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**Seminar on Command, Control,  
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**Command and Control Education and Research  
Stuart E. Johnson**

**Guest Presentations, Spring 1989**

Stuart E. Johnson; John F. Magee; John T. Myers;  
Charles A. Zraket; James M. Fox; David Y. McManis;  
Robert T. Herres

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*Chairman*  
Anthony G. Oettinger

*Managing Director*  
John C. B. LeGates

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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>  
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## Command and Control Education and Research

Stuart E. Johnson

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*Since 1988, Dr. Johnson has been Director of the Strategic Concepts Development Center of the National Defense University (NDU). He joined NDU in 1985 as Senior Fellow of the Center's Institute for National Strategic Studies, and in 1986 was named Director of the Center's Command and Control Research Program. From 1982 to 1985, Dr. Johnson was Director of Systems Analysis at NATO Headquarters in Brussels. Previously, he was a systems analyst in the Office of the Secretary of Defense, Division of Program Analysis and Evaluation, and before that a systems analyst at R&D Associates. He is the author of The Military Equation in Northeast Asia, published by the Brookings Institution in 1977.*

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**Oettinger:** Our speaker today is Stu Johnson of the National Defense University. I am not going to waste his and your time by giving an elaborate introduction since you have his biography and I presume you have read it. I had asked him to talk about both the substance of the research and education problems that he's concerned about and the process of addressing them, which is about as wide a latitude as possible in that, or to talk about anything else he bloody well wants to. It's a pleasure to have you here, Stu, and it's all yours. You are interruptable, I presume.

**Johnson:** By all means, please. I feel very comfortable with polite or otherwise interruptions as we go along.

I'd like to begin with an overview of what we do at the National Defense University in the command and control research program that concerns itself with education and research in the command and control area. After that, I'll take a few minutes to look at some of the problems that we've unearthed in the program that cry for education, further research, and, above all, solutions.

This unexpurgated pair of vignettes from a *Beetle Bailey* cartoon summarizes one of the first things we ran into in the area of looking at command and control. That's going to be a bit of the theme of my paper when I sit down, and that is our great technological base that we start with in the field of command and control and information processing

technologies and how we cope with it and what to do with it — how we exploit it.

**Oettinger:** In case you think that's funny, 25 years ago when I was looking at the State Department communications, the bulk of the teletype traffic in the basement was ambassadors' liquor orders. Nowadays it's pizza!

**Johnson:** The command and control research program at the National Defense University was founded back in the early 1980s when General Herres (who is now the Vice Chairman of the Joint Chiefs of Staff) was the director on the Joint Chiefs of Staff for C<sup>3</sup> Systems. He got together with Mr. Don Latham, who was the Assistant Secretary of Defense for C<sup>3</sup>I on the OSD staff at the time. They said, "Look, what we need is a group of people to step aside from the bureaucracy, step aside from the day-to-day operations, and think about the first two Cs in the C<sup>3</sup>I world."

I got the job as director in 1986, and one of the first things I did was to acquaint myself with the C<sup>3</sup> community. Very early on I went to a conference down at the MITRE Corporation — a conference on military C<sup>3</sup>. Well, I sat in on the first day of the conference and, like all other good conferences, at 4 o'clock everyone broke up, went out, and began to enjoy a glass of wine, and some cheese, and that sort of thing, and get together with their old paisanos and talk about what was going on. Being kind of new to

the community, I wandered from group to group kind of listening in. One group after another was talking sort of in this way. The first group was talking about the problem of the JTIDS (Joint Tactical Information Distribution System) interface between the Navy system and the Air Force system. Another group was talking about fiber optics and the enhancement of capacity — the throughput that would come from that, the great advantages presented. And so on, going from group to group. Not one group that I eavesdropped on was talking about the first two Cs in our C<sup>3</sup> process. Everyone was talking about communications technology; no one was talking about command and control. And yet we have this great network of MITREs and RANDs and everyone else thinking about C<sup>3</sup> really thinking very heavily about communications technology.

What we were told to do at NDU was to perform basic research on the command and control process. General Herres\* will tell you we just don't even have a body of knowledge on command and control by itself. What should a commander understand about the process of command and control? We've got to get that kind of thinking into our educational system, particularly the senior service schools. We've got to figure out how to train officers in the exercise of command and control; we've got to start building a community — the dissemination of command and control research being a way of building a network of people concerned with the first two Cs of this C<sup>3</sup> process.

I'll touch very quickly on each of those four characters (figure 1). First, let's talk about the basic research that we're doing there, and I've just listed the topics.

\*General Robert T. Herres, USAF, Vice Chairman, Joint Chiefs of Staff. See his presentation later in this volume.

What we're doing are some in-depth analyses of these issues (figure 2). There's evaluating C<sup>3</sup>. How do you know when a system's better than the one it's replacing — and I'm not talking here just of communications technology, where it's replacing one data transmission or processing system with one that does it faster or better. We're also looking very hard at joint and combined operations. Now jointness is a very strong religion in Washington nowadays; there's the Goldwater-Nichols Act and just a perception that we have to do better at joint operations. We don't have the luxury anymore of the Navy fighting its own war, the Army fighting its own war, and the Air Force fighting its own war. We don't have the luxury of not working with allies. So the complexity that joint and combined operations add to the command and control process is something we're looking into. And we have a variety of things that are on the basic principles of command and control.

In the next area, which is command and control education (figure 3), this research isn't much use if you don't get it somewhere into the educational process for the senior officers. We've worked with Tony and with Frank Snyder from the Naval War College on developing a strawman course. If someone said, "We'll actually let you teach command and control rather than C<sup>3</sup> to senior officers, how would you do it?" We developed a ten-unit course that is now making its way into the curriculum of the service schools. Interestingly, and I don't have an explanation for this, it's been the junior schools, the schools that teach the captains or, in the Navy, lieutenants at Fort Leavenworth or Monterey, California; it's been those schools that have tended to adopt this.

This is the way the inherited circumstances force SACEUR, General Galvin, to arrange his defense forces in central Europe (figure 4). Now, that's certainly less than the ideal way to organize your forces.

- Basic requirements of the C<sup>2</sup> process**
- C<sup>2</sup> education**
- Training in joint and combined C<sup>2</sup>**
- Dissemination of C<sup>2</sup> research**

**Figure 1. C<sup>2</sup> Research Program Mission**

- ❑ **Experiments in C<sup>3</sup> evaluation**
- ❑ **Development of C<sup>2</sup> theory for joint and combined operations**
- ❑ **Research on basic principles of C<sup>2</sup> processes**

**Figure 2. Research and Analysis: C<sup>2</sup> Issues**

If you're going to fight a battle, you do what Lee did when he was defending Richmond, and that is he put his Virginia regiments out front (the people who are defending their homeland). If you were going to do this right, you'd put German forces on the front line and you'd back them up with French defending their homeland, and Dutch theirs, the Belgians theirs, etc. So this is just an unfortunate way to arrange things. Well, why is it arranged this way?

**Student:** That's the way World War II ended up.

**Johnson:** Of course, as far as the U.S. and the British positions go, that's the way World War II ended up, but World War II didn't end up with Germans on the front line defending against Czechoslovakia. The broader issue here is that one of the more clever SACEURs, when the Germans came into NATO, decided that the best way of extracting a great price from the Soviets for attacking was to make sure that Soviets had to shoot not just German troops but British, American, Belgians, and Dutch, all at once, so that by definition any aggression would politically involve them in this great morass

with the major western European nations and the United States.

