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SUPPLEMENT TO AD HOC STUDY

FINAL REPORT

"Use of Technologies in Education and Training"

December 1995

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ARMY SCIENCE BOARD

SUPPLEMENT
TO
AD HOC STUDY

FINAL REPORT

"USE OF TECHNOLOGIES IN EDUCATION AND TRAINING"

DECEMBER 1995

LIST OF APPENDICES TO THE ARMY SCIENCE BOARD'S
AD HOC STUDY
"USE OF TECHNOLOGIES IN EDUCATION AND TRAINING"

APPENDIX 1

FORCE XXI
THE CHIEF OF STAFF
5 MARCH 1994

UNITED STATES ARMY

THE CHIEF OF STAFF

5 March 1994

FORCE XXI

America's Army must be ready to fight and win today and tomorrow. Our 21st Century Army—the Army of 2010—is forming right now. The senior leadership of that Army can be found among the majors of today studying at Fort Leavenworth. Tomorrow's brigade commanders are running today's companies, batteries, and troops. The battalion commanders of 2010 lead today's platoons. Future company commanders now attend the fourth and fifth grades. The platoon leaders of 2010 are in the first grade. What kind of Army will these people lead?

We know a few things for sure. In 2010, our Army's mission will be the same as it has been since 1775—to fight and win our Nation's wars, to serve America, to gain decisive success at whatever we are asked to do. We must fulfill that mission today, tomorrow, and the day after tomorrow, in 1994, in 2010, and in every year between. That is a given.

External events will certainly change our Army over the next 16 years, and we cannot foresee all of them. The Army of 2010 will be different from the Army of 1994. To shape the Army of 2010 we must act now and influence the course our Army pursues. The real challenge, what we as Army leaders are charged to do, is to think beyond the inevitable and the likely, to take hold of our own destiny. We must do our part to create the 21st Century army that our experience, analyses, and insights tell us can best defend America.

Today, we are at a threshold of a new era, and we must proceed into it decisively. Today the Industrial Age is being superseded by the Information Age, the Third Wave, hard on the heels of the agrarian and industrial eras. Our present Army is well-configured to fight and win in the late Industrial Age, and we can handle Agrarian-Age foes as well. We have begun to move into Third Wave warfare, to evolve a new force for a new century—Force XXI.

Force XXI will synthesize the science of modern computer technology, the art of integrating doctrine and organization, and the optimization of our quality people. The goal is to create new formations that operate at even greater performance levels in speed, space, and time. Force XXI—not "Division XXI," and there is a message there about breaking free of old concepts—will use command and control technology to leverage the power of the Information Age. But this new force must be more than just today's Army with more computer networks. Force XXI will represent a new way of thinking for a new wave of warfare. We must be strategically flexible and more lethal. We must leverage the power of the best soldiers in our history through the use of state-of-the-art simulations and realistic, simulator-enhanced training. We must accommodate the wide range of operations being demanded of us. Intellectual change leads physical change—the mental shift goes before the software and hardware.

We are beginning to define the parameters of Force XXI. Building upon ongoing work in the Department of the Army, the Army Staff, the Army Materiel Command (AMC), Information Systems Command (ISC), Medical Command (MEDCOM), the Intelligence and Security Command (INSCOM), and the other major commands, our thinkers at the Training and Doctrine Command (TRADOC) must deal with a whole series of important questions that we will strive to answer as we create Force XXI.

- Are new forms of maneuver required?

- How do we set the conditions for decisive maneuver?

- How do we combine combat, combat support, and combat service support to create a flexible, networked, self-tailoring organization?

- How do we command Information-Age forces?

- How do we synchronize the operations of fully modernized, digitized forces with other forces—our own, other Services, and allies?

We will not answer those questions overnight. And there will be other questions, some of which we cannot yet guess. We are getting ready for wars that nobody sees right now. But we must try to see them and be ready for their challenges. It is time to redesign the force.

Much work has already been done—the Advanced Warfighter Demonstration at Fort Knox, the Mobile Strike Force played during Prairie Warrior '93 at Fort Leavenworth, and the design of the 2nd Cavalry Regiment, to name just a few examples. The results of that work have encouraged us to reshape our battle organizations for the 21st Century. We need to reinforce success, to build on our momentum. It is time to get on with it.

To support the concepts of Force XXI, it is necessary to develop the means, the hardware and software; we must enable ourselves to "digitize the force." To take that step, on January 14, Secretary of the Army Togo D. West, Jr. and I announced the formation of a Special Task Force on Digitization. This Department-level task force will become the Army Digitization Office (ADO) under the supervision of the Vice Chief of Staff. Its multidisciplined membership will include doctrinal thinkers, technical experts, scientists, engineers, and procurement specialists. The ADO will develop the means that will enable us to create Force XXI. I expect the digitization project office to create the means for the U.S. Army to field a fully "digitized" division-sized force before the turn of the Century.

Development of concepts is the next step—although this will be an interactive, parallel process. TRADOC will lead in this part of the effort, but in a "joint venture" format with other issue proponents from throughout the Army. I will rely on Louisiana Maneuvers to synchronize the work of the ADO and the Force XXI joint venture.

