. We tried retiring them, we tried putting them in a corner, and the only solution that seemed to have real terminal effectiveness was Bob Everett's solution of taking them out and shooting them. So the problem's still there. We haven't shot anybody, but yes, there is a difference between the military side, the government side, and industry.

One thing about industry is that somebody is really in charge. I'll give you a little corporate anecdote. The number one guy who made TRW is named Fred Crawford. His birthday's this week, he's going to be 90 years old. In 1941 or '42 he was the head of what was then called Aircraft Industries Association, Aerospace now, and he'd been running that Cleveland outfit and Bill Allen had just been made president of Boeing. Allen was on a trip to some Army base; at the time the Army had the airplanes. And he said, "Mr. Crawford, tell me how to be an operating manager. I'm an attorney, I've never operated a bunch of people." Fred told him, "Bill, don't you worry about it. You keep two jobs for yourself and you give all the other jobs away." Bill said, "That sounds like a reasonable thing, which ones do you keep?" Fred says, "You schedule the company airplane out of your office, and you're the chairman of the Executive Compensation Committee. You know where everybody's been going and you know how to control their pay — you've got complete control over everything." And to this day, we still schedule the company airplane out of the chairman's office! (In Boeing's case, they don't have any company airplane, they don't want to compete with their customer; but that's the way to keep control.)

Now, you don't have that on the government side. You have a change of administration every four or eight years; that has some sobering influence, but it isn't a question of managing the enterprise over the long term the way the leadership wants to do it. Instead it's a complete periodic change of leadership, you get a whole new team which is going to have the same goldarn problems every other team had: how to get rid of the people who don't want to go along with what you think is the right solution.

**Student.** Aren't there two other things on the government side, particularly with respect to national security, that might be worth examining? One is the consequences of error, the other is the "real-timeness." Those can make a very real difference.

**DeLauer.** There are parallels that have to do with feedback. There are the shareholders. On the government side, that's the public; on the corporation side it's the guy who owns the stock. Their leverages are different; it's the way that people perceive, the way people want to do things. The shareholder, if he's disappointed, can get rid of his shares tomorrow. If he is a big institutional holder, I guarantee his move gets the attention of the chief executive officer. At least the chief financial officer knows tomorrow if somebody decided today that he didn't like the way things were going at XYZ and unloaded his shares. The market is an immediate flag on that. Right away somebody gets very concerned about what's caused it, and there's some tight feedback with cause and effect. You don't quite have the same kind of feedback in the government system. It's a much more complicated, many-faceted problem. All you can do is point out the analogies as a base, without really discovering how experiences in one case apply to the solutions of others. All you can say is, they've got a lot of common characteristics.

Well, we were talking about control. When you start talking about that, you have to ask: "What do I want to control? How do I want to see it?" — and that's how we got into our digression about the corporate world. As for communications, that is now in the realm of hardware, software, things you can buy, install and operate; the communications system is a concrete fact: you have to be sure that the command structure is such that the button is pushed down when you start to talk, or the communications system won't function. That part of it is now institutionalized to a degree within the Services. The Defense Department has its Defense Communications Agency. What brought much of the integration of the Services' communications tasks was primarily congressional pressure over the years. Congress felt the Defense Department ought to have some kind of central buying agency for things that are used in common across all three Services, at the headquarters and so forth. The DCA is the organization in charge of the national networks, it's the one that buys all the leased lines, that establishes what the future communications systems are going to be. DCA has a lot to say about what kind of format is going to evolve. It also operates many of the systems after they've been procured.

**Student.** Are you equating technology systems with communication?

**DeLauer.** Not equating them, but certainly the anatomy of the communications system has a lot to do with what the current technology is about. I'll give you an analysis. I was over in NATO about three years ago to talk about doing some business. In Europe the military communications systems are controlled to a great extent by the PT&Ts (Postal, Telegraph and Telephone organizations). They're all national concerns and the people running them have a lot to say about what's going to go on — especially what is going to be bought. John Boyce, then in NATO and now retired and running AFCEA (the Armed Forces Communication Electronic Association), told me, "Look, you can't do anything now. The guy in Germany is an analog man, don't come over here talking digital



communications to him because he's locked in on analog. Until that changes, Germany, which is the heart of the NATO communications net, is going to be an analog, not a digital system." And it turned out to be very tough for several of our Army and Air Force units to talk into the terrestrial net because of the use of the German telephone system. Now that's been changed; he retired and somebody else is in there, and there's a big effort to go digital everywhere along the line. But to the technician it's not all simple. Their timing format's different from ours; you can't just take our digital switch and put it over in Europe and have it work, any more than you can put an American color TV into Europe and have it work.