But given that, imagine what a command and control nightmare this is. There was a war game that was run out at the RAND Corporation where the traditional attack came across the British and Belgian sectors. The first thing that the man playing blue did was move the German brigade up here to stiffen up the Belgians, the Brits began straddling the corps sector, the United States had some pre-positioned equipment there for a corps to come in from Texas, and they moved in to stiffen up this area, and the French, who still have three divisions in Germany, began showing up in the Belgian sector. So you had Belgian, French, British, German, and U.S. soldiers all in this little sector all at once in the war game, and the thing we worry about in command and control is that we don't realize that having five different forces with five different doctrines and four different languages, etc., is just not a matter of moving a little mouse on the screen and all of a sudden all these forces show up there. It's a command and control

- ❑ **A course in C<sup>2</sup> for senior officers**
- ❑ **Course materials on:**
  - C<sup>2</sup> for maneuver warfare in NATO
  - C<sup>2</sup> problems in NATO's changing Theater Nuclear Forces (TNF)

**Figure 3. C<sup>2</sup> Education**

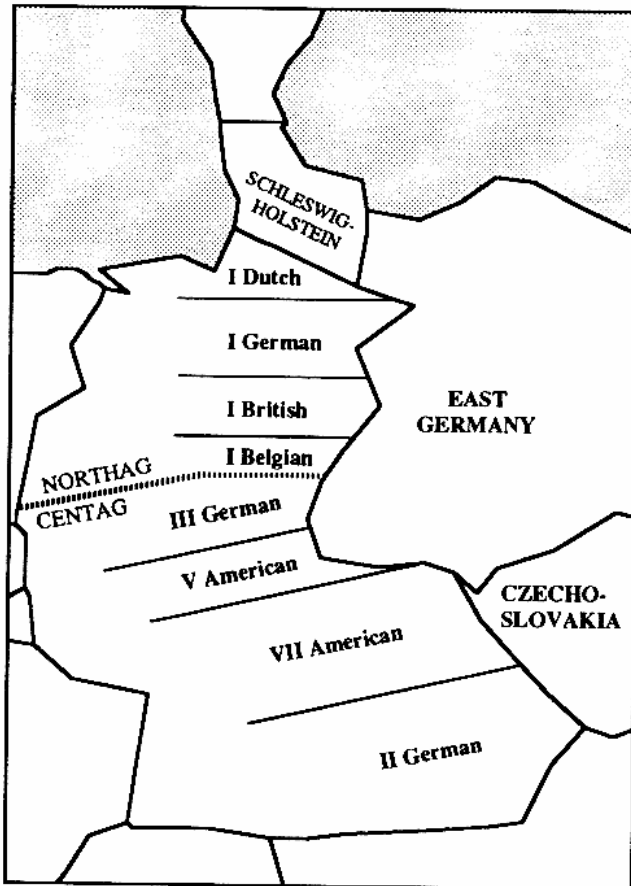


Figure 4. NATO Corps Sectors, West Germany

nightmare dictated by the political decision to deploy the forces this way. And we haven't even talked about integrating with air forces, and so on. So we're taking a look at that problem because the new SA-CEUR has said, "My defense is going to depend increasingly on maneuver warfare, being able to out-flank and adapt to a very fluid situation."

**Oettinger:** Before you move on, what in your view is the current status of the thinking that surfaced in the tail end of the Reagan Administration about competitive strategies, which would take that whole map that you have there and knock it into a cocked hat, because if it were ever adopted, it would have a very different view of how to deal with an incipient Soviet thrust. Or would you prefer not to comment?

**Johnson:** There are not only competitive strategies, but the maritime strategy, of course, has also attacked this as being too rigid a defense posture. I agree with all that; it is pretty rigid. But when we've actually tried to play table-top war games or whatever with senior officials, generals, etc., we have never had a situation where there was not the threat (no matter where a conflict started) of Europe being drawn into the superpower competition. So this is going to be with us for a long time and competitive strategies may or may not be with us for a long time. When it's with us no longer, we're going to have to solve this problem anyway.

A field exercise is a bad way to train officers in command and control (figure 5). By necessity, it involves a lot of troops, a lot of fellows get in the field, and it has to be very tightly scripted because it costs so much in money, time, and attention that you can't leave anything to chance, or you can leave very little to chance. So, for moving big forces around, which is what you want to train a senior officer to think about (big movements, of course, as in the field), I found the most valuable way to attack this is to fall back on our increasingly sophisticated interactive computer wargaming techniques. That's what we're working with in the program to provide better, more realistic opportunities.

Finally, the last topic is this business of trying to build a network of people who think about command and control (figure 6). What we've done is begun a program to disseminate command and control research and broaden the community that we reach. Every year we sponsor a command and control research symposium — one year on the East Coast; one year on the West Coast. This year it will be at NDU. It is the latest and best research which is done in this community. I wish there were more of it and that what we have were better, but we're making progress and your participation would be welcome.

We are looking for ways to bring in our allies into thinking about command and control, because I think the day when we go it alone, even in some of the smaller operations like escorting tankers in the Persian Gulf, is becoming limited to smaller and smaller operations. Anytime we do something, even as limited as what was done in the Persian Gulf, there are going to be political and indeed force structure imperatives for doing it with our allies.

I'm going to stop there and, with that overview of what we're up to at NDU, talk about some of the

- ❑ **Joint/Coalition wargaming with allied officers**
- ❑ **Soviet operational C<sup>2</sup>**
- ❑ **Research sessions for CINCs' staffs on C<sup>2</sup> system requirements**

**Figure 5. Enhanced C<sup>2</sup> Content in Wargaming**

issues that we've surfaced as needing attention in the area of command and control. Colonel John Rothrock has already been introduced. John is the director of the command and control research program at the National Defense University. It's the job I used to have; I'm now director of the overall center, which means for a while I was my own boss until I appointed John. John's very good, he comes out of the operational side of the Air Force with both operational and intelligence background, so I asked John to help me put together some thoughts for this portion of the talk today.

I did this very cautiously. It reminded me of a story of one midwestern senator — it was Senator Hickenlooper, I think, from Iowa — and Hickenlooper was not very nice to his staff. He was a curmudgeon; he worked them long hours doing things like writing speeches, constituent services, getting his laundry, any number of things that one can think of that the staff would be useful for. He was about to go out to Iowa to Pierce County and give a talk on agricultural policy. He came running in and found one of his staff members. In his usual impolite way, he told him to get a speech ready in a draconian

short time period — “The day after tomorrow I have to give this speech to Pierce County farmers; get it ready!” He came running in the next day, grabbed the speech, hopped on the airplane, and out to Pierce County he went. Well, the speech was dynamite, he had the farmers enthralled, he was saying what we have to do better — it was a year of drought in Pierce County, things were going badly, and the farmers were nervous. And he came to a point in the speech where he said, “Now let me lay out to you farmers here in Pierce County the plan that I'm about to unveil to solve the problems you're facing right now.” He turned the page; right in the middle of the paper it said, “You're on your own, you dirty son of a bitch!” I've gone through my speech; I've gone through this part before!

I've enjoyed working in the area of command and control. I've found no area in the defense community more fraught with complexity and paradox than this field. Its complexity results not only from the sophistication of the technology and the hardware we deal with, but also from just the magnitude of its task: the employment of our enormously complex and diverse national security apparatus that we've

- ❑ **C<sup>2</sup> research symposium**
- ❑ **NATO political/military decision-making workshop**

**Figure 6. Dissemination of C<sup>2</sup> Research**

built up since World War II. Command and control is the point at which the grand visions of our U.S. national security policy meet with the dirty business of employing military forces. By definition, this bridge is a very complex bridge.

The fundamental paradox I've come to see is that our great strengths in technology have not translated into a corresponding strength in our command and control effectiveness. I've asked myself why we've been so severely inhibited in realizing the full potential of our technology in this field. Setting aside the complexity of the technology that comprises the physical building blocks of command and control, what I've observed in Washington is a real schism in the command and control community that makes it very difficult to discuss command and control with the proper vocabulary on the proper playing field. We have a schism between the acquisition community and the employment community.

I deliberately cited acquisition first because, like it or not, in the Pentagon's planning, programming, and budgeting system (PPBS), command and control capabilities are defined and discussed almost exclusively in terms of hardware systems and the budgetary implications of contracting to buy such a system. Questions of the implications of a new technology for military doctrine, organization, or procedure are considered, if they're considered at all, very much on the margin and on a post facto basis. The programming and budgeting piece of planning for command and control (or for anything, for that matter) is by far the most competitive playing field in the Pentagon. Systems compete head on with one another for funding, and the advocates typically justify their system first and foremost by its own intrinsic standalone capability, certainly not by the degree to which it could complement or, God forbid, depend upon some other system. Now I wish we could find a way to focus the same level of creativity and adrenaline on the more fundamental issues of command and control — the first two Cs that I've cited.

Let me pass to an even more subtle and more diabolical hindrance to our seizing the opportunities presented by new technologies. There's a tradition to the PPBS in the Pentagon that investment in new equipment is to be in response to readily defined and agreed-on problems or threats. What this does is condemn us to applying new technologies to old problems rather than permitting new technologies to ride new concepts, tailored to their potentials to re-define or even obviate the traditional problems and threats we face.

Let me cite as an analogy the years between World War I and II. Both Germany and France had developed roughly similar levels of military technology — tanks, armored combat vehicles, aircraft, etc. The French applied the technology to the problems defined by World War I. They made incremental improvements in their ability to fight World War I. The Germans, on the other hand, saw in the same technologies opportunities to develop entirely new doctrines that defined a new style of warfare. The most obvious example of that is the blitzkrieg campaign through the Ardennes in the early portions of the war. The rest is history.