Today, we have the means to step through this process in a far more sophisticated manner than our predecessors. Moving toward Force XXI makes the most of our superb simulation systems. We will think, test in the Battle Labs, then test in actual field units—all with feedback loops. Theory leads practice, but then practice modifies theory. It is a two-way street. We can and will continue to work the design issues in our Battle Labs even as units conduct field validations, allowing for constant feedback. The work being done right now indicates that we are on the right track. In fact, the very Information-Age hardware and software that has created Third Wave warfare also allow us to experiment with its realities today.

I want us to think about all this in terms of battle command and battle space. Battle command is about imposing control on battle space which I think of in terms of the dimensions of speed, space, and time—all of which are compressing. The key to dominating the 21st Century battlefield will be tempo—being able to shut down an opponent in all three dimensions—faster in a physical sense, over greater distance, and with greater alacrity in an organizational sense. We will achieve this quantum improvement in effectiveness through the power of information, through knowledge-based warfare. We cannot understand, at this point in time, the broadest implications of that, but we are opening the door to the future.

Soldiers have advanced into uncertainty before. In the spring of 1864, General Ulysses S. Grant stood with the Army of the Potomac at Culpeper, Virginia. He did not know exactly what he would face as he marched south. But he knew that to win the war he had to keep moving forward. Grant and his Army crossed the Rapidan, fought in the Wilderness, moved by the flank, fought again at Spotsylvania—tough, costly battles against a determined foe. Despite this, Grant and his soldiers did not turn back. They did not know exactly what was ahead. They did know, though, that standing still or going back across the river would not preserve the Union. So they kept moving on, toward victory.

We do not know exactly what lies ahead. But we are moving forward. We have the best Army in the world—quality people, sound doctrine, a solid industrial base. Plus, we have something Grant did not have, simulations and systems that give us the confidence to experiment, analyze, and project how new thinking might work on future battlefields. We must seize this opportunity.

America's Army—Into the 21st Century.

Gordon R. Sullivan
General, United States Army
Chief of Staff

APPENDIX 2

TRIP REPORT
CSA TO EUROPE AND AFRICA
9-15 AUGUST 1994

UNITED STATES ARMY

THE CHIEF OF STAFF

DACS-ZAA

16 August 1994

MEMORANDUM FOR SEE DISTRIBUTION

SUBJECT: Trip to Europe and Africa, 9 to 15 August 1994

1. **PURPOSE:** From 9 to 15 August I traveled to Europe and Africa to observe Operation Support Hope, visit the Marshall Center, and participate in World War II commemoration ceremonies in Southern France. On the Africa portion of my trip, I was accompanied by Sergeant Major of the Army Kidd.

2. **OBJECTIVES:**

a. To receive Operation Support Hope briefings and discuss operations with USCINCEUR.

b. To visit Operation Support Hope operations in Uganda, Zaire, Rwanda, and Kenya.

c. To visit the Marshall Center and discuss and assess first year operations.

d. To receive an update on the US-Russian peacekeeping operation to be conducted this September.

e. To represent the Department of Defense at ceremonies commemorating the Allied invasion of Southern France, Operations Anvil and Dragoon.

f. To conduct discussions with my Egyptian counterpart, LTG Halabi.

g. To conduct discussions with my French counterpart, GEN Monchal.

h. To conduct discussions with CINCUSAREUR, GEN Maddox and other US leaders in Europe.

3. **HIGHLIGHTS AND SIGNIFICANT DISCUSSIONS:**

a. At SHAPE I met with GEN Joulwan, SACEUR/USCINCEUR and discussed and number of issues relating to current operations and to the future of the Army. I participated in a video teleconference with the DCINC and EUCOM staff at

Stuttgart. We reviewed operations throughout the theater and concentrated on Operation Support Hope. I could not help but be impressed how the European theater has changed. Like the US Army, it is more fully engaged today than at any time during the Cold War. US Army Europe is at the heart of all those operations, most especially Able Sentry (FYROM) and Support Hope (Rwanda). The CINC was very pleased with the Army's execution of both operations and expressed his appreciation for the planning assistance from HQDA. (Info)

b. Operation Support Hope

(1) In the Support Hope Area of Operations, I visited JTF headquarters at Entebbe, Uganda and operations in Kigali, Rwanda and Goma, Zaire. My visit took place in week three of the operation; but the decisive contribution of American forces was already evident. LTG Schroeder is the Task Force commander and has his headquarters at the airfield at Entebbe. His forces are located primarily at Entebbe, Goma, Kigali and Mombassa, Kenya. The task force mission is to provide assistance to humanitarian agencies and third nation forces conducting relief operations to alleviate the immediate suffering of refugees fleeing the civil war in Rwanda. These refugees, numbering in the millions, have occupied camps in all the neighboring countries; but principally in Zaire. Some of these camps date to similar troubles in 1959, but the capacity of the relief agencies has been overwhelmed by the huge displaced population. (Info)