**Student.** Has DCA approved a standard narrowband digital voice system? They were working on it five or six years ago.

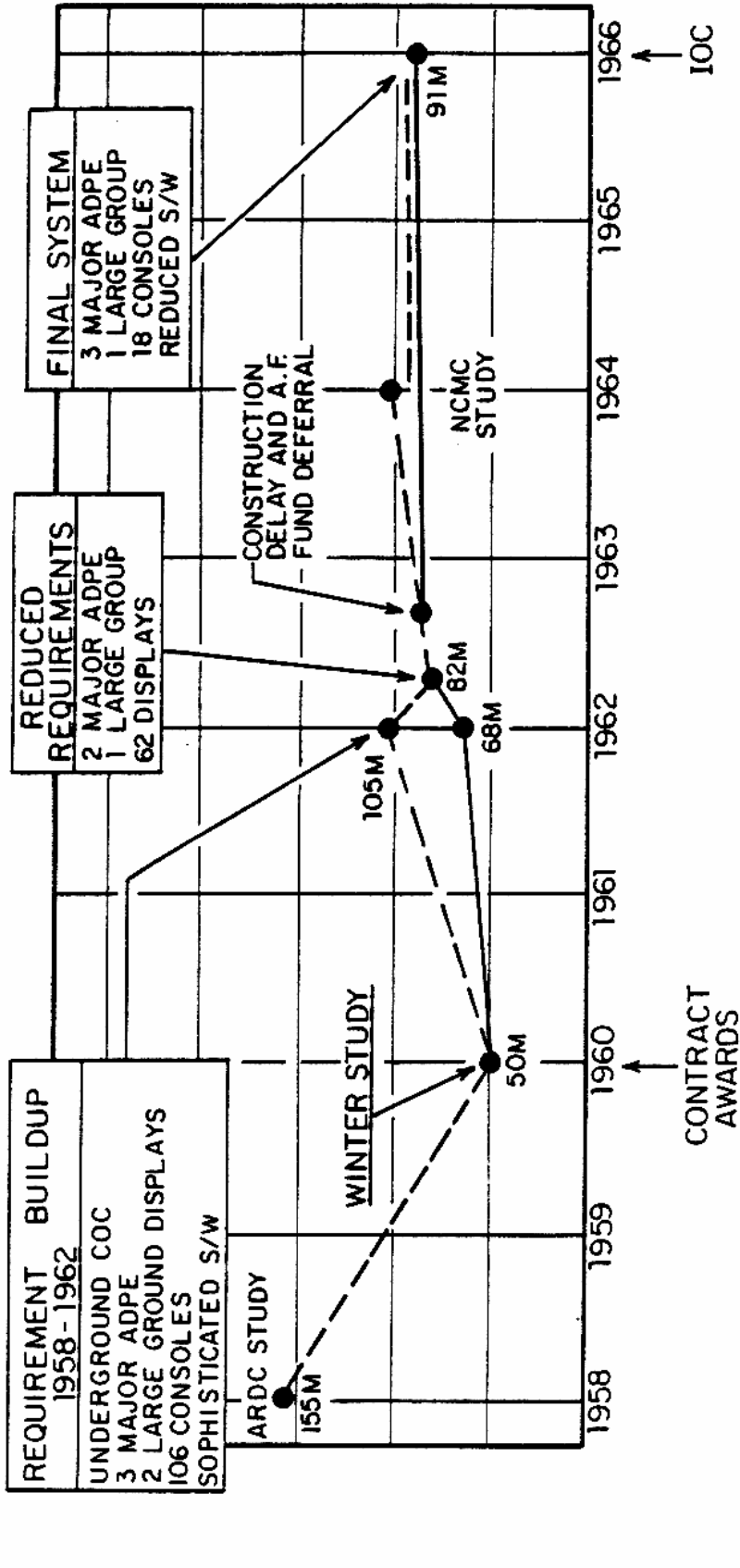
**DeLauer.** I think that they have reached system definition and are procuring some equipment. As a matter of fact, TRW is working on DRAMA, which is the multiplexing and digital radio program for it. So there is some basis for that digital voice net right now.

**Student.** About five years ago there was a flyoff between the Service components. ITT had the input in the Navy and the Air Force. There are six or seven different components.

**DeLauer.** While they may have agreed, and while the DCA might have come up with a standard format and some standard specs, the three Services aren't very well in synch on implementing that system. The real fight is over the Rapid Deployment Force issue. The Rapid Deployment Force is an Army unit, and they want to put Air Force units in it. But there's about a three-year mismatch between the two Services' abilities to talk to each other; the Army's equipment is about three years further along, so if you put those two operational units together they really can't talk to each other unless something's done with an interface unit. Now that's dumb. We have to speed one up, or slow the other down, or do something to make them able to operate together. That issue is on my desk right now. Even though the spec may be agreed to, I have to confess that I think uniform implementation is what you want for a communications system — that's the final message, really. It's the Bob Everett solution.

Everett and the MITRE Corporation have been involved in a great many systems over the years, including a number of the "L" systems, among them the NORAD Command Operations Center in Cheyenne Mountain, the air defense command and control system. Figure 1 shows MITRE's work during the eight years from 1958 to 1966, beginning when the first spec was put out to the first IOC (interim operational capability), working with the Air Research and Development Command (now the Air Force Systems Command). It was going to cost \$155 million in 1958 dollars. Two years later the Winter Study decided to clip the cost ceiling to only \$50 million. They didn't change the requirement, they just cut the price. And, you know, that's nonsense. Well, as they started putting the system together, within two years it was projected to cost \$68 million, and then it was up to \$105 million, so they said halt! and reduced the requirements. As the requirements were understood, the NORAD system was going to be an underground command operations

**425L vs. 427M**      **425L REQUIREMENT/  
COST EVOLUTION**



--- REQUIRED  
 — AVAILABLE

Figure 1. 425L Requirement and Cost Evolution

center — a large data processing installation, three large-screen displays, 106 consoles and a lot of sophisticated software. Reviewing that, they reduced it from three to two automatic data processors and only one large-screen display, and they cut the 106 display consoles down to 62. Then they changed the requirements, and they finally went for \$91 million — not a bad increase over the \$50 million, especially in eight years; those were low inflation years, 4% years at the most. Your dollars weren't that bad then. At that cost of \$91 million, it finally grew to three ADP systems, one large display group and 182 display consoles, with reduced software requirements.

Now, despite what some might think, this is a good program — precisely because they did keep changing the requirements, kept it flexible and kept throwing things out to make it happen. If instead they had kept to the original program lines, in Bob Everett's view they would still be working on it, and we still wouldn't have it in 1981. The heart of the recommendation of the Defense Science Board study on systems acquisition was that you ought to build command and control systems in an evolutionary fashion and get them in the user's hands very quickly. You find out what the commander wants, evolve the system, add to it, update it, bring it along; in the meantime you install a backbone system that really works, and we've been trying to do that. Finally after much blood, sweat and tears we have gotten the Services to admit that command and control systems are different kinds of things from airplanes or guns. They're acquired in small numbers, generally they're one of a kind, and their operational characteristics are largely determined by the user in an evolutionary process. In many cases existing commercial equipment can emulate the function, and you ought to be flexible and be ready to take advantage of that in procurement. And remember that these systems are not just for use at major command headquarters, but are also deployed at small units down to the corps, even perhaps the division and company levels. They all ought to take a common approach; at the same time, such wide deployment and such a wide range of needs demands flexibility.

**Student.** Does that mean that, for instance, the Air Force should be doing its R&D within the major operational divisions, and shouldn't have a Systems Command?

**DeLauer.** No, what it really means is that the Systems Command shouldn't take the thing on alone, or think it knows better than the operational people — they ought to work together hand in hand.