In fact, though, the metric that we still use very widely today to measure success or the utility of a new system is the relative attrition imposed on one side by the other. How many targets do you kill on the other side versus how many targets of ours are killed? If you used that metric on the early stages of World War II, you'll find that the French fought very well against the Germans in 1940! Unfortunately, they lost Paris in the process, but in terms of lethal attrition, they were more than holding their own. So when we speak of a western lead in command and control-relevant technologies, the leads are real and enormous but exploitation of the potentials of those technologies requires our military services, our joint commands, and the rest of the DOD community to step back and think differently.

I would say that the leads that we talk about are real and they're substantial. Dr. Philip Hansen of the University of Birmingham in the U.K. estimates that in microelectronics we lead the East by a decade; in general use of computers, 8 to 10 years; in software, maybe 10 to 11 years. But if we're not looking at our problems flexibly, examining concepts and doctrines in nontraditional ways, we may well never see our way clear to the holistic kinds of solutions that give us a quantum leap to doing not what we do now a little better but perhaps something entirely different to address the broader problems that we ought to be looking at.

**Oettinger:** Stop me if I'm getting you off track here, and you're going to get to it a little bit later, but you said "holistic." Is that the right term? "Holistic" I contrast to piecemeal, and given what you just said a few minutes ago, it seems to me you're contrasting it to wrong or backward-looking.

**Johnson:** Contrasting what to wrong?

**Oettinger:** Not to piecemeal, but to the tradition of fighting the last war. I'm not sure why "holistic" gets in there.

**Rothrock:** If I might interject, I think that he's contrasting it to both in that you are piecemeally backward-looking.

**Oettinger:** Okay. But if you can help with the piecemeal, it does not mean holistic because that means that you can in a grand and complete way look backwards, and you're still looking backwards.

**Rothrock:** Yes, I know; and you have to avoid both.

**Johnson:** I think though, Tony, we continue to look at new technologies as providing us the opportunities to solve old problems without looking more broadly at the problems themselves — are we addressing the right problems? Our military, I think, will soon wind up in a position something like the manager of a complex business operation who's presented with a Cray II computer and says, "Oh, great; now I can solve my queuing problems more rapidly," and is not looking at the broader applications those technologies have and just redefining the whole set of problems they deal with.

Well, let me move on and say I'm not the only one wringing my hands in frustration about our inability to exploit our lead in command and control technology. But I do want to make a distinction because I think what our other speakers have said raised some of the same concerns. Most analysts who do wring their hands about this lay out the problem pretty much as follows: the technology opportunities exist but the Pentagon procurement system is so long, torturous, and complicated that it takes a decade or more to get new technology into the field, so what we're doing is we're always working with technology that's a decade old. Now all this is true — the awkwardness and the cumbersomeness of the procurement process — and it's all lamentable, but streamlining the procurement process, in my opinion, won't solve the problem. I used to think it would solve the problem; I don't think that it would any more.

I think we have to stop evaluating systems as doing more, quantitatively measured, in extracting a greater attrition on the enemy's forces or whatever, because this quantitative, attrition-oriented mindset makes it very hard to develop an appreciation for other, more important combat factors that get us into the first two Cs of command and control. We have to

look at factors that make excellence in command and control so important in modern warfare. I would say that more important than how many individual tanks we can kill are the ability to control the tempo of the battle, the ability to disrupt the enemy actions as opposed again to killing a tank here, a tank there, and the ability to discriminate among like targets or like assets or like opportunities in a complex situation and choose the most important asset to kill or neutralize the enemy's arsenal — all based upon an accurate and complete understanding of the situation.

That's a little vague and all sounds good. I'd like to put my finger on a real-life story from Vietnam. One of our primary weapon systems in the later stages of the war in Vietnam was the B-52 bomber. That carries a lot of warheads — 108 500-pound bombs — and they would be employed against suspected enemy concentrations and supplies. The command structure was very interested in feedback on how the B-52s were doing; employing B-52s in this way was, of course, very controversial politically and militarily. Colonel Rothrock for one was head of an interrogation team that was feeding intelligence on B-52 impacts on the enemy back up the chain of command. Among the highest priority information that these interrogation teams were asked to report on was testimony from captured enemy soldiers as to the effectiveness of the B-52s. What did the command chain mean by effectiveness? All the way back to Washington the command structure valued very highly reports that *quantified* the number of enemy soldiers killed, the number of structures destroyed, or whatever, as a measure of the aircraft's effectiveness. Less valued, and even ignored, were interrogation reports that indicated that enemy divisions and regiments were under orders to limit large-scale operations because of the fear that large preparations would be detected and, therefore, would invite B-52 attacks. Now to someone on the ground, it was militarily and intuitively obvious that this denial to the enemy of the option of a large-scale attack was very useful militarily and probably the most important contribution the B-52s were making, but it couldn't be quantified and the quantitative measures of merit for evaluating the B-52s effectiveness that ran all the way up the command chain were what occupied our commanders' attention. Late in the war we stopped using the B-52s and the value they had had in limiting those large-scale enemy operations, or removing their option for large-scale operations, became painfully apparent. The operation was effective but you couldn't tell it on the basis of these lim-



ited, attrition-based linear measures of effectiveness that we were using for those command decisions.

I'm going to conclude with two examples of how we've also seen command and control technology actually misused; in fact, leading to at least what I hope is only an intermediate step backwards. Claims for artificial intelligence notwithstanding, and I find the claims for artificial intelligence to be very inflated — I hope I'm not insulting any of the other speakers or whatever.

**Oettinger:** I don't have many friends left in the artificial intelligentsia anyway.

**Johnson:** So we don't have to strike it from the record or whatever.

**McLaughlin:** It's largely discovering the term "artificial intelligentsia" that lost Tony his friends.

**Johnson:** What modern automatic data processing technologies really are selling are efficiency and effectiveness in clerical tasks — counting, collating, and comparing data. Now the capacity to do this is very impressive and, in fact, it's so much greater than that of a human that it doesn't constitute just a difference in quantity, it's really a qualitative difference of kind, not just degree. But I'm afraid we fail to acknowledge this. I have observed that we tend to intersperse machine and human functions linearly, which means that the machine's vastly superior clerical capabilities have actually increased, not relieved, the pace and load of clerical functions still performed by intermediate personnel in the command chain. An intermediate staff officer or NCO in many cases is inundated with avalanches of data generated by this technology in amounts and in forms that a human simply can't handle or can't handle without neglecting more important duties. At a number of command centers that you go to you just see the officers adrift in seas of computer printouts or congested, impossibly complex CRT displays that are very difficult to interpret. They are comprehensive to a fault.

Ironically, what I observe in these circumstances is that mid-level officers are forced to work harder clerically with less time to perform the task that their commander values in them or really needs them to do, which is the exercise of judgment in understanding what it is that he needs to keep his boss informed. I think here we need to apply a very simple dictum — have machines do what they do so well (count, collate, compare) and train humans to do what they and only they can do, at least as of now, and that is to infer, evaluate, and exercise judgment.

The second misuse that I've observed is the ability of computers to look deeply through the hierarchy of a complex organization. Now this capability on the surface can be very attractive to a commander, but it can be paralyzing to his organization if it centralizes concern and responsibility for low-order problems at ever-higher levels. Let me cite a military command and control hypothetical example of just this danger. The D Day invasion of Europe may be the most complex single military operation in history. It would appear that the complexity and size of the operation and preparations for the operation just begged for computer applications. But in delving into the history of preparations for D Day, I've learned that it was a very human undertaking — that is, with glaring imperfections, stupidity, and neglect just rampant throughout the preparative process. Fortunately, the monitoring of that process was also a human endeavor. It was incomplete, imprecise, incompetent, given to wishful thinking, and of limited ability to absorb detail. All these that I've mentioned are human frailties that are readily overcome with modern information technologies vigorously applied.

Given that context, I'd like to pose the following questions. Would modern information technologies, as we apply them today in our military, have streamlined or inhibited the preparation and execution of D Day? Would the problems in the preparation have shown up more clearly to the staffs, allowing them to solve them on the spot, smoothing out the rough edges, thereby freeing the senior commanders to concentrate on the broad strategy decisions of the invasion? Or, as I tend to believe, with the computers as they're used today in our military staffs, would that powerful monitoring capability have revealed problem after problem, exceeding the staff's capability to cope with them and thereby forcing more and more trivia to be dealt with at a higher command level? This would have led to a paralysis in the command chain as automatic data processing made the glitches ever more readily apparent to ever-higher levels of command, and we'd still be preparing to invade Europe today.