(2) The operation began on 24 July following President Clinton's order to deploy. By 26 July, US Army units were providing water in Goma to attack the cholera outbreaks and JTF command and control elements were beginning to effectively integrate the transportation and delivery of relief supplies. By 1 August, the mortality rate in Goma was reduced below 1000 per day. By 3 August, the Army and others were producing and distributing 500,000 gallons of water a day in Goma and by 8 August, cholera and dysentery had been reduced to 1000 cases per day from a high of 6000 per day. Deaths stand at fewer than 500 per day. More importantly, this respite has enabled the UN and other agencies to get the camps organized and get new camps established. A significant number of refugees have returned to Rwanda. (Info)

(3) In every case, I was very proud of our soldiers. They moved quickly into a very ambiguous and sometimes threatening situation and responded with characteristic professionalism and initiative. They are up beat and very proud of what they are doing. The Task Force Commander will redeploy them as the

situation permits and I believe that our numbers there will draw down fairly quickly. Some soldiers, especially those providing command and control or special skills relating to command and control, will probably remain in theater much longer. I assured US Ambassador Rawson that we would stay, in whatever numbers are required, until the mission is completed. (Info)

(4) Our Civil Military Operations Centers (CMOC) provide the nerve centers for coordinating assistance to the relief agencies. They provide clearing houses to coordinate distribution, exchange information, identify and solve problems, and share assets. We are becoming very experienced in these operations and are building trust and understanding with many of the agencies. It is important that we continue to involve these agencies in our training and exercise program so that we can develop better doctrine and procedures. I want to ensure that our best people get into theater to help and to learn. (Action: DCSOPS) I would also like to make a video tape explaining the purpose and function of the CMOC that we can distribute to the relief agencies. (Action: TRADOC)

(5) Upon completion of this exercise, I want to conduct an AAR for the Army and appropriate Department of State and non-governmental representatives. LTG Schroeder will be responsible to prepare the AAR supported by the Peace Institute. The TRADOC Commander and I will attend the outbrief. (Action: AWC)

(6) I believe that this kind of operation, with a non-traditional headquarters and a highly task organized troop list is typical of that which we will conduct in the future. To enhance our preparedness for that, I want to work with CINCEUR to make the Southern European Task Force a fully deployable JTF oriented primarily on Africa. The end strength must be accommodated within the EUCOM troop strength ceiling. This reorganized SETAF is to be prioritized in Force Package One with a sufficiently high priority to be up and running before the end of FY 95. (Action: DCSOPS ICW USAREUR and ARSOC)

(7) I want to ensure that the soldiers participating in Support Hope receive the Humanitarian Service Badge in a timely manner. Because of the ad hoc nature of some units, it will be an especially difficult challenge to get soldiers their awards if we do not do this right away. I would like to be briefed on a plan to accomplish that objective this. (Action: DCSPER)

(8) Once again, I find that soldiers deploying are being placed at a hardship because of losing separate rations. If possible, want to handle this as an exception

to policy and to re-examine our overall policy options. (Action: DCSPER) I am also troubled by the differential pay and allowances policies between the services. I would like to be briefed fully on the differentials and the rationale for differentials and on how we might address this issue at the DOD level. (Action: ASA M&RA)

(9) At both Entebbe and Kigali, I visited the Air Force Tactical Air Lift Control Element. They are equipped with a communications shelter (expando-van) that gives them a complete global communications packet (called a MARC) immediately upon arrival on the ground. That operation was a stark contrast to the JTF HQ which was running on a mixed bag of personal laptops and SATCOM. I would like to put together a packet similar to the Air Force packet that could be used by a small JTF or ACC. If possible, we should experiment with a prototype during one of our FY 95 Force XXI experiments. (Action: INSCOM)

(10) I was unable to visit Mombassa where 7th Transportation Group is facilitating port operations and is prepared to receive our afloat prepositioned ships if they are required. LTG Schroeder believes they provided him leverage in the international community and a major planning option early on. At this point they may not be necessary; however, it is important that we keep them on hand until LTG Schroeder makes the determination that they are no longer needed. (Info)

c. The Marshall Center, established on the site of the former Russian Institute, is supported by the Army as a DOD facility to bring together leaders from throughout Europe to promote an understanding of the role of a military force in a liberal democracy and to bring together European defense leaders on a the whole range of common issues. (Info)

(1) Only one year after its inauguration, the Marshall Center is up and running having developed a curriculum, remodeled the facility to suit its current mission, recruited a faculty and begun teaching. The Research and Conference Center has conducted six conferences and seminars including peacekeeping, military law, the media, and other topics. The College of Strategic Studies and Defense Economics is executing its first nineteen week course with eighty students in residence from throughout the former Warsaw Pact nations and with faculty and fellows from both NATO and the former East. I met with the class and faculty and emphasized the importance of what they are doing to the future of Europe and the world. The Center is at the heart of our efforts to forge a partnership with the new nations of Eastern Europe and the accomplishment of Dr. Bernstein and his staff, in this short time, is commendable. (Info)

(2) The United States Army continues to have an interest in the Center not only because we provide its funding but also because we conduct our Eastern European foreign area officer training and language refresher at the Center. This is a complementary relationship that enriches both FAO training and the Center. I want to undertake a review of funding and personnel issues for the Center, including funding from other nations. The Army will continue to be fully supportive of the Center. (Info)