**Student.** What would happen to the people involved, though? What about the star of the Systems Command, who wants to hitch his wagon to the success of the biggest thing? I'm overstating it, okay, but there is that scenario: you want to build a system that's as big and glorious and gold plated as possible, and you don't worry about the consequences, because it's not going to be delivered on your tour of duty anyway.

**DeLauer.** Well, that's exactly right. Most commanders are gone before they ever have the system they were going to be involved in. It's been a real problem to overcome that.

**Oettinger.** The inference is that if the commanders stayed around longer, or systems people were smarter, or contractors were better at producing things faster, as either a backbone or a completed system, this problem could be solved. Doesn't the real problem lie deeper? An operational guy is likely to state his requirements in terms of functions — he needs this, that or the other thing — if he's capable of articulating them at all. The technical guy at ESD is more likely to talk about capabilities — the gears, the technology.

**DeLauer.** Not only that; he wants to put a fence around it so he can meet the budget.

**Oettinger.** Even given a greater amount of time, though, mightn't that kind of cultural gap be unbridgeable?

**DeLauer.** All those tendencies are going to continue, and the characteristics of the people involved aren't going to change very much. All we had hoped was that we could achieve an operational system sooner by starting reasonably modestly, with limited objectives, to handle one piece of the problem with the understanding that it can be an evolutionary process, rather than taking a full-blown all-at-once approach. There's a case right now that is headed for real problems: the Joint Tactical Information Distribution System (JTIDS), which has been the number one integrated joint program that has been run by what was the C<sup>3</sup>I organization in research and engineering. Boy, it's gotten flak from everybody.

**Everett.** It's getting flak for different reasons. But it does illustrate your point about the interface and what does and doesn't need to be done. You talked about the PTTs in Germany — what is the requirement for entry into the national PTT systems by the military networks? Does the guy in the foxhole need to get into the PTT network, or does he participate in some sublevel network that eventually goes into the PTT? Do all the PTTs have to be hooked together at all points, or can they be hooked together at selected points? These are big things to think about. It's the same with JTIDS. JTIDS was designed to be a common integrated information communication system. It was also designed to be jam resistant, to provide a secure voice capability — to meet many, many needs. Like the F-111, it has some features people like and some that people don't like. It's big, heavy, costly, but it will do a hell of a lot of things. The point is that JTIDS will not meet all the communication requirements of all the Services at any one time. Other communications networks are needed to supplement the network that JTIDS might serve. Another thing: the communications requirements of the United States far exceed those of any one of our allies — may even exceed the combined total needs of all our allies. So JTIDS may be a little more, in fact maybe a lot more of a communications system than any one of our allies really needs. From their standpoint, then, should they be integrated with our network? And to what extent is it necessary to be integrated with our network? That gets back to my main premise, that the first thing one thinks about when one thinks about integration and interoperability is, "What is the real need for interoperability, and how can you achieve that with the least amount of pain?"

**McLaughlin.** But the question is, can such a system be evolved to maximum flexibility? The comprehensive systems required for something like JTIDS may seem impossible.

**Everett.** JTIDS was also a tactical system. It was first designed as a communications system, then it changed. That's important. It was just a tactical communications system; then it was decided that it and a similar system were so close that they would combine the two.

**DeLauer.** We rest our case.

**McLaughlin.** My point is, though, that while I'm sure the evolutionary approach sounds good in maintaining flexibility and recognizing that not all NATO countries or all forces would have the same requirements, you also wind up trying to put together something like the Rapid Deployment Force, where the Air Force and Navy can't talk to each other.

**DeLauer.** Well, they can, but it's even worse now. There are divisions and subdivision elements of the Army that can't speak to each other because of incompatible formats.

**Everett.** But then again, the first questions you have to ask are: is it necessary that they talk? And who are "they?"

**McLaughlin.** But our experience from 1941 on shows that modern warfare entails combined operations. If you go through the military and naval histories, there's enough of a catalogue of disasters stemming from lack of Service interoperative ability. That does not seem to be a luxury, but a necessity. We know that for the 1980s and '90s the Services will require some degree of interoperability.

**Everett.** But what degree? Do you need interoperability only to communicate between a task force and some other command body, or does each ship have to be able to communicate with every aircraft?

**DeLauer.** Well, that depends on who you want to talk to. A Specified/Unified commander, Noel Gayler, who was CINCPAC, Commander in Chief of the Pacific, argues that you have to take communication away from everybody because they chatter so much that they're the world's worst security breakers, just by talking to each other. Now he's an extremist.

**Everett.** The last thing you want to do is give the communications capability to the President. Evolutionary development can be like what the African colonials used to call the "white man's madness" — big changes every time a new administrator came to the colonies. One would be an agricultural bug and say, "The boll weevils are eating up all the cotton plants by the roots. Pull out the cotton roots, that's how to solve that problem." So the natives would run out and pull up the cotton roots. The next guy would be a civil engineer and he would say, "We need roads. So forget that boll weevil nonsense and get on with road building." And they would go along with whatever the new thing was,

because they didn't want to spend their time in jail. Similarly, in the command and control function, every incoming commander's background, environment, personality, whether he likes staff or hates staff, whether he's an authoritarian or not — his whole style, his whole being will dictate to one hell of an extent his and his staff's command information requirements. A lot of thought has been given to this, to identify basic informational requirements. As we get down to tactical situations we arrive at some constants — things that tend to happen over and over. But that only gives us maybe ten percent of the needs. There's still the other 90 percent that's going to change with every new "white man" who comes in.

**Oettinger.** The metaphor is an interesting one. These commanders don't come out of nowhere, and they certainly don't come from a foreign colonial power; they come from Services that are part of the establishment in which all of this is taking place. Which leads to the question: How come this problem is so perennial? What is there about the training and indoctrination of junior on toward senior commanders, relative to the development of the command systems that we are talking about, that over a period of 30 years has perpetrated this great variance between what, if I hear you correctly, commanders expect and what the technical development system produces? Is that variance a fundamental, a given? Or is it an accident of faulty structures, or human nature, or what?

**DeLauer.** If you put them all in one room, and they all had to write down what they wanted to have to do their job, I would be willing to bet they'd be at least 90 percent in agreement. The 10 percent would be scattered; the main elements would be agreed on. That's never been the problem. The problem has been — after you have agreed that such and such is the nature of the command function — how you implement it. Pretty soon you find you are looking at the process itself, and that is what we've been trying to get away from. Don't narrow it down to people specifying a particular black box with a particular function to do a particular thing, for you will have to wait a long time before you ever get it all put together as an operating capability.