Well, I probably should stop here because I'm much better at defining problems than at solving them. Still, I'll give a few general prescriptions that present themselves just from having described the problem. First, I think we have to recognize that our advantage in command and control technology does not automatically translate into advantages in command and control on the battlefield. This sounds like a very naive or very self-evident statement but it's

not. Most of the C<sup>3</sup> community, going back to my earlier example — the C<sup>3</sup> conference I attended at MITRE, does not recognize this and indeed pushes the bulk of its effort in the area of improving the technology itself, very little attention being given to the application of that technology in the sense of looking at the process of command and control itself.

Second, I think we have to make even clearer the limitations of quantifiable measures of merit. The budget and programming game is still the driving game in town; it's the way people get promoted, it's the way people look good in the Pentagon, and we have to go further than we have in pointing out the limitations of these measures inherent in judging systems, especially when we get to something like command and control systems.

Finally, for whatever we can do for the system, and that's a very difficult problem, we also have to encourage a cadre of people in academia and in the government to think flexibly, iteratively, about how to accommodate in our armed forces the opportunities that this technology presents.

Thank you very much!

**Oettinger:** Can we go back to World War II?

**Johnson:** Sure.

**Oettinger:** You know there is truth in what you said — that one of the wryest statements among the technical people is that isn't it wonderful that a computer can now make in one second a mistake that it used to take people 20 years to make, or garbage in, garbage out; that sort of thing. On the other hand, when was the last time that you flew in an airplane whose pilot made any difference? Every time you step into an airplane nowadays, from somewhere getting up to 15,000 or 20,000 feet on to the approaches to the runway at the other end, you've got an aircraft pretty much on autopilot. That autopilot is essentially a specialized computer. So, what you're groping for, it seems to me, has to be beyond what you just said.

**Rothrock:** Could I interject here? The autopilot is performing functions that are handled very well clerically after the takeoff and to the landing. The accidents typically involve pilot error, judgment, in the takeoff and the landing. Very seldom is there a fatal error of judgment by the pilot in the middle portions of flight.

**Oettinger:** Which is a strong reason for suggesting that the flight be entirely automatic. The earliest automated flights were tried around 1946, and successfully took off and landed airplanes. One could argue

that you're absolutely right, and that in fact implies more reliance on computers.

**Rothrock:** Well, that's true, except when you come to extraordinary circumstances, such as wind shear, severe weather, etc. I'm not an aviator or flyer myself; I'll defer to those in the room who are. But the point is that, for example, the Soviets very impressively had their shuttle take off and fly around a bit and land wholly on an automated basis. That was an enormous undertaking that allowed them to achieve success under ideal conditions. The reason that we have been reluctant to put that sort of investment into our shuttle capability is because we are thinking that after we do that, we will still have a system that can only perform under ideal sets of conditions that have already been programmed. You've got to have the human there for the nth degree situation of complexity that can't be accommodated by preprogramming. That isn't to say that there aren't an awful lot of things — increasing ranges and degree of things — that can be accommodated by these sorts of clerical capabilities of these machines. In fact, you can get low but useful levels of inference out of these machines' clerical capabilities now, especially for comparing patterns and what have you. But don't confuse it with a judgmental level of inference that you have to reserve for humans.

**McLaughlin:** The idea is that the future of the Air Force and the manned aircraft are very tightly tied up.

**Johnson:** I'm not arguing that there is not a cultural lag there. I'm not arguing that at all. What I am arguing is that the hesitation to go out and fully automate your aircraft is not based wholly on that. There is some logical concern as to the inability of preprogrammed technology to handle unusual circumstances.

**McLaughlin:** Let me pursue the World War II business.

**Johnson:** Actually though, Tony; we haven't answered your question yet. What I was talking about was a technological opportunity and my Lewis Carroll vision of how it could be badly misused. I'd like your student just to repeat the story you told us at lunch on the stock of cables he has to go through now; what the copying machine, as misused, has done.

**Student:** As misused, I think, is the key. You're giving good examples of how it can be used correctly and properly and, in fact, enhance the process.

**Oettinger:** Okay, my aim as you tailor your remarks is to try and make the distinction more

precise. What you try to do is get a sharper line drawn as to the boundaries. You know my fanaticism for balance.

**Student:** I don't think I've read Stuart's comments as saying that the machines are taking us backwards and, in fact, they're inhibiting some of the very processes they're intended to enhance, but that, as used, they can in fact result in exactly that happening. At lunch, I gave the example of the copying machine as being a diabolical invention. On the one hand it does provide an incredibly useful function, used properly, in disseminating information. On the other hand, in a place like the State Department, where everybody wants to tell everyone everything, you end up with enormous stacks of paper. As a result, that in fact dilutes the information you want to transmit so much that you probably are transmitting less information, as the guy has to spend two hours sorting through his huge stack of stuff and, in fact, ends up dumping half of it without even having looked at it. So, in fact, technology is frequently a double-edged sword.

I think the D Day example might be a good one, because I guess in more modern times we have things like the Grenada invasion which I don't know a great deal about, but that had all of the advantages of information technology and one would have to say it was the coordination of that which was also an invasion and also a group maneuver. Was the coordination, was the command, was the control of that operation significantly enhanced by the fact that, theoretically at least, there was this information panopticon where everyone could know, according to the technology, according to the laser beams, according to the light guys, etc., what everyone else was doing. Did it help? That's sort of the question you have to ask. Has the structure grown to the point where the technology is being used wisely, or is there a natural tendency of human beings to pull things like that technology down by their inclinations to overuse?

**Oettinger:** The unclassified report on Grenada is on your bibliography, and one of the members of the Flanagan Panel that investigated it is our own Bob Murray here at the Kennedy School, so if you want background on that particular one, there happens to be a clear amount of material available.

**Student:** I was interested in this notion of monitoring, that is, a commander's motive to monitor what is going on to follow up, to make sure that what is happening is what he wanted to happen. The suspicion I have is that if you have a large amount of this data generated by computers, the degree of urgency

about monitoring that a commander would otherwise feel may be diluted if he believes that the computer is doing this work well for him. I don't know whether a computer can have a sense of urgency or whether a computer can prioritize and say "A" is more important than "B," whereas the commander might recognize those relative importances and changing degrees of importance of one mission as opposed to another and have a real sense of — maybe it's goes beyond urgency, maybe a sense of fear or whatever emotion it is that's driving or helping to drive his decision-making process, which could be diluted if he thinks that the machines are doing part of it for him instead.

**Johnson:** I think I'll give that one to John. Sounds like a tough one!

**Rothrock:** The D Day analogy, I think, has to do with national style. There's an issue of national style (culture, whatever, organizational culture) separate from technology. I think that what we have to understand is the great power of these technologies really to change the effect of elements of organizational and even personal style. For example, you can have a colonel or a brigadier in the D Day preparation structure, a very, very astute guy, with great attention to detail. If something came to his attention he'd see it. Well, that guy, within that day and age of communications and monitoring capability, was probably very much a net plus to the big-picture guys who were responsible for the overall effort. But give that guy a computer, where he can indulge his penchant for detail down six and seven echelons you deny yourself the benefit of what remains a great lubricant in large organizations — ignorance. (I'm not being facetious here.) He is going to see all sorts of things that are just going to drive him crazy as far as disconnects and things that the lieutenant colonel two and three echelons down hasn't attended to — the fact that the pier couplings aren't right — and this and that. Those are all the kinds of things where, in that day and age, they said the hell with it; at a certain level such disconnects ceased to be highlighted any further and the operation went ahead.

Stu's point, and I think it's a good one, is that if you use the technology in such a way that you don't alter your style, that you continue, writ large, these stylistic tendencies, in our case in particular, you could wind up just paralyzing yourself. You'd wind up at the four-star level with all of these goddamn problems that for better or for worse are left in the D Day scenario and could have been solved or not solved at the major or lieutenant colonel level.

**Student:** I want to bring to this a slant from the various control theories that we handle in the business world. There's a natural tendency of any brainy type of commander or business leader to try and centralize, because there are two very opposing things pulling. One is this idea that if you decentralize, you've got different units going off with varying system objectives, and in order to maximize the objective unity, decisions should be made on a centralized level. The opposite of that is you can't make decisions at the central level because you just don't have the information — the theory calls it specific knowledge, specific because it's very difficult to transmit from the decentralized level up to the centralized level or for the centralized level to absorb it. So there are two elements to that. The computer analogy to World War II can engage both of those. One is you now have the ability to bring a lot of knowledge up very cheaply, so it's no longer specific knowledge. It's now very cheap for the central person to get that, because of the communication ability.