(3) I now have a fellow at the Marshall Center and the Army War College has been involved with several of their conferences and projects. I would like to expand the War College relationship to the Center, perhaps by a series of exchanges, perhaps with a visiting instructor for short periods of time, or perhaps in some other way. A more formal relationship would be beneficial to both institutions. I would like to see options about how we might accomplish this. (Action: DCSOPS ICW AWC)

d. During my visit to the Marshall Center, MG Holder, CG 3ID briefed me on the upcoming US-Russian Peacekeeper 94 Exercise to be held at the Totskoye Training Area, in Russia, 2-10 September. This exercise will place about 250 soldiers from 3ID side by side with a similar number from the 27th GMRD in a peacekeeping scenario (UN Chapter 6) to develop common skills, provide insights about interoperability that would relate to this very realistic mission, and to provide a vehicle for our continuing army-to-army programs. Although largely an Army exercise, it includes a substantial airlift element and is providing USAFE the means to accomplish similar objectives. I am extremely pleased with planning to date and with the involvement of TRADOC supporting the development of exercise tactics, techniques, and procedures. I would like the exercise to be tracked in our daily operations briefings and, at an appropriate time, after completion of the exercise, I would like to be provided an After Action Review. (Action: DCSOPS) I would also like to be provided our public affairs plan. (Action: OCPA)

e. In France I participated in the 50th Anniversary commemoration of the invasion and liberation of Southern France, Operations Dragoon and Anvil. As the senior representative of the Department of Defense I spoke at the Rhone American Military Cemetery and attended ceremonies at Dramont (the 36th Infantry Division beaches) and at La Motte (the airborne ceremony). I was accompanied by numerous veterans of all grades — many returning to battlefields where they had truly performed as heroes. America's Army was also represented by the CINCUSAREUR, GEN Maddox and by Under Secretary Reeder. USAREUR provided support for the commemoration and did a magnificent job. Today's soldiers are a credit to the memory of what these proud veterans accomplished. (Info)

f. During my layover in Egypt, 10-11 August, I met briefly with my counterpart, LTG Halabi. This meeting provided us both an opportunity to reaffirm our friendship and our commitment to sustaining our army-to-army programs. I noted the appreciation of the United States Government for Egypt's cooperation in Support Hope and for operations in Somalia and we both took note of our security assistance and exchange programs, which continue at a high level. LTG Halabi expressed continuing optimism about prospects for peace in the Middle East and we noted that much progress had been made since my last visit when he expressed a similar optimism. On Africa, he is less optimistic, fearing that the current crisis may very well extend into Burundi or even Zaire where weak governments may be unable to deal with a sustained refugee crisis. We also discussed the terrorist situation throughout the region which appears to have improved considerably although the long term threat remains very much in his mind. (Info)

g. During my visit to France, I met with GEN Monchal, my French counterpart, and thanked him for the support of the French Army and the French people in the World War II Commemoration activities. GEN Monchal and I have met several times and this provided an opportunity to follow up on a number of issues. This was a short but very substantive meeting.

(1) With respect to the situation in Africa, GEN Monchal shares my view that things are stabilized for the present. He explained to me that the political decision to remove French troops from Rwanda is essentially non-negotiable but that every effort will be made to make the transition between the French forces and UNAMIR II in a rational and deliberate way. I explained that my perception, from my visit, was that an orderly transition was well underway with the arrival of troops from Ghana and the distribution of food into the southwestern regions by the World Food Organization. (Info)

(2) I noted that the French experience in Africa is much more extensive than ours and expressed an interest in a continuing program of information exchanges. GEN Monchal explained that they maintain a school and study center near Paris which might be useful for selected US personnel to visit. I would like to pursue this initiative. (Action: DCSOPS ICW TRADOC and USDAO, Paris)

(3) We discussed formalizing a memorandum of understanding that would permit US and French troops to fly on each others aircraft in the course of unit exchanges and combined training. We agreed in principal that such an MOU, similar to those we have in effect with the UK and Canada, would be very helpful. I want to pursue that as a priority action. (Action: DCSOPS)

(4) We also discussed such varied topics as acquisition reform, doctrine development, force design, peacekeeping, force protection, Atlantic Resolve, and soldier issues in general. I told him I would send him both the new 525-5 and (draft) 100-23. (Action: DCSOPS) We also discussed "soldier systems" at some length and I would like to ensure that we are sharing developments in this area. (Action: DCSLOG) We are both very satisfied that our attache and liaison networks are functioning effectively to keep our armies sufficiently abreast of each others developments. (Info)

h. While in France I also met with GEN Maddox to review a number of issues including our current operations in Africa and the former Yugoslavia, the up-coming US-Russia PKX, and year end issues. GEN Maddox is finding that current operations and our expanding army-to-army programs are creating requirements for leaders with very special skills as opposed to units. As a result he is constantly taking leaders out of units to employ them as individuals or in small teams. While it is true that this demonstrates the flexibility of our Army and of Army people, it has some unfavorable readiness implications. As we build Force XXI structures, we must understand the demands today's world places on us for leaders and for situationally tailored organizations. We must create pools of skilled leaders that we can draw on to accomplish these missions without unacceptably degrading other units.