I'll give you an example. Two different commanders tried to implement growth by evolution in the European theater. General Blanchard, when he was over there, was a great believer in getting systems into place and trying them out. A system called Guardrail, primarily an intelligence system of a kind — an intercept system — went over there. It flies in a small airplane and uses ten-year-old technology; there are no microelectronics in it yet, but it does the job: intercepts signals, operates on them and locates their emitters. Guardrail went into Europe as a small system almost ten years ago, and it's gone through a couple of evolutions. Because it was a small system it was never a big deal; as an adjunct to the information system it was never really in the mainline of the command center. So there was no great interoperability problem. It was simply a piece of data that came in that was very helpful to them. And over the years it has grown into a pretty good system. I visited a Guardrail site, a little battalion on top of a hill copying foreign language transmissions staffed by young people, about half men, half women. There were probably about ten people on duty at all times, which means they must have had about 30 or 40 people in their complement. They participated in the Reforger exercise and did an

outstanding job. Now what you have to guard against with this kind of system is that somebody doesn't try to make it the biggest full-blown system in the world and try to include everything. Its whole value is that it's in place, it's limited, it does its job and you can take its information and feed it into someplace else. General Blanchard liked that, and so did Al Haig when he was Supreme Commander: "Get things over here and let us get our hands on them."

Other commanders have come over, like General Rogers, who says, "If this thing isn't ready for field army use, don't bring it over." The boss has just changed the whole damn concept. You can see the result in the BETA (Battlefield Exploitation of Target Acquisition) system, a fusion center which took data from Guardrail and everybody else, put it all together and presented it in a common format. That system ought to have gone to Europe last fall, just to see how it worked. It was supposed to have been a testbed. But somewhere along the way somebody got the idea that it had to be a kind of weapons system, had to pass a whole bunch of tests. ESD got involved with it, became the lead division (the ESD commander, General Marsh, was the lead boss on it), turned it down, and it never got to Europe. Congress got into the act, said it was going to cost too much money — everybody got into the act. That's a perfect example of the full-blown approach. If the system had been set up to evolve into operability, it would just have been sent over to Europe and fitted in.

**Oettinger.** I sense that there may be "pure gold" evolution and "fool's gold" evolution. Where is the distinction? The ideal evolutionary model, as I hear you, is a simple "backbone" kind of thing to which you can add on. But another model, not incompatible with a naive notion of evolution, says that you evolve a German PTT, a French PTT, some U.S. military service facilities, separately. They're all nicely evolved — until the day comes when you try to hook them together, totally or partially, and things come to a grinding halt. And somebody says, "Jeez, you know, if only we had planned ahead and thought the thing through up front, we wouldn't have had to come to a grinding halt now and build interfaces which are larger than all the systems together." Somebody else says, "Well, we did it in an evolutionary way." Is that not what you mean when you say "evolutionary," or is there some qualification to that notion of evolution which makes it good? And if so, how do I tell "pure gold" evolution from "fool's gold" evolution?

**Everett.** In the first place, the systems do evolve — they're enormously complicated, with a large number of people, things, technologies — and, at all stages, they do evolve. Now the question is, do we have a procedures organization which is making that evolution work out in a sensible fashion? Well, there are two fundamental troubles. First, the DoD is set up as a procurement agency. It doesn't develop communications abilities, it buys things. If you want to buy an airplane, it buys airplanes. If you want to buy radar, it buys radar. If you want to buy a command system, though, it's helpless. There's really no way to organize a SPO to "make" a command system. The second problem is that evolution is a process which takes place in some kind of real world. There are a lot of steps, a lot of things are tried and fail, and the pressures of the realities of the world determine what things succeed and what form they are to take. That's the way it's supposed to work in

nature, and it's the way evolution works in technical development as well. Now, if you allow a military system to evolve under unrealistic conditions and in unrealistic ways — if, for example, you don't run joint exercises — then you shouldn't be surprised if the systems don't work.

Now as it turns out, the German and French PTTs will work together; the French and Germans do talk to each other, and that's been true ever since the early days. Therefore, in the course of evolution, it's worked. But if they had never talked to each other and a time comes, at two o'clock in the morning, when they will need to talk together, rest assured that they won't be able to. This is the situation in our military. People say, "It's just absurd that the Army and the Navy can't talk to each other. We'll legislate it: 'Everybody shall buy the same radios;' or, 'we'll make them all get together in one room and design the communications center.'" Those things don't work. The only way you're going to get them to work together is to make them work together, make them work joint exercises, and when they can't work together and the thing fails, you sneer at them and they have to go out and fix it. If you don't do that, they won't ever fix it.

The point is that they've got all kinds of trouble even running their own systems; it's barely possible for the Navy to run the Navy, the Army to run the Army, the Air Force to run the Air Force. What makes you think they're going to stop and deal with the tremendous difficulty of making the Army and Navy work together, unless they have to? Now, when there's a war, you have to work together and you learn how. In 1941 people knew this, they worked together, sure they did; they would have been shot if they didn't. That's not true any more. If we really start a war and start running individual Service operations, after a while we'll have to learn how to integrate them. But we may not have enough time. My strong feeling is that the systems and the Services do evolve, but that you can only make them evolve under realistic conditions. And wars are too expensive to serve as realistic exercises.

**Oettinger.** What I hear you saying now is that two things are somewhat reversed. Are the notion of systems engineering in the macroscopic sense, and the notion of engineering economy, really snares and delusions? To take a concrete example, the Bell System's success in operating as an evolving, integrated entity paradoxically lies in the demonstrated fact that pieces of it are archaic — there are still some switchboards in Maine that are manual plug-in systems, there are still some number five crossbars, a variety of ESSs. The Bell System is a prime apostle of systems engineering, but what has made the Bell System work was, first, an evolutionary process, and second, the ability to patch all that diverse stuff together without worrying too much about the details of the economics and where the costs fell. If you really tried to practice full-blown systems engineering on it, and optimized or minimized costs systemwide, you'd fall flat on your ass. Or am I caricaturing that example too far?