**Johnson:** You mean bring knowledge up, or bring data up?

**Student:** In this case, data, and there's a third twist. This data is only useful, as you say, if it's not inundating the decision maker, but the value of the data can be so high, if you can find some relatively cheap way of turning it into knowledge, that the solution here is not, in my mind, saying, "Well, we've got all these computer systems that are inundating us with data." There's a judgment level there that you have to take resources away from the decentralized people and focus the resources on manpower, perhaps — people who can take this massive data and turn it into knowledge. But I think the tradeoff there is a very good tradeoff. If you can get all this data together and collect it in a central area, you turn it into knowledge with a dozen people or so. The expense of it doesn't keep rising, so it's a tremendous tradeoff.

**Rothrock:** The monitoring function is not a creative function and, therefore, benefits very greatly from the clerical capabilities of the computer. At the lieutenant colonel level, there are all sorts of problems down there that require creative solutions. The computer is probably going to do less of a dramatic job in having him fix his creative problem than it is going to do in aiding the essential clerical monitoring problems. So you're going to wind up with a disconnect; you're going to wind up with a lot of data uncreatively applied.

**McLaughlin:** I have to get in here. There's a fallacy of reasoning here talking about applications of computers in World War II. You are conjecturing a whole bunch of negative effects without conjecturing all the positive effects that one might attribute. We used an awful lot of keypunch machines in World War II, an awful lot of telex machines, and mimeograph machines, which were performing many of these same functions. We may have had the equivalent of another seven divisions deployable, who were out running mimeograph machines or keypunch machines. Also, we forget the computer's ability to do things, if you will, without mistakes or minimizing mistakes. I was just thinking of your pilot. I first started flying a lot in 1961 with the FAA. You walked into the cockpit of the plane and every pilot, copilot, and flight engineer was equipped with six different kinds of slide rules. There was no calculator, no computer on deck. What were these people doing? Usually they were figuring headings. You know what? They screwed up an awful lot, and if you go back 20 or 25 years ago, the likelihood of an accident being caused wasn't just takeoffs and landings; it was navigational errors — winding up in the wrong place. Lots of people got killed by that! Very few people are killed in airplanes today due to navigational errors because the pocket calculator solves the problem.

**Oettinger:** One of the most ardent advocates of computers, in fact of PCs, on that score is an old artillery man named Jack Vessey, who after he retired from being Chairman of the Joint Chiefs made a number of comments on that score. His view is that of aiming guns and your point about all the mistakes being made applies in spades pointing guns. From his point of view, the PC is just sort of the right thing, because it's on the artillery man's scale.

What I'd like to do is stop the discussion for a moment and redirect it briefly. It's something that Stu started. What we're doing right now is debating a set of questions which in a sense will occupy us for the rest of the semester. I'm perfectly happy to have them debated substantively here for whatever remains of this period, but what Stu and John got us started on was sort of a prior question which is: Here's this technology. By and large, the subject we're dealing with today, I heard Stu say, has been a subject pretty much in the hands of technologists.

**Johnson:** And programmers. Programmers and the budgeting programmers.

**Oettinger:** Those are again technicians. They are the technicians of the tool and technicians of the budget, or that sort of thing.

**Johnson:** Good fellows sometimes, nonetheless!

**Oettinger:** An essential component of the world, but not in a sense discussed by line officers, the folks in whose name all of this good is being done. Commanders! And so I want to spend a few minutes before we get back to this on the prior question: Why is this so? Why has the employment of this tool not been the subject of this kind of discussion in the war colleges, among senior planning staffs, over drinks among tank drivers and ship drivers and airplane drivers, and so forth. It would seem to me that we happen to have a sort of living example here of some of the background on that score and I wonder whether it might be timely to have Tom Coakley say a word or two about his attitudes as one of the folks who rumor presumes to do good. Tell the story!

**Johnson:** Does everyone know how Tom got to where he is now? As I said, I was director of the command and control research program, and we had had a very successful project — Tony, Frank Snyder from the Naval War College, and I — in developing command and control curriculum materials. How would you teach the first two Cs of C<sup>3</sup>I to lieutenant colonels and colonels who one day will be generals, admirals, etc.? What I felt we needed was someone to take a look at the kind of discussion that went on in this very forum. Tony, by this time, had built up a pretty good rack of archives or proceedings of this forum. Distill out of that, what lessons collectively we have learned from pulling all these senior people in to talk to this gang here, and are there some threads and emphases that lend themselves to further research, and so on. So, the research director of our National Defense University Press said, "Hey, I've got just the guy for you! He's a lieutenant colonel out at the Air Force Academy. He's going to be with us for two years. They don't have any good ideas for what he can do. Why don't we have him work on it? He's an English professor; that means, by definition, he writes well, and so on." We had a lot of trouble talking Tom into taking this project on command and control on. We finally had to bribe him with trips up to Cambridge, and he could stay at home in Colorado and work on his word processor with a modem, and he could name his price on travel money, and so forth. Why the tremendous resistance?

**Coakley:** Well, from my own experience, the term "C<sup>3</sup>I" is something you come across, and I think some of you can recognize this feeling if you've

been exposed to what's called "PME," professional military education. At a middle level squadron officers school in the Air Force or Air Command Staff, Air War College, it's the kind of thing whenever I came across that term and was involved in that sort of education, I just sort of skipped by it because I knew there was nothing there that had any applicability to anything I did or that had any real-world applicability. Inevitably those discussions consisted of groups of acronyms — JTIDS and what have you — and lots of wire diagrams with organizational charts and the systems analysis approach to decision making and that sort of thing that were essentially unintelligible, to me at least. So when I saw the stack of about a foot and a half of C<sup>3</sup>I material, my initial response was, "No way! Thanks! It's acronyms; it has no applicability in my life or in the life of anybody I know, so what's the point?" I simply did not recognize just by looking at some of these materials that there's a human element, that there are human questions that are very vital and very important, involved in this thing called C<sup>3</sup>I — the kinds of things that you're talking about in here. They simply have been left out of the professional military education materials. The human being is not represented in those materials.

**Oettinger:** Thank you for that testimonial, sir! I want to go back to an earlier point, because what was pointed out with the State Department example was essentially an abuse of the technology. Let me turn the point around, as I did with him over lunch, in that that abuse is itself traceable to or related to institutional organizational conditions and it happened specifically in that instance, I would argue, although it happens in other contexts as well. We've had in this seminar a former commander of the Sixth Fleet saying that life has become impossible because of the excessively many and too lengthy messages; that the art of writing dispatches in short telegraphic style had been essentially lost.

But in the State Department, essentially institutional prohibitions against using the telephone for quick reporting and putting everything through the chain on paper are one of the contributing elements of a burial by excessive communication. So, we can resume these aspects of the relationship between technology tools and the organizations that use them and how each shapes the other, etc. That's in a sense the mission of not only this hour but the whole of the seminar. Some of you who elected to come into this course in a sense came here because either you didn't know any better or you had gone beyond the kind of qualms, for whatever reason, that Tom ex-

pressed. But what I wanted to make clear is that the rest of the world by and large sees this subject pretty much as he does, and therefore, the transition from encapsulated techy talk, either the programming, budgeting, and/or the engineering level, to dealing with the subject as the core of understanding modern military, or for that matter any other organizational operations is what I want to make sure is underlined here. Because in a sense, this protective environment makes it a little bit too easy. We're talking about things here that are not all that easy to talk about in other areas. In other words, you'll get your asses shot off the minute you walk out of here, to put it bluntly!

**Student:** Springing from that, I've a question that ultimately deals with perhaps your optimism or pessimism that you can in fact teach the first two Cs of C<sup>3</sup>. Looking at the government and other governments for a number of years, one thing that struck me as the difference between governments and private organizations is that governments seem to have more activities that they are pursuing heroically, in the sense that you have people trying to stop drugs from coming across the border, you have people who try to clean up Boston Harbor, you have these people who toil for years and years. You yourself were at NATO, I believe. I met a man who worked 22 years on putting together a NATO consolidated intelligence plan, heroically, and never did. One other one I would add is that the Defense Department had a group out in Monterey in the wake of the Walker/Whitworth spy scandal that is trying to come up with a metric — a quantified psychological approach — to predict what they call spy-proneness. I wish them good luck in it! I think 20 years from now they'll still be working on that as well.