i. Throughout the trip, I reviewed TRADOC Pam 525-5, FM 100-23 (draft) and *Ethnic Conflict and Regional Instability*, recently published by SSI. I believe that our doctrine and our thinking is very much in line with the challenges we can expect to face. 525-5 takes an exceptionally wide view of the operational environment and establishes a very flexible operational concept that, I believe, is widely applicable across the spectrum. In the very real context of my trip — humanitarian operations, peacekeeping with the Russians, and theater army level combat operations — I could not help but be impressed by the very broad range of operations we must be prepared for. I believe these books are helping us make that intellectual shift but the press of current operations demands that we develop the tactics, techniques, and procedures to implement these new concepts at the same time that we remain sufficient intellectual flexibility to recognize that each future operation will be different from the last. (Info)

j. I believe Ethnic Conflict and Regional Instability is a valuable collection of essays on this difficult subject. I would like to sponsor a similar conference this year, at Carlisle, and focus the themes on peace operations in this environment. This conference should include a range of people from our Army, from throughout government and academia, from the NGO's and PVO's, and from other nations with experiences in this area. The conference should result in a book similar to Ethnic Conflict and Regional Instability. (Action: AWC)

4. **SUMMARY:** This was a remarkable trip: humanitarian assistance in Africa, military-to-military with the nations of the former Warsaw Pact, World War II commemoration to remind us of the need to always be able to execute the "high end," meetings with two counterparts — and all of that while we are executing our second peacekeeping exercise at JRTC and our operational deployments throughout the world. America's Army today is more engaged, and engaged in more ways, than at any time in our lifetimes as soldiers. The quality of our soldiers, the strength of our leader development, and our training programs are what enables us to do all of that and to do it well. The US Army, soldiers on the ground, did in fact stop the dying in Africa. That crisis is not resolved, nor will it be in the near term, but only the US Army could create the conditions that make resolution feasible. Today's world and the world of the near future will continue to be this kind of complex and difficult world. Our nation will call on us to serve in many ways. Our purpose, to fight and win our nations wars, our vision of selfless service, and our uncompromising quest for quality make us the world leader. A trip like this helps me renew my commitment to that role, to keeping our Army trained and ready, to taking care of our people, and to moving into the 21st Century — not as we would like it to be — but as it is. America's Army.

Gordon R. Sullivan
General, United States Army
Chief of Staff

DACS-ZAA
SUBJECT: Trip to Europe and Africa, 9 to 15 August 1994

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APPENDIX 3

THE
UNITED STATES MILITARY ACADEMY'S
ADVANCED TECHNOLOGY CLASSROOM

WEST POINT'S ADVANCED TECHNOLOGY CLASSROOM LABORATORY

The United States Military Academy has established a new laboratory facility called the Advanced Technology Classroom Laboratory (ATCL'54). Sponsored in part by a grant from the West Point Class of 1954 and costing over $500,000, the laboratory is part of an effort at West Point to identify and incorporate new methods of instruction, many of which are a result of advancing technology. The facility was constructed in the Fall of 1993, and it houses 20 student desks in a classroom that is arranged in rows of desks facing a theater-like stage. Each desk contains a 486 computer that is linked to a network. The "stage" is equipped with a number of modern educational devices, including a multi-source projector, CD-ROM and video playback devices, sophisticated light control systems, stereophonic sound, and the like. It is, in short, an assembly of modern devices which faculty members may use in a classroom setting to enhance learning.

ATCL'54 is the most visible feature of modern educational technology at West Point. However, it is really only a part of a larger effort to enhance learning. West Point's strategy is to form a coalition of faculty members, technologists, and educational specialists whose mission is to wisely incorporate high technology into the educational process. The organizational entity that supports this mission is the Center for Teaching Excellence -- a subset of the Academic Affairs Division of the Office of the Dean. Headed by an educational psychologist (Ph.D.), the CTE offers a wide range of faculty development activities and opportunities at West Point. It responds to feedback from assessment activities at West Point, course feedback, instructor comments and activities, and direction from the Dean. The intent of the organization is to provide an educational beacon to guide the use of technology so that enhancements do more than look good; they actually improve learning.

The Dean of West Point, BG Gerald E.Galloway, described in the September 1994 Assembly magazine what West Point has learned so far from the ATCL: "Both faculty and cadets tell us we are enhancing the quality of our instruction. We are learning that we can successfully integrate advanced technology with class room discussion and small class size." Later in the article he states: "The equipment does work. As we learn to employ state of the art teaching techniques, the cadets are becoming more familiar with the technologies they will see throughout their careers in the Army." (Assembly, September 1994, p 63.)

To know whether modern devices are indeed improving learning, faculty members who are involved with the classroom must take part in real experiments which test the effectiveness of the high tech gizmos, rather than just demonstrate their use. To date, unfortunately, there has been little or no real experimentation taking place. The ATCL has been under the control of the technologists, who see their role as making the most use of the devices available, rather than identifying what really contributes to education. As the new CTE organization takes hold, however, this paradigm is shifting. The educational psychologist who directs the CTE is now on board, and she is beginning to employ the ATCL in its real purpose -- as a laboratory for determining what really does lead to better learning. Instructors using the ATCL in the Spring Semester (1995) must have carefully defined objectives and measures of effectiveness. (See enclosures.) Thus, after a year of operation, ATCL'54 is now performing a very important function for West Point as the Academy brings its educational philosophy into the 21st Century.