**DeLauer.** You're implying that the systems engineering discipline and the systems engineering effort should be on the total all-encompassing system. But there's no reason



in the world why the systems engineering effort can't be done on certain parts of the system that would eventually grow.

**Oettinger.** That's the magic line I'm looking for, between "pure gold" and "fool's gold" evolution. You're saying it's better to suboptimize on subsystems than to deal macroscopically?

**DeLauer.** Oh, no question about it.

**Everett.** In Darwinian evolution you go out and keep doing things; the ones that fail you throw away; the ones that work, you keep. I expect that you might be able to mend the telephone system by means of evolutionary function, but we don't have a few million years. So you need to assess the course of the evolution — try to make the things you try sensible, and fix the small difficulties. That is a tremendous engineering task, and it is what is normally thought of as systems engineering. The trouble comes when you say, "Look, the present telephone system is all analog; what you ought to do is throw it away and build a new one using digital technology. We'll set up a SPO, we'll write specs and get everybody going, and the IOC will be 1992."

**DeLauer.** And it's going to cost this number of dollars to four significant figures.

**Everett.** Now you know that nobody would be able to talk to anybody in the United States till God knows when. We try that all the time in the military.

**Oettinger.** Here are two of you who are in full agreement on that score; why is the rest of the world so dumb?

**DeLauer.** Well, we're just about to fix it. That is, we think we're going to fix it, but the problem is how everybody perceives its importance. I told you about the commander who perceives the importance of doing things another way. Some changes are made which don't match what is on his list. He doesn't say he doesn't agree with the approach, he doesn't say it wouldn't be very nice to do that, but "On my list of things that are important to help me understand how these troops are working," says General Rodgers, "I want to concentrate on something else." So the thing that's high on Al Haig's list goes down to the bottom on Rodgers' list; and that happens everywhere. Now that's the problem we have within the Services.

As a matter of fact, one of the things that got the WWMCCS started was that one guy decided that he was going to make it work. The Deputy Secretary, Bill Clements, who was an oil man, a politician, not a technician, said, "Look, this is dumb, and we're going to make it work." At the first meeting he said, "We're going to get a systems engineer;" we competed, and IBM won. They put a group of five guys on it, they started working, and we ended up with a WWMCCS system. Tom Reed, a protégé of Bill Clements, was put in to run what was called DTACS, which was the first recognition that there was a DOD-level office responsible for doing some of this.

Then, primarily, I think, through Gene Fubini's lobbying, other people said, "Look, we're not solving the problem, so now what are we going to do? We're going to create a C<sup>3</sup>I (I haven't talked about the 'I' yet; I'll get to it in a minute) — C<sup>3</sup>I organization, and we're going to make it work by setting up an Assistant Secretary of Defense title for that particular job;" that was done in the Harold Brown reign, and that's what Gerry Dinneen did. Now Gerry Dinneen, if you read the charter, had control of the dough, pretty much. It was a resource allocation problem and he did a pretty good job. They had good people working on it, keeping it together. They controlled the money, fought with Congress — and that was their biggest problem, because they had guys like Chuck Snodgrass,\* who thought he could run the whole damn communications business, and he was designing the system from Congress and telling people what kind of systems they had to have. Dinneen fought the battle in Congress and got them a lot of money; but he didn't have the contractors, or the people to manage the program. He gave it to the Services and bingo, the minute the Services got it the priorities changed, the rate of implementation changed, a whole bunch of things changed. He certainly was a very forceful guy, he really understood the technology; but somehow or other he never could make the Services fall in line.

Now I've got the same problem. Now what do we do? Everybody who's talked to me says, "Let's do away with C<sup>3</sup>I." So we do away with C<sup>3</sup>I — but you can't make it disappear, we're still going to have some resource allocation. One of the problems we have had with the C<sup>3</sup>I organization was that when we did focus it, and aggregate it to, at least, define what the needs were, the warfare groups — strategic, space, general purpose — didn't have enough capability in it, and since they're not looking for things to do, they went on their merry way without considering the command, control and communications requirements. In MX that's still missing; we really haven't addressed that leftover problem yet. What I want to do is be sure that the weapons systems people, who are putting in all that money, consider the implications of the command, control and communications requirements when they start thinking about the weapons system.

Now the problem is, how do I do that? I come out of an environment of 23 years in a matrix organization — and I'm telling you, matrix organization in the Department of Defense is something new. So we're going to see whether or not a matrix will contribute; and I think it's a good experiment. Maybe I'll come back in about four years and tell you it isn't going to work.

How do you make a matrix organization work in industry? By virtue of the fact that if a guy is a contracts man, he belongs to a contract organization — or better, take industrial relations, that's quicker because it's got a culture. The IR guy belongs to the IR culture, the finance guy to the finance culture, and the top IR or financial guy in the organization is Daddy Rabbit. Now the people who need his services are in the product organization, working on the product line, so when you delegate him, you put him under the operational control of the person responsible for that profit center and that product line, and he

\*For Snodgrass' views, see his presentation in this volume.

supports that guy. But when it comes time for his salary review, he gets it from both sides; both finance and product contribute to the recommendation to the next level up. That has a certain amount of attention-getting effect. In the DOD, however, we don't have that same kind of "near-term leverage." We have to find some other kind of incentive. There ought to be a way to "incentify" the system so that both sides consider themselves responsible for that person's activity. The person he's supporting feels that this guy has been giving him good support and that he needs him, and the person who owns him functionally says, "He's my man over there, and the better the job he does, the better the job I'm seen to be doing." If I can "incent" him in some way, we can use a matrix organization.

**Oettinger.** Before you go on to the intelligence part, one last remark on this aspect. You've just indicated how something can have enough financial resource allocation, etc., at the DOD, yet when the action is delegated to the Services it dribbles away, and you're left mulling over matrix organizations. At the other end, though, we're going to hear Jack Cushman\* talking about the commander's viewpoint and the notion that it's not the Service but the commander who's the customer. You've talked about the problems that are created if the commander is in the saddle. Where might the balance be struck between regarding the commander as the customer and the yo-yo effect you've described as happening when you switch commanders?