It seems to me what I heard you say is that you've identified the first part of the fundamental issue; that is, that yes, there's too much of a focus on technology, on what one of the previous figures here referred to, I guess, as "wirehead" activities. I think we could all agree with that. I certainly have seen that. You made a reference (and I realize I'm being a little roundabout here) to the way people get promoted and the way they're trained. It seems to be we have this endemic system that you're up against if you want to teach the first two Cs, because people are indeed promoted on the basis of how well their program flies. When I was at the EUCOM headquarters nobody ever raised the question, "Do we need to communicate?" That's the first question before you go on to putting in an elaborate system. So my question is if you could comment on those factors.

But how we teach the warriorhood or the holistic aspects, and do you have any chance of doing it given the pervasive personnel and bureaucratic system that seems to make it, in my opinion is an almost impossible task.

**Johnson:** You've said a mouthful. I'm going to take it piece by piece. Someone commented on "wireheads," and there is a tendency for the discussion to gravitate and be limited to the technological aspects, because that's a well delineated, well corralled area where you can go ahead and talk and you have clear boundary conditions, and that makes it easier to stick in the technical area.

You didn't mention the partner problem to that, which is that not only does the field attract technologists who are most comfortable talking in limited terms, but the dynamic also pushes you in the direction of being able to quantify the payoff of what you're buying, which is not the same as discussing technology. Admiral Tuttle, who spoke here last year (he's the Director on the Joint Chiefs of Staff for C<sup>3</sup> systems), is so frustrated right now that he has said, "You know, I go into the Tank" (this is where all the brass meets in the JCS and they argue over the program and who gets what share of the pie, and so on, and can you do anything to quantifying the usefulness of a new C<sup>3</sup> system?) "and the J-5 (the plans guy) has his act together and he tells us why we need the Bradley fighting vehicle in such-and-such numbers, or someone else argues for the F-15, and they all have their act well together and well quantified, and I'm not talking the same vocabulary, so I'm really at a disadvantage. Sometimes my people pass up to me perfectly good stuff but I can't use it because it's a different metric altogether." So I would add that as a problem on top of the technology. Now, what do we do about it?

**Student:** If I could just give you an example which is right on the research that I'm doing during my year here. What I found is after surveying a great deal of the business literature on the value of information technology, most of it is nonsense. Somewhere along the line a number comes out of a cloud, and that number is very elaborately manipulated. When you trace back to where's the difference between a decision maker and his information system or the commander and his command and control system, you find that all of these analyses, I believe, break down. So it seems to me that would add to the impossibility. Admiral Tuttle's not going to get a metric that he can sell in the Tank.

**Oettinger:** Tuttle is not stupid, and he's asking for a weapon of truth, and that's very different. So it's

another element of distinction among users of computers. The autopilot — we can argue over how far it can go and what is the relationship with monkeys, etc., but the task is real enough. The computer used to generate bogus figures is still a tool of theater. Computerized theater is not the same thing as computerized flight. The quantification problem is again something where you want to distinguish the objectives or the arena (the theater) from flight.

**Rothrock:** People frequently fail to make that distinction.

**Oettinger:** And it gets very important. The tools can be used or misused in both environments, but nonetheless, theater remains theater and flying an airplane from Boston to Richmond, Virginia, remains a rather different task. And if you do that theatrically, you're in a heap of trouble and if you have some good theater to bring into the Tank with you, you win a budget skirmish.

**Student:** Can I suggest the weird analogy in the field of English composition, which I'm sure everybody's vitally interested in. Funding for those kinds of programs was essentially nonexistent until about 10 years ago, when some people at the University of Pittsburgh started quantifying results. Now, the reliability of those numbers is suspect, but it's hard to prove that they're wrong, too! Since those results have been quantified, you're seeing a string of Composition departments at universities throughout the country. So again, using the computer as a tool and very successful!

**Student:** I just think one interesting dimension relates to the distinction you made between the continued pursuit of technological advances, probably at the expense of actual developments in the process. From my limited experience (I'm in the Army), you can stumble across a great number of platitudes about the process and about why we have all these people. Well, we have these guys attached to your unit because they're there to assist command and control, or the vertical layers of command in the helicopters in Vietnam and all these analogies that you think about, and everybody wants a piece of the pie. One of the things, I think, that's so simple about the education process is trying to make stipulations that are already coming to pass, because if any commander, and I would venture to say across all the services, looked at the things that he's required to do, one of those things is clearly exercise command and control over his forces. It seems so basic, but from the things that I've looked at in trying to gain a better understanding about the whole thing, there's not

much of a tangible or specific nature, or even a standardized approach, that would say that you need to have X, Y, and Z in order to achieve such and such. There isn't a doctrine for command and control, although there's much written about it and it's in circulars that it bespeaks doctrine, but there really isn't. I just think that's a theme that aside from the technology and the smoke and mirrors and lights and the things that we could all throw out that we know about this field, there are basic premises that have been in military writings for years and years and years and they're not necessarily acted upon. That's just my contribution!

**Johnson:** Yes, but things have changed and the battlefield is not as simple as it was as recently as when you were at West Point or Officers Candidate School or however you came into the business. Already the battlefield is much more complicated. I'm thinking that the last time that there was a big engagement in which the commander could survey the entire battlefield, I'm told, was Alexander the Great at Issus when he stood in front of his troops and looked and visually decided where to attack the Persian line. Maybe there were some small battles afterwards where the commander still stood out in front, but now, of necessity, you have a commander sitting in a room like this with a staff like this and he has to surmise what's going on out there in the battlefield. The process has been, if anything, accelerating as the size of the battlefield grows to 300 kilometers deep now, whereas it was 50 yards deep during Alexander's time.

**Student:** I agree with all you're saying about the pace and intensity of modern combat.

**Johnson:** And size of the battlefield!

**Student:** I agree with that too! What I'm saying is you can try this as a very simple question, for example, NDU. Ask those O5 promotable or O6 level commanders how, given a specific situation, they would do it, and I'm talking to the detail of "This guy's job is this, he goes here and does this, he goes here, here's the redundancy of communications." Just actually to think through the process is what I'm suggesting would be a very effective means for making it happen. I listened to General Crist (he was recently here) and he talked a great deal about how he tackled that problem while in control of the whole Persian Gulf operation, when he was at CENTCOM. He said that the tool that he found particularly useful was the Joint Task Force and putting the Joint Task Force under the various different headings of people. He alluded to the fact that he did this in training and forced these people to have to address the things and

at least surface the fact that, “Well, these guys have a VHF system and we have an FM system and, therefore, ....”

**Johnson:** Yes, make the friction visible!

**Student:** That’s it. Everything you said, I believe, is true about the pace of operations, the advent of automation, and how it accelerates clerical functions and takes the time of reasonably senior or intermediate decision makers at the expense of — when you finally get out and focus on “Now it’s time to command and control these forces, and what about so and so, and he can’t talk to him, and we don’t have any antenna, and we don’t have this.” My only point is a great deal of money can be made in the process of thinking things through in, as you talk about, quantifiable terms, but how would you really do it? Because it just seems that in the blocks of instructions that I’ve received and the readings from the literature and from what I’ve heard about the business, we live by the platitudes and we live on the banalities that imply that it’s going to be there when you need it. That’s all!

**McLaughlin:** Let me just make one comment on that which I think we may have made earlier and that is that fortunately, given the preponderance of peacetime, it tends in this kind of organizational structure to generate this smoke, this philosophical bullshit, and whatever else, because people aren’t doing it. When you’ve got a war, you learn how to make it work. That’s the whole history!

**Rothrock:** We’d better learn fast this time!

**McLaughlin:** That’s right! I’m not arguing that for a moment, but it’s also one of the reasons we find that you don’t have these same problems at the philosophical level in businesses or certainly in competitive industries because you’re getting audited all the time and you are constantly fighting the war and you’re making constant corrections or you’re dead.

**Oettinger:** These remarks essentially point to the fact that for a period of time that is not yet predictable, the messages of the last few years have gotten across. You’re describing a process that was essentially put into place as a consequence of the Desert One and Grenada failures, which were attributed to the lack, among other factors, of precisely the kind of exercise you describe Crist as having engaged in. So it says that certain lessons learned from the last two that got away were, in fact, learned, which I think is very interesting. And so, as a consequence, the problems there manifested themselves in another realm. It surfaced in the kind of problems with dis-

plays, one thing and another, that led to the *Vincennes* shooting down an airliner. There are many layers and sometimes one learns, but the central point is that it is very difficult to duplicate in peacetime the ongoing kind of thing, which is why we are having here later this semester James Fox from the FBI as a kind of intermediate point between the you’re-at-war-every-day kind of thing and you get your feedback immediately and this once-upon-a-random-time (one hopes it’s not too often) military end. So quizzing our FBI guest about this is another datum I think will be very important. Next time, we’ll have John Magee of A.D. Little again bringing some of the business perspective from the point of view of a consultant but nonetheless one who’s been in touch with a number of business organizations. You may have some other thoughts to add to that in terms of the spectrum, but in terms of our plan for the seminar, it is part of trying to cover a number of bases on that spectrum.