West Point's efforts regarding ATCL'54 are important to the Army in that they form a microcosm of what the Army will experience as we attempt to incorporate high technology devices into the Army's vast learning environment. The multitude of high technology gizmos that are out there have immediate appeal. They look good, pack a punch, and provide spectacular effects. But they are also expensive -- and their worth is unproved. It is highly tempting to adopt these devices, as their immediate effect can be easily visualized. For example, a new projector system that plays video clips stored on CD-ROM has instant appeal as a visual enhancement to a history class on World War II. The instructor sees herself projecting vivid images before her students, mesmerizing them with the sound and fury of World War II combat footage. But how long did she spend finding the video clip and figuring out how to incorporate it? What did it cost in terms of time and money to add that enhancement to the class. And just how much did this video footage really contribute to the overall objectives of the class and to the institutional learning goals. What were the unexpected side effects of the added technology (e.g., less student-instructor interaction, excessive instructor time spent in class preparation)? The real question is whether the cost was worth the value, as measured in the terms of contribution to learning objectives. Devices and techniques will vary in effectiveness depending on the type of material being taught, the nature of the students, and the overarching learning goals that carry far more importance than just learning World War II history.

The Army could make some big mistakes in its use or misuse of technology in education. We can make mistakes by spending large sums of money to buy gizmos which do not contribute to learning. We can make mistakes by adopting technology which may improve the information transfer but which may seriously denigrate primary educational goals of the institution. But we can also make mistakes by not investing in devices that do work and could vastly improve the way we teach. Efforts such as those taking place in West Point's ATCL'54 are important to the Army, and the Army should learn from them. We should conduct experiments and prove the worth of a device or technique before adopting it on a wide scale. We should know the difference between an experiment and a demonstration. And we should get into the arena and conduct experiments to develop our own first-hand knowledge.

Center for Teaching Excellence

Thayer Hall **Phone: 938-7947**
Room 119 **E-mail: ka4643**

Experiments in Teaching in ATCL-54

Spring Semester 1995

During the Fall semester, faculty who wished to experiment with technology in instruction were invited to submit proposals. The Acting Director of the CTE and a subcommittee of the Teaching Excellence Committee of the Faculty Council reviewed these proposals and accepted the following classes for the laboratory/classroom.

LG 204 Basic German **MAJ Gross**

The student of a language must be able to hear, see, comprehend, and then respond to the culture through a variety of means. The technology available in the ATCL will be used to help the cadets learn German through the use of all the senses. The key will be to present a particular topic through at least two of the senses at a time. The central question will be whether or not this enhancement significantly improves student learning and, if so, how technology can be successfully applied to all cadet language study to improve learning. MAJ Gross has already taught a German class in the ATCL and has been working with the developers to create instructional software. One critical issue to be assessed is the amount of material that needs to be presented in the classroom environment relative to the computer-assisted instruction that can be delivered to the barracks.

A & B Hours

EN100 Remedial Composition **Dr. Gandolfo**

Research has shown that word processing is particularly effective in composition instruction for developmental writers. Since cadets in EN100 have not had success in their first writing experience, the goal of this course is to use the technology of the ATCL to enable these students to make significant improvements in their writing skills. The technology will enable the instructor to employ a variety of instructional strategies to create a positive yet academically challenging experience for students. One measure of the improvement of student learning with technology will be a comparison between student writing at the end of this course and that produced by students at the end of EN100 in Spring 94. The course will also include an experiment to determine the extent to which improvements in writing with technology are carried over to the writer's handwritten work, an area that has not yet been addressed in composition research.

C & E Hours

HI393 Weapons and Warfare in the 20th Century **Dr. Waddell**

The course objective is to trace the development of warfare in the 20th century, having the cadets understand the relationship between tactical, operational, and strategic doctrine, and battlefield realities. The instructor will use the technology of the ATCL to plan a more interactive classroom environment, providing cadets with the capability of moving units around a computer-generated map to illustrate tactical/operational problems. The networking provides opportunities for both individual and group learning. In addition, the audio-visual capabilities of the ATCL will enable the instructor to bring the historical past into the present moment in a manner impossible in. a standard classroom. The critical question will be: How valuable is this technology for student learning? By comparing student learning in this section with that of students in another section taught by the same instructor but in a standard classroom, a measure of the effectiveness of technology in enhancing instruction should be possible.

F Hour

ME 387 Introduction to Applied Aerodynamics: CPT Hood & MAJ Arterburn

The three-dimensional nature of the study of aerodynamics does not lend itself to instruction on a two-dimensional blackboard. In addition, the development of the equations and discussion of the physical significance of key parameters consume large amounts of classroom time without the cadets participating in any form of problem solving during the class hour, limiting their ability to apply their knowledge to many significant applications of aerodynamics. The instructors plan to remedy both problems with the use of technology available in ATCL. They will enhance active learning in the classroom through the use of networked computers and multi-media and computer simulations of the physical world. They also plan to determine the optimum mix of group-individual problem solving and traditional classroom lecture for effective instruction of applied aerodynamics. The critical questions include: Does the technology improve student learning? What changes in instruction are indicated? How much technology is necessary to replicate this experience for students in a traditional classroom environment?