**DeLauer.** I've talked with Jack Cushman on and off about that, most recently three or four weeks ago. He was a consultant to our people out in California, so he came by the office and he was talking. He'd been working for Bob Everett at MITRE for the last two or three years, writing some special reports on this very issue. If you ask him that question, you'll find he's just as frustrated as I am by the fact that we can't keep these damn commanders in line. As a technologist I feel that way, and as a commander with orderly views, he feels that way too. It would seem that we ought to be able to put together a Good Book with "Ten Commandments for the commander," so that the rest of us who are trying to implement things can at least keep the table of contents constant for the period of time that it takes you to go build the system. He'll probably tell you the same.

The Services buy things; it's the buying that sets up the problem. You can do a lot of things before the buy, and get agreement on something, but the minute you start buying, the minute you start spending money, the minute the stuff starts getting delivered on the dock (and sometimes it doesn't work) is when it gets very tough and you just have to go work it, you've got to go fix it. I noticed you passed something out that said, "Are our weapons too complex for people?" I'll probably get asked that next week at my confirmation, because it's somebody's hobby horse. My answer is: no, they're not too complicated; in certain instances maybe we can do something to make them less complicated — though that's the wrong phrase; "more useful" is better. People tend to say a system is complicated when it just doesn't work. Well, we've made things that work. It generally costs money, it takes time and attention. But we've got things that work forever. Satellites, Minuteman guidance systems, the Polaris all work very well, those things run forever. I

\*For General Cushman's remarks, see his presentation in this volume.

mean, seven or eight thousand hours mean time between failures is a lot of time between failures. Comparing this to 50 or even ten hours between failures, as with some of the radars in the new advanced fighters, you want to ask: why the dichotomy? It's simple. Take a look at the way they were developed and the amount of money allotted to them. In short, I think we're going to have to try to do fewer things and do them better, not so much better as more completely, because these problems are fixable, if you're willing to put the time and effort into it.

**Waks.** I would hate to leave this evolutionary thought at too simple a level. I think if you put together the other pieces effectively, you will perhaps be able to deal with the problem of the change of individual commanders as personalities. Another element of that idea is the user as developer — besides being the requirer, he's part of the development team. Third, we're talking about continuous testbeds — development testbeds, operational testbeds. Bob Everett was encompassing this in the notion of exercises: continuous testing of the idea as it evolves in the user's environment.

**Oettinger.** But if you're successful in that, then all you've succeeded in doing is making it better for the user who has participated in the development — not necessarily for his successor.

**Waks.** No, you see, the using command doesn't link inextricably with the using commander. The commander of that command may change, but the testbed will not. It's not an either/or question. You're really developing the system at multiple levels simultaneously, even though not necessarily in a physical form. You're designing it from the smallest evolutionary piece to the highest level, all at the same time, and the using commanders, as personalities, can't change that very readily because you have a fair longterm investment in that capability. NORAD, for instance, is evolving.

**DeLauer.** They're a much more stable organization; now you've got to worry about whether they're getting hardening of the arteries too.

**Waks.** Well, it's a more complex idea.

**Everett.** Let me say one further thing. You were talking about organization earlier — I think that takes us back to a point Dick made earlier today. The question is whether the people are in agreement. It seems to me history shows that when people are in agreement, organization is of little importance. But when people aren't in agreement, you just can't fix it by ordinary measures.

**DeLauer.** That's what everybody attempted to do.

**Everett.** Matrix organization works at TRW and Raytheon because people are aligned, their purposes are aligned, they can make it work. But you can organize the DOD till the cows come home, yet unless you get some consensus nothing's going to happen.

**DeLauer.** Like I say, I'm trying to grope for the incentive. In some way you've got to make it worthwhile for people to come to an agreement.

**Everett.** Maybe the thing to do is give the fellow in charge of C'I scheduling the responsibility for T39s.

**DeLauer.** Something like that. It used to be that if you were in charge of flight pay, you could keep the guys from getting their flight pay and get their attention.

**Everett.** How about controlling the mess halls in the Pentagon?

**DeLauer.** Oh, I don't know about that. I saw my appointment floating around; I didn't know what it was, but I figured I had it made when I got a note saying that I could go in and eat in the executive lunchrooms. That guy got the message.

**McLaughlin.** Realistically, though — I spent 16 years in the Feds. What can you do with incentives and a matrix organization in the DOD? When you have a flock of GS-15s working for you, earning at most \$48,500 —

**DeLauer.** I've got a little carrot now, because they have put the special award program into effect; that is relatively a good thing. I mean, some people would like an extra \$10,000 a year. I bet I could get you interested. I don't think you can necessarily do it financially; I'm just saying there's a way.

**McLaughlin.** Well, at least based on the operations of a couple of years, most of the people in the Senior Executive Service aren't terribly excited.

**DeLauer.** Well, that's because it's kind of an "old boys' club."

**McLaughlin.** Hey, you can make it a new boys' club. The other people will see it as a new boys' club. But you also have the problem, for most intents and purposes, of the absence of the stick. With very little carrot and no stick to speak of, I'm not sure how realistic a matrix organization is.

**DeLauer.** That's the toughest leadership job there is: to provide leadership when you really don't have the carrot or the stick. It's a cinch when you've got lots of both: a big stick and a big carrot.

**Student.** One of the reasons it works at TRW and probably will not work in government is the type of people you're attracting: people who have a great interest in academia. The type of collaborative environment we're sitting in right now attracts a certain type of person who works well in a matrix organization. I think a different type of person is attracted to the government, the military — responsive to the chain of command, rather than owing allegiance to an individual function.

**DeLauer.** Well, incentives are used within the services themselves, to get good people to go into functions.

The Army, I think, was very poor in what we call SPOs, in program managers, System Program Office heads. In the Army, the road to promotion was “General, let’s take that hill” — you know, that’s what they’ve been taught since they were second lieutenants or even before. When they needed people to really run a program, the XM-1 tank or the MCV — well, I talked to the MCV Program Manager; boy, I mean, he was a tough looking colonel, young, shaved right up to here, spit and polish and everything else. I said, “What do you know about programming?” He said, “What?” “How did you get to be a program manager?” He said, “Beats the hell out of me, I wanted to go to Fort Bragg.” And there he was running the MCV program, and his big decision was what kind of transmission to put in this armored vehicle. No question, his record was probably super. You know, he came up, he did everything, and they thought, here was this hard driving leader and they would give him this very important procurement responsibility. But he was completely untrained for it; he’d gone to some graduate school, I don’t think he came here to the Business School. He had some kind of training, but it wasn’t in program management, maybe personnel management or something like that. He really didn’t know why he was there — nobody had explained that it was a hell of an important program and he ought to do it.