**Student:** Martin Van Creveld writes a lot, very wistfully, about something he calls military genius, which is certainly not new to Van Creveld, and he talks about Napoleon as having been the most competent human being who ever lived, which is the first time I’ve seen anybody say that about anybody. He thinks he’s superseded Dukakis in the competency area.

**McLaughlin:** And got whipped as badly by Wellington!

**Student:** I was going to make an observation that perhaps trying to teach command and control is a method of compensating for a lack of military genius and trying to approximate some sense of military genius — trying to develop a kind of scientific methodology to do this or to codify it, when in fact it depends more upon inherent human qualities than on scientific methodology.

**Student:** By the way, that was what my question was about — whether you were optimistic that you could, in fact, teach this kind of thing?

**Johnson:** In fact, I was in the process of answering your question sort of along these lines, although we’re all going to differ a little bit. We got sidetracked, which is fine. What I am careful to try to say when I’m talking about the educational component of the command and control research program at NDU is that when you’re trying to teach the 06 who’s going to be a flag officer — the Navy captain or the Army or Air Force or Marine colonel — is how to think about the command and control process. If we can succeed in doing that, I think we’ve



come a long way. That means that some are going to turn out, nevertheless, to be mediocre commanders and some are going to be very good commanders, but we are going to bring up the general level and we are going to give them a context for thinking, we hope, on the operational level of warfare — on the level of warfare that the general should be thinking about, not the level that a major should be thinking about.

Now, that's what's done in a lot of our education. In English class, the most the professor was able to do with me in college was to make me look critically at Robert Frost. I can't write poetry, but Peter Grossinger, sitting next to me, wrote great poetry. He got us up to where we could understand how to look at poetry, critique it, and think about poetry.

I am fairly optimistic about our education, to answer your question. Getting this very promising gang of O6s in the classroom and talking about command and control to include historical examples, and putting them through a war game, where you get Navy, Air Force, Army, Marine officers together and force them to plan a computer-assisted tabletop war game, is a very good way of bringing out in the open this friction that you've talked about. You talked about systemic friction: this radio doesn't work with that radio. I'm talking something a little different, but analogous: the doctrinal friction you get with how the Navy and the Marines would approach a situation such as Grenada or something else, and how the Army and Air Force would approach it.

**Student:** My point illustrates why it's important for you to do what you're doing, because even within a realm in which there should be a reasonably clear expectation of doctrinal capabilities and roles, and even when the equipment, because it's all one service, should be made intercompatible, there still exists a tremendous variety of problems that occur. That's pretty interesting here, and I'm speaking clearly from a tactical level, because there are problems at the tactical level that will be compounded as they go up to higher levels, so I think it has some pertinence.

Another thought is the National Training Center, on which the Army has spent a great deal of money, and they're producing one in Europe, and it has produced, by all accounts, a great deal of improvement in performance. One of the things that they specify that must be briefed and thought through, and for many units, it's in essence a virgin birth, is to think through this thing which I alluded to before about a command and control plan. It basically includes physical sighting of units, the different components

that are required; everything from remoting antennas, to secure communications, and this is principally with FM communications. I had a chance — you may be familiar with the new control system?

**Johnson:** No, I'm not. I'm familiar with the one out in Irvine.

**Student:** This is the project that General Meyer\* tossed out to the 9th Infantry Division in the early 1980s. Basically it was a system of mating, let's say, late 1970s or 1980s computer technology with vintage 1960 radio equipment to try and get data and exchange it by e-mail and stuff like that. It didn't work too well.

**Johnson:** I don't think the earlier statement was finished.

**Student:** I just wanted to follow with one level of modifier. I'm doing a research project on rules of engagement (ROE), and I was just curious as to your perception of the degree to which the threat of nuclear escalation runs up against command and control and to what degree both peacetime or wartime ROE drive the command and control parameters.

**Johnson:** Well, we've never seen a modern-day conflict escalate to a nuclear exchange. There were Hiroshima and Nagasaki, but we haven't got to a nuclear exchange yet; so I can only talk in terms of my experience in exercises and what I've observed. I was head of the alerts committee at NATO during the Wintex and Highlex exercises that you're probably familiar with in broad outline. Generally speaking, at alerts there are steps that the military is given permission to take by the civilian authorities of NATO to prepare for war. What generally happens is SACEUR will say, "Good God, they're massing on the border. I want to do X, Y, and Z." A cable is sent out to all the 16 NATO headquarters, and the 16 NATO capitals respond back Brussels, saying, "Yes, go ahead," and only when it's unanimous on each of those individual things a commander wants to do is SACEUR allowed to implement them (or SACLANT or CINCCENT).

Now, rules of engagement in the allied arena are a very, very combative playing field. Generally, I observed that our European allies, the Brits in particular, were nervous about our Navy being trigger-happy, and, therefore, were very reluctant to move up the scale of giving the commander on the ship more and more leeway to react to a situation on his own judgment. That was driven more by the fear of

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\*General Edward C. Meyer, USA (Ret.), former Army Chief of Staff.

escalation in general than of nuclear escalation. I didn't see a lot of the fear of going to nuclear warfare impinging on the permission to go up to a more aggressive level of rules of engagement. I saw more (I was there from 1982 to 1985 when the maritime strategy was rattling around in our allies' brains) a real reluctance just to risk escalation in general by a commander on the ship at sea.

**Student:** Which cements the resistance to decentralization.

**Oettinger:** You ought to look at the obverse of this and take a look at Admiral Hilton's presentation in this seminar.\* Here's a fellow who helped negotiate the treaty with the Soviets on the prevention of incidents at sea — and you have there an anti-rules-of-engagement process that says, here are the things you do to avoid having to get to that point. Here's a set of protocols and interactions for what you do if you're bottled up; if you have two fleets engaged in the Mediterranean where you inevitably have friction on one thing or another; or if you get a storm or the Israelis declare an alert and move both fleets into the western part of the Mediterranean. His account of how the United States and the Soviets get themselves tangled up in a fog and bumped into one another, and avoided doing anything other than swearing at one another, deserves as close a look as the other way around, because that happens a hell of a lot more often than the obverse. So you need to look at both sides.

**Rothrock:** I'd like to respond to your earlier observations regarding genius and the relationship to these technologies. I don't think anybody worth his salt as a military man thinks that technology is going to drive out the "art" component of successful warfare. But I will say that you can use these machines to either accelerate and exacerbate a penchant for attempting to industrialize warfare areas as a process and to, in fact, drive out this art form regard for it, or you can, as I advocate and I think Stuart does, use the machines in such a way so that you minimize the extent to which the enormous complexity occasioned by these technologies that now characterize warfare impinges upon the ability of human capacities to exercise judgment or genius. If you organize your people and your machines procedurally and structurally in the right way, the machines will, to a great extent at least, relieve the staffs of these clerical functions

and thus free up the staffs to exercise this judgment and genius. So you've got to do two things with the staffs and commanders. You've got to make sure that they are trained (as differentiated from education) to be able to use the clerical capabilities of the machines and then you have to make sure that they're properly educated (as differentiated from training) to be able to recognize and think their way through problems in such a way that they can make profitable use of the opportunities that the machines have freed up for them to use their judgment and genius. Without that education you're not going to have any geniuses, I don't care how great the native intelligence might be, so I really think that there's a real opportunity here to make sure that the machines and the humans are in complement. I'm relatively optimistic that if we think of it in these terms, we can do it. It's a big organizational and conceptual problem.

**Student:** I want to shift the subject, so if anyone else wants to speak on this...

**Oettinger:** May I take a moment then to put a cap on this, because the complexity question deserves a slightly deeper look under the present circumstances. Going back to technology, we're in a period of extraordinarily rapid change. There is a tendency in a period of change to see everything as complex. One of the ways that we historically have coped with complexity is by packaging it and making it disappear. Think about almost all of the things you take for granted, whether it's the flush toilet or the automobile or the refrigerator or the faucet that you turn on to get water in your house, or whatever. They were all, in the period where they originated, high-tech elements of enormous complexity, etc., which have become stable over the years and have acquired a degree of packaging which makes their innards essentially invisible and they become simple again because they're stable; the innards are hidden. You push one button and the car starts and you're no longer aware of what's inside. You push one button and the toilet flushes and you're not aware of all the complicated hydraulics inside, etc. In the civilian sector, this sort of thing is called packaging and marketing. You essentially define some product and you now sell it as a package and people are happy with it and you make a lot of money until the day when fashion changes or technology changes and the complexity is there all over again. You have all of this experimentation with things that don't fly. Think of the generations of VCRs, including all the battles over the Beta standard, which then ultimately became court cases over that. Somebody comes along

\*Rear Admiral Robert Hilton, "Roles of the Joint Chiefs of Staff in Crisis Management," in *Seminar on Command, Control, Communications, and Intelligence: Guest Presentations, Spring 1985*. Program on Information Resources Policy, Harvard University, Cambridge, MA: February 1986.

with a VCR in the VHS standard and all of a sudden all the Betas are gone, and you have a stable package again.