I & J Hours

EN102 Literature COL Freeman

While EN102 attempts to develop an understanding of the diverse themes of American cutlture through contemporary American poetry, the course also aims to improve cadets' skills in oral and written communication. COL Freeman, who has previously taught an elective class in the ATCL, speculates that the technology available in the ATCL will enhance the development of these skills. The networking capability will allow for easier sharing of student writing and, it is hoped, improve cadets' ability to improve their thinking and writing. The ATCL also provides the instructor with the capability of easily videotaping student oral presentations. Cadets will not only be able to hear and critique how they sound at the moment, but they can also judge their progress by viewing their performance at earlier lessons in the course. COL Freeman will be able to use the tapes not only with the students but in faculty development for other EN102 instructors. Since this is a core course, a comparison will be made between student work in this ATCL section and that of students in other sections in an effort to document the effectiveness of technology in improving student learning.

K Hour

Anyone who wants more information about these classes or would like to visit a session is invited to contact the instructor.

In February, proposals for using the ATCL for Fall 1995 will be invited from the faculty. Anyone who wishes more information about that process can contact the CTE.

APPENDIX 4

TRIP REPORT
TO
AIR COMMAND AND STAFF COLLEGE
MONTGOMERY, ALABAMA
13 JUNE 1994

MERCER UNIVERSITY

SCHOOL OF ENGINEERING
Computer and Information Systems

MEMORANDUM

DATE: 13 June, 1994

TO: Dr. Grum

FROM: Dr. Palmer

SUBJECT: Air Command and Staff College Visit

This memo describes my 10 June visit to the Air Command and Staff College at Maxwell Air Force Base and includes personal observations on the use of technology in the programs there.

The Visit

As indicated on the attached itinerary, I received a comprehensive briefing on ACSC programs from the commandant, Col Warden. This was followed by visits to the Space Applications Lab, a briefing by Col Krueger, Senior Officer of the US Army Advisory Group, a question/answer session with faculty members, a separate meeting with students, and a tour of a number of ACSC facilities, many of which are dedicated to preparation and use of simulations, war games, video, and multi-media software. The faculty group included officers responsible for ACSC technology applications and for the non-resident program and correspondence courses. The student group included the 1994 distinguished graduate (a US Army Ordnance Corps Officer) and another Army officer, both of whom had incorporated impressive multi-media software into their research projects.

Several views of the curriculum are included in the attached briefing materials along with a typical class schedule and a daily workload breakout for students. Note that, while students only average three hours in class each day, their reading load (91 books plus other documents,) research, and other class preparation requirements sum to a daily total of 10 hours.

Starting with the 1993-94 class, each student is loaned an IBM compatible notebook computer with color screen and a complement of Windows-based software. This facilitates word processing, spreadsheet manipulation, and graphical presentation of data. The ACSC building includes an extensive local area network which serves seminar rooms, lecture halls, offices, etc. Both faculty and students can connect to this resource and, while they are still experimenting with its capabilities, both groups appear to be enthusiastic about its potential. E-mail, scheduling, uploading, and downloading information in a variety of formats are the most common uses to date.

1400 Coleman Avenue • Macon, Georgia 31207-0001
(912) 752-2210 • FAX (912) 752-2166

ACSC has begun experimenting with Toolbook, software which allows users to develop hypermedia programs. This package provides a very versatile vehicle for authoring material with a broad range of applications. The resulting programs run under Windows without the user having to have a copy of Toolbook. This facilitates exporting the resulting material and seems to have excellent potential in the non-resident program and in correspondence courses as well as in the resident course.

ACSC students are required to do a research project and, this year, a number of them used the Toolbook software to develop hypermedia packages which are quite impressive. With a mouse or trackball, users may select words, icons, buttons, pull down menus, dialog boxes, etc. In many cases this gives the user the capability to pursue topics which interest them rather than being constrained to a pre-structured path. The combination of text, graphics, video, audio, and scanned images can be very effective vehicles for communicating information or creating challenging simulations which require the user to make decisions. Many of these decisions are followed by rapid feedback concerning the associated consequences. Because the students bring an enormous breadth and depth of experience and expertise to the course, they are able to supplement the strengths of the ACSC staff and faculty. It is noteworthy that the staff and faculty have moved quickly to take advantage of this resource.

The Space Lab is also impressive in its use of technology. Its facilities allow students to exercise a variety of software to see near-real-time information on weather, status of aircraft (both on the ground and airborne), logistical support items, etc. Each student spends 10 hours in front of this equipment, and its capabilities complement a number of the exercises used in the course.

Academic year 1993-94 students are being given a CDROM disk containing all the research papers generated by the class, all Toolbook applications, and all the lesson plans for the year. This is the first in a series of uses planned for CDROM. The non-resident program and correspondence courses expect to make increasing use of this technology, allowing them to more nearly parallel resident course work.

Personal Observations

The ACSC Commandant has moved aggressively to get technology into the hands of the students and, while the efforts are young, they are certainly eye-catching. To date, there has been no formal effort to evaluate the effectiveness of these innovations, and none of the people with whom I spoke knew of any plans to apply any rigorous techniques to a comparison of the "new" vs "old" ways of teaching. No one on the staff is considered an "expert" in the use of technology in an educational environment. A number of people spoke of themselves as being involved in an "educational lab" but when I asked about plans for the future, they were not certain where their next efforts would focus. At least one person speculated on the use of virtual reality and advanced distributed simulation but several others noted that initiatives such as the use of technology in the curriculum are driven largely by the vision of the person at the top, and that a new Commandant might emphasize something quite different.

There does not appear to be any formal mechanism for sharing ideas between schools about uses of technology in education and training. This is true whether the schools are next door to each other as they are at Maxwell AFB or whether they are located on separate bases. There are a number of informal mechanisms, but most of these depend on people involved in TDY or PCS moves transporting ideas from one place to another. These mechanisms seem to neglect almost entirely the wealth of "technology in education" work going on at civilian institutions. Maybe even more important, there does not appear to be much incentive to use ideas developed by others. Creativity and innovation are noted on efficiency reports while borrowing ideas from others does not merit lots of recognition. This seems to foster a "non invented here" attitude which can result in duplication of effort and an unnecessary and unprofitable expenditure of time and other resources.

In my judgement, identifying, assigning, and grooming high quality instructors does not seem to receive as much attention as does the curriculum or the technology for presenting that curriculum. This is not meant to demean the ACSC faculty in any way. It simply notes that instructors normally serve a two year tour, leaving at just the time they are really becoming proficient in their teaching and advisor roles. They are frequently expected to teach or lead discussions about material over which they have little mastery. Consequently, they are very busy attempting to stay ahead of the students, and have limited time to learn about new technology and use it in creative ways to enhance instruction.

Students are also very busy and the environment in which they find themselves is very competitive. Their class standing depends largely on a series of tests and papers which draw heavily on their reading in the 91 books noted earlier. They cannot be faulted for investing their time on such material while neglecting innovative technology which may interest them but has little payoff on the exams.

While a number of students generated Toolbook applications they did so with no real guidance about developing effective software. They did the best they could in deciding whether to use graphics, video, audio, scanned images, or text and their layout of screens, use of color, etc., varied dramatically. Much of their work allows totally unstructured paths to be traced through the included data. This may be good under some circumstances but, in other situations, the user may profit more from a limited set of constrained options. Access to a technical communication specialist would have helped.

Use of CDROM may provide an innovative vehicle for exporting educational materials to non-resident students but it will do little, if anything, to overcome the standard concerns about an absence of opportunities for socialization, camaraderie, and networking.

Recommendations

1. Look for ways to reduce the "not invented here" syndrome. Provide incentives to share ideas, particularly ideas about uses of technology in education. This should include information about "failed" experiments as well as "successes".

2. Establish a "clearing house" for technology-in-education ideas, techniques, software reviews, etc. This can be as simple as an electronic bulletin board or as elaborate as one or more annual conferences at which users demonstrate, share, criticize, etc.

3. Develop "measures of effectiveness" for uses of technology in education and training. We know that a lot of money, time, and energy can be invested in buying hardware and developing software. We need some basis for judging the cost effectiveness of those expenditures.

4. Consider "accreditation agencies" or "visiting review boards" which do much more than just look at curricula. They need to ask the hard questions such as "why did you choose to teach it this way?", and "how do you know that this approach achieves better results than some other approach which would have cost the same or less?"

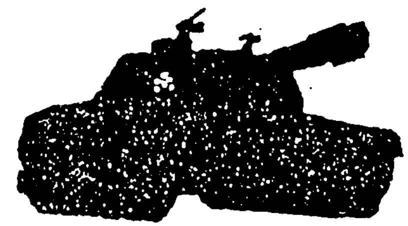
5. Hire educational and technical communication specialists who can serve as consultants. Such people can help in a wide variety of ways, from demonstrating good software development techniques to guiding formal educational experiments. These people may not need to be located at each school if faculty members can gain access to them via technological links.

6. Place a high premium on selecting and grooming faculty members, then leave them in their assignments long enough to realize a payoff on the investment. Above all, these people must see their work as important (read that "career enhancing") and they must be dedicated to helping their students learn. They need to master all of the tools which they are going to use, including the ever expanding array of hardware and software available to them.

7. If the use of technology in education and training is really important, it should provide a tangible "payoff" for students. In a competitive environment this means that technology should be considered in the development of tests, graded exercises, and other vehicles which impact class standing.

8. Beware of an over reliance on technology. Teach students how to use a variety of tools, with some emphasis on the stubby pencil as a fall back alternative when their Space Lab equipment blows a fuse or gets taken out by an electronic pulse.

9. Look at the possibility of using computer networks to involve non-resident students in dialog with their instructors and with each other. Encourage non-resident students to form "local seminars" for discussion and exchange of ideas. Consider a mentor program in conjunction with non-resident instruction.



UNITED STATES ARMY ADVISORY GROUP (AAG)

AIR COMMAND AND STAFF COLLEGE

MAXWELL AIR FORCE BASE, ALABAMA

ITINERARY