The Army did change that though, through a big study called the ARMAC, Army Material Acquisition study, aimed at selecting and promoting program managers. The program managers who were successful were suddenly promoted from colonel to general, and then they had everybody’s attention. But then, by God, the Chief of Staff who had backed that effort left and another one came in, and it was back to “We’re going to take that hill” again. Now he’s gone, and the present assistant secretary for research and engineering in the Army secretariat — he and I had a meeting the other day and I said, “Well, General Mayer, what do you think is the most important thing?” And he says, “Look, we’ve invented almost everything by now to make the kind of Army we want. We can decide whether it’s going to be a light army or a heavy army, this kind of army or that kind of army. What we’ve got to do is decide what we want to do and then go get the equipment. I need program managers. I need a guy up there in the secretariat who understands program management, not a goddamn detailed nuclear physicist who’s going to tell me how to build bombs. I want someone to tell me whether our people are doing a good job in program management.” And I said, “Well, what are you going to do about your program?” and he says, “By God, we’re going to . . .”

And then I said, “Okay, you’ve told me what you want; now I’ll try to help you get that guy. Now, in return will you let me confer with you when you replace Jack Guthrey?” (Jack Guthrey is the four-star general who runs DARCOM, which is the acquisition research and development element.) And he said, “Absolutely.” Well, now, this is a big leverage for me. If the new DARCOM commander comes in knowing that I had something to do with his being selected, I go a long way toward being able to get the kind of consensus Bob Everett was talking about. They’re just people, and if the guys up there can agree, and they tell their guys, “Look, you go agree,” before long you do have the

ability to go do the job. This is what we are trying to do; we'll see how it works. You always have rose-colored glasses before you take the job — it's the only way you'd take it.

Well, let's cover intelligence quickly. The problem with intelligence: everyone wants it, in a form that lets them assess what it means to them, and they don't want anybody mucking around with it. Consequently, when you start looking at systems that will tend to fuse the available intelligence information, to pull out of it what somebody thinks a particular commander needs, you always have a lot of problems. Commanders want to look at the pictures themselves — they almost want to interrogate the HUMINT guy themselves. They're not willing to say, "Look, here's a broad category of things, now I'll be explicit about what I need." And then the inverse problem — many of the intelligence systems are tasked through a different command chain. And it is not easy to give the operational commander the means to state his high-level requirements and his needs in an operational sense in a form that can in turn be tasked into some of these systems so that the right information gets acquired.

And the other problem is that there is a hierarchy of intelligence priorities. Suppose I'm the guy running the land war; I need to know the positions of certain things, maybe the data source, to be able to ascertain what the situation is and know how to weigh the data — but that conflicts with the fact that the sensor system is also going to be used for something else. People start to work on some tactical intelligence system and they think "I've got to own it, I've got to have my hands around it; it can't be national means because the national means too often even gets right out of the Defense Department into other areas."

I ought to just leave it at that. You're going to be hearing B. R. Inman this semester, and Inman is in a new job, he's left NSA and is now the number two guy in the CIA. He has been in naval intelligence most of his life. There isn't a better guy to talk about this whole subject: how do you feed intelligence information into the command and control system so that it will be usable? How can you provide a capability over a period of time that permits the user to get his request back in to you in a responsible, timely fashion? It's a very tough problem. And whoever he talks to in the Department of Defense is behind a green door — special access.

A good friend of mine ended up as Sixth Fleet commander at the time of the Yom Kippur War: Dan Murphy. The Israelis said, "Americans and the Soviets get the hell west! Anything that's beyond this particular longitude, you're in our territory." So that shoved 62 Soviet ships and 58 American ships and cut the ocean down a little bit, and these guys were running all over each other. Dan was trying to get information; he asked a staffer a question, and he says, "I can't answer that." Dan says, "Why?" "Because it's behind the green door." (They had a classified section in the flagship.) Well, Dan told me, "I broke the green door down." He says, "By God, this was serious now. This was not a peacetime operation. We were here and the Soviets were there and we were looking down their throats." My son Dick, meanwhile, was over there flying off a carrier, and Danny's son was a lieutenant on a destroyer. Dick was flying an A-5 photo-reconnaissance airplane right overhead; the clouds opened and he saw all those Russian ships down there, and

they didn't know what to do about them; they weren't alerted, they got all jammed up. It was a Sunday morning and Dan was feeling kind of low and he thought he'd talk to his boy. So he sent his helicopter pilot over to the destroyer. The helicopter landed, and the kid walked up forward to where Dan was, got right in front of his Dad and said, "I hope the hell you know what you're doing!" So you see, the average lieutenant thought it was absolutely mass confusion. That's command, control and communications, and that's where I think I'll end.

**Everett.** You just mentioned what I think is one of the major problems with tactical intelligence and its use, the fact that the intelligence community is so reluctant to let the non-intelligence community know what it knows. I'll give you an example. One of the obvious things to do when your communications are being jammed is to operate on the same frequency as the other guy, because obviously he has greater difficulty jamming you while trying to keep his own things going. But the intelligence people are most reluctant to let you know that they know what frequencies he's on so you can do that — because if you operate on the same frequency, then they would know that you know what they know. I don't know where we draw the line. The book *A Man Called Intrepid* tells how the British let the Germans shoot down an airplane because they didn't want the Germans to know they had broken the code or heard anything. They couldn't warn the guy — they just let him go swoosh. Now that's rather dramatic, but I think it typifies the thought.

**DeLauer.** Yes, and it's going to get tougher because of the whole question of access. In the next decade, with the advent of the very large scale, very high speed integrated circuit work that's now going on, called VHSIC, the ability to do signal processing is going to be fantastic. It's the most exciting opportunity for a young person who's really interested in technology. In secure voice the fidelity is going to be superb. We're going to be able to pick signals out of the noise as we've never done before. We're going to be able to handle masses of information very quickly, and so completely that the commander will really be able to say, "Look, I want you to give me a picture of that battlefield. I want to know which tank has the most senior guy in it. I want to know who the tank commander is, and I want to target that tank commander — I don't want to target all the troops. Get them one at a time." It's going to happen, and it's exciting, it really is. And for the first time, in some respects, the application for the military problem is ahead — much further ahead of the need in the non-military field. The civilian economy doesn't need that capability now, and consequently a lot of people are dragging their feet. But the military can really use it.