My point is that, during a period where technological as well as organizational political changes are rampant, packaging becomes very difficult because there is instability. And so you have the perception of complexity continuing; you have attempts to package to simplify; but the instabilities, whether political or technological, make it burst out again and on the civilian side there is a period of intense competition where people are trying to figure out what it is that the market wants, what combination of features. But in a period of instability, entrepreneurs lose their shirts; in a period of instability you have the kind of discussions that we're having here with respect to organizations where there isn't the market test. Part of genius during that kind of period is figuring out what to package and what not to package and how to have this chase between the development of skills and attitudes through education and training versus the kinds of things that you bury inside boxes that stay put and hide the complexity. The price of hiding that complexity is if it's the wrong package and you need the flexibility, you're dead. And so, I want to make sure that we don't sort of use complexity the way semantics are sometimes used — you know, things are complex! It's an extraordinarily important element in a period of rapid change to understand how to deal with unstable conditions, because you can't package it and it overwhelms you if you take in every damn detail.

**Rothrock:** It's the moving train problem for the artist.

**Oettinger:** It's the moving train problem for the artist, and it's a very, very critical one. The fact that it happens here in a high-tech environment, you know, shouldn't blind you to the fact that it is the perennial problem for which lessons can be learned historically.

**Student:** We've talked about a great number of subjects, but I'm looking for a little direction. Earlier, someone mentioned things about tactical problems and how they grow, probably exponentially, as you go up through the command structure. In your position you mention that you do experiments in C<sup>3</sup> evaluation and you've developed theory toward C<sup>2</sup> for both joint and combined operations. You mentioned that you had spoken to the military advocate, Admiral Tuttle, trying to establish an improved C<sup>3</sup>I. I wonder if you could be a little bit more specific about what the direction is and what that discussion

might have been. Are you talking about another reorganization act or are you talking about simply the acquisition of new technologies, again to further enhance the C<sup>3</sup>?

**Johnson:** The answer is that we're not looking at another reorganization act. There's a lot of heat generated about the Goldwater-Nichols Act, and I concern myself with only that slice of it which gave the commanders-in-chief, the CINCs, more respect and a greater voice in general in the training, and gave the Joint Staff a stronger charter than it had before. So it is Admiral Crowe's staff, as Chairman of the Joint Chiefs of Staff, and no longer entirely beholden to the individual services. You never keep an Air Force officer from looking over his shoulder to see what his service is thinking while he's sitting on the Joint Staff, of course, but those areas have created an ethic in Washington in the defense community that this business of jointness is pretty serious stuff and we'd better get on it and attack it. More than lip service is being paid to it, so I think the reorganization act in broad outline has done good things.

I'm going to leave aside the thing that Colonel Rothrock and I always argue about: whether, by including the CINCs in the PPBS process, in the budgeting process, we didn't do a bad thing. Maybe we did. But leaving that aside, just from a command and control point of view, the whole reorganization act has given us the charter to take very seriously joint education in general and joint education in command and control in particular, because as soon as you start talking about joint operations seriously, the first piece of friction that comes up is the command and control issues — straightening out what the command relationships are going to be.

Admiral Tuttle is very interested, and Herres two notches before him was very interested, that we start teaching command and control as a subject in the senior service schools from a joint perspective, in the context of the operational level of warfare. You may not even know what that means, but I'll just tell you quickly. The tactical level of warfare is, very generally, how you command a small unit to hold a piece of ground or achieve a limited perceivable objective. On the operational level, you're standing back and you're looking at the broad evolution of the battlefield, and there the decision is made that attacking and neutralizing that asset of the enemy will have a geometric effect, will upset his battle plan, and so on. We're trying to teach the O6s, who are going to be flag officers, to think about that level of warfare in a joint context. Admiral Tuttle has been very supportive of that, as has General Herres. We're begin-

ning to see pressure being brought to bear on the individual service schools — Navy War College, Army War College, and Air War College — to get with the joint perspective, and it's happening. It's happening because, in part I must say, it's now become attractive for good people to serve on the Joint Chiefs of Staff and other joint billets and so a higher quality of officer is coming into those billets and the older generation is leaving. So there's more than just an individual program; this program is a symptom of a broader ethic that's coming along in the defense and military community in general of the importance of jointness and the importance of senior officers looking at the battlefield from the appropriate level where they are. John, do you want to add anything about the difference between tactical and operational?

**Rothrock:** There's an assumption, which perhaps you didn't mean, that the tactical problems are expanding in intensity and importance as you get up the line of perspective. The fact is that the things that are important at the tactical level are not necessarily of the same relative importance at the operational level and vice versa. For example, at the tactical level, you are most typically in an attritive ratio in comparison to the situation. You know, you will win if you kill more of him than he kills of you and you as a commander have got to be very, very worried about the specifics of attrition tradeoff. At the operational level, attrition becomes less of a direct concern to you in that you can lose at the operational level by losing all of your tactical operations but you cannot necessarily win at the operational level only by winning at all of your tactical encounters. You can wind up winning all the battles and still losing the war. We now have joined that club.

General Lee had General Jackson, 1862, out in the Shenandoah Valley. Jackson lost every encounter at the tactical level with federal forces. You had federal commanders lined up to get out into the valley to fight General Jackson. The fact was that the federals were winning at the tactical level; they were losing at the operational level, because General Lee had General Jackson out there so that the federals would do just that and not invest it in the confederate capital of Richmond. So at the operational level, you've got to have a different perspective than simply one that would imply that your operational responsibilities are a cumulation of your tactical responsibilities. There's a difference; and what we're trying to do through the educational process is to see to it that that's recognized. I might say that I think the clerical capability of these computers has a much greater

relevance at the tactical level than it does, at this point, at the operational level, but what it can do is free up staffs from these very, very detailed tactical perspectives at high levels and free them up to exert the sorts of judgment that Stuart talked about that's required at the operational level.

**Oettinger:** Let me disagree with this, however, in one respect, because what you're describing is admirable and unassailable on a classical, central front new Europe NATO kind of traditional battle. At the two ends of the spectrum, either at the lower intensity or at the nuclear end, the difference between the strategic and the tactical and I would say in between, gets somewhat short-circuited, which is one of the reasons for these fundamental tensions between the boss looking down into the bunker and everything in between. We really have very different situations in the classical middle and to either extreme of intensity.

**Student:** I have a question that, since we are running out of time, changes the subject. You have been talking about many changes in the technology, changes in the perceptions of human behavior, and all these, but one thing that seems to be constant throughout history is hierarchical structure of defense. Now we have been in courses here where we are doing tests on group decision support systems that enable the same amount of fast response as can be provided by one person but, coming from a group, maybe will help to evaluate all these amounts of information that maybe one person cannot handle. Does that look like anathema in the military because it will not be only one head of the pyramid? Has that technology been studied or are you hearing about that?

**Student:** That brings up a question that I was going to ask about what is being done about distributive decision making, which seems like exactly what you're talking about. I understand from Frank Snyder that is the most forward-looking of the training that is going on right now. Can you comment on that?

**Johnson:** John, can you comment better than I can on it?

**Rothrock:** As a matter of fact, one of the training materials that we've just gotten in in draft from one of our consultants emphasizes the potential of these technologies to permit the distributed decision making you're talking about, while still retaining fundamentally the hierarchy that we still think is necessary within military organizations when you're having people go out and do things that are not natural to

people, that is, run out and risk their lives and not necessarily make money for that. So, the tactic or the approach that's being taken is the German Auftrags-taktik, in that an organization made up of assorted subordinates is given a general understanding of what the boss wants and needs to be done and then they are given a set of generally defined responsibilities so that, if they all are able to approximate them,

the organization achieves that goal. The means by which they achieve the specifics of their responsibility are left largely up to them. As they communicate back and forth, they let each other know essentially what the important aspects are of their tasks.

**Oettinger:** I've got to declare this over, because the next class is beating at the walls. Stu, thank you very much.