**Student.** With that kind of technology becoming available in the mid- and long term, what effects do you see it having on the structure of command itself? We talked before about some of the problems in skipping echelons.

**DeLauer.** Well, I'm just speculating now, but the fact is that it can do whatever you want it to do. It turns out the equipment will not all have to be special-purpose; its bandwidth is wide enough to accommodate special applications. You won't have to structure command requirements ahead of time; the system will provide greater flexibility. It's going to take



some time, but in general you ought to be able to ask it any question you want and get the answer back, because it's got the capacity and the capability, and will do it in almost real time.

**Student.** Does that make joint force operations more or less easy within that kind of time frame?

**DeLauer.** I don't think I can answer that, because it really doesn't have that much to do with communication. It mostly has to do with intelligence information — it's really signal processing to find out where the transmitting unit is, and to arrive at a targeting capability.

**Student.** Yes, but surely it has a direct impact on the tactics you use.

**DeLauer.** Oh, no question about it. I would say offhand that it would be bound to have some positive effect, but how much I don't know.

**Everett.** But it also has some negative aspects. With some of the integrated information systems and communications systems it's just like JTIDS, where you're depending on automated formats. Unless everybody has the same kind of format, or a compatible format, you have a hell of a time trying to pass information from one Service to another.

**Student.** I'm not just thinking of that. I'm also thinking that, particularly on the tactical side, we've looked towards the idea of designing systems in common sensor language, with microprocessing capabilities, all of which fed back to a division TOC 15 or 20 kilometers behind the forward edge of the battle area. That works very well if you believe in the current dogma that we're going to fight a war of attrition somewhere in central Europe, and hopefully imitate the fine example of the French in 1940. If, however, you look at it from a different standpoint, and you don't want to fight in a line, but instead break up into smaller, much more mobile, active, defensive units, than you want the division commander right on the front lines, à la Rommel in the Afrika Korps in World War Two. So there's a problem, and indeed in many cases I think technology tends to drive the tactics. We certainly haven't yet fought through to an adequate understanding of those implications.

**DeLauer.** I can't disagree with you, but right now it's a technology program, even though we're finally getting some people to think about that issue. The way the DOD program is laid out, it's been \$125 million over three or four years, which is peanuts. In a meeting Secretary Brown attended, that \$125 million program was laid out and Brainerd Holmes said, "Never has so much been said about so little," because the amount that was really being spent was so much more than that.

**Everett.** There is a big problem as to the use of technology and the evolution of tactics, yes.

**Student.** Creating systems for the Air Force means integrating with the whole doctrinal concept: the way things operate, training, the cost of maintenance. We've been focusing mostly on performance, while, it seems to me, the problems people find in the systems are with system integration. It's so extensive you can't afford to maintain it, or your people are insufficiently trained, or the downtime is so great that when the crunch comes the system doesn't work — that sort of thing.

**DeLauer.** That part of it is fixable, I think. We had the same problem in the ballistic missile business, and fixed it. As a matter of fact that's a perfect example. The M-10 guidance system for Minuteman I had a mean time between failures of over 6000 hours. They went over to the M-17 and four or five years later it fell on its face. They went to the M-20 and, with the next generation, it's up to an MTBF of 9000 hours. The only difference between the M-17 and the other two is that they tried to poor-boy it, to the point where it cost them three times as much before they got through with it.

**Student.** What are the security capabilities of the existing communications systems?

**DeLauer.** Secure communications? Not very good. They have the capabilities to exist. Their capacity is limited, but the traffic is low and they have a reasonable amount of priority, so they do the job. What happens in a crisis situation, however, is that people just start bypassing it. Then you get your capacity all right, as in the Yom Kippur War! Danny Murphy was talking to Ambassador Sisco who was in Turkey then (it was a Cyprus problem too), and the crazy guy was talking over the air in the clear. He told everybody in the world what he was trying to say. They had a secure channel in the satellite and they wanted to use it — he just didn't do it. So the problems, in my view, are not so much in equipment capability as in people's failure to take advantage of it. They're not careful enough when things get tough.

The use of LEASESAT also hampers us. We're going to do all our satellite communication using leased facilities; it's economical, because the supplier can sell his surplus capability to somebody else; but now what are you going to do about secure capability? We'll have to use LEASESAT for ordinary traffic, but then, bingo, the minute they want to go to a secure mode they'll have to switch to something else, probably FLTSAT. So the capability is there, but operationally I would think it's pretty spotty.

**Student.** It seems to me from what you've said, given the technological capabilities today, that Defense might be trying not just to get the bugs out of the technology, but to focus on training the people who have to use the technology.

**DeLauer.** That's all included in a thing called readiness. I have to tread very carefully here, because I'm supposed to be speaking as a representative of the broad spectrum of research and engineering. The emphasis, if you listen to Congress or the President, is that we're weak, so we've got to focus on readiness. That even includes citizens — you know, the President has supported the volunteer concept, though I don't know how long it will last. You've got to focus on equipment and its readiness, and you've got to have enough of

it; that's got to be the focus. We certainly don't want people to feel we're going to be neglecting the front end, research, which we have to continue or presently there'll be a big hole in the pipeline. One of my predecessors in the USDR&E job, Mal Curry, turned it around to some extent; it was going down fast after the Vietnam War. Research money, in the parlance of the Defense Department, is called 6-1 and 6-2 money. 6-1 and 6-2 start the process. 6-3 brings you over into fullscale development. 6-4 is when you buy everything. So if you're a researcher — universities, labs, people like that — you're looking at 6-1 and 6-2 funds. Curry turned it around so that now there's more money in the 6-1 and 6-2 categories than in the past, and I'm not going to let that stop; we've got to keep the positive slope on it in spite of inflation. But there is going to be a focus on readiness — which includes everything you've been talking about. The right people doing the right job with the right equipment. And that's the main task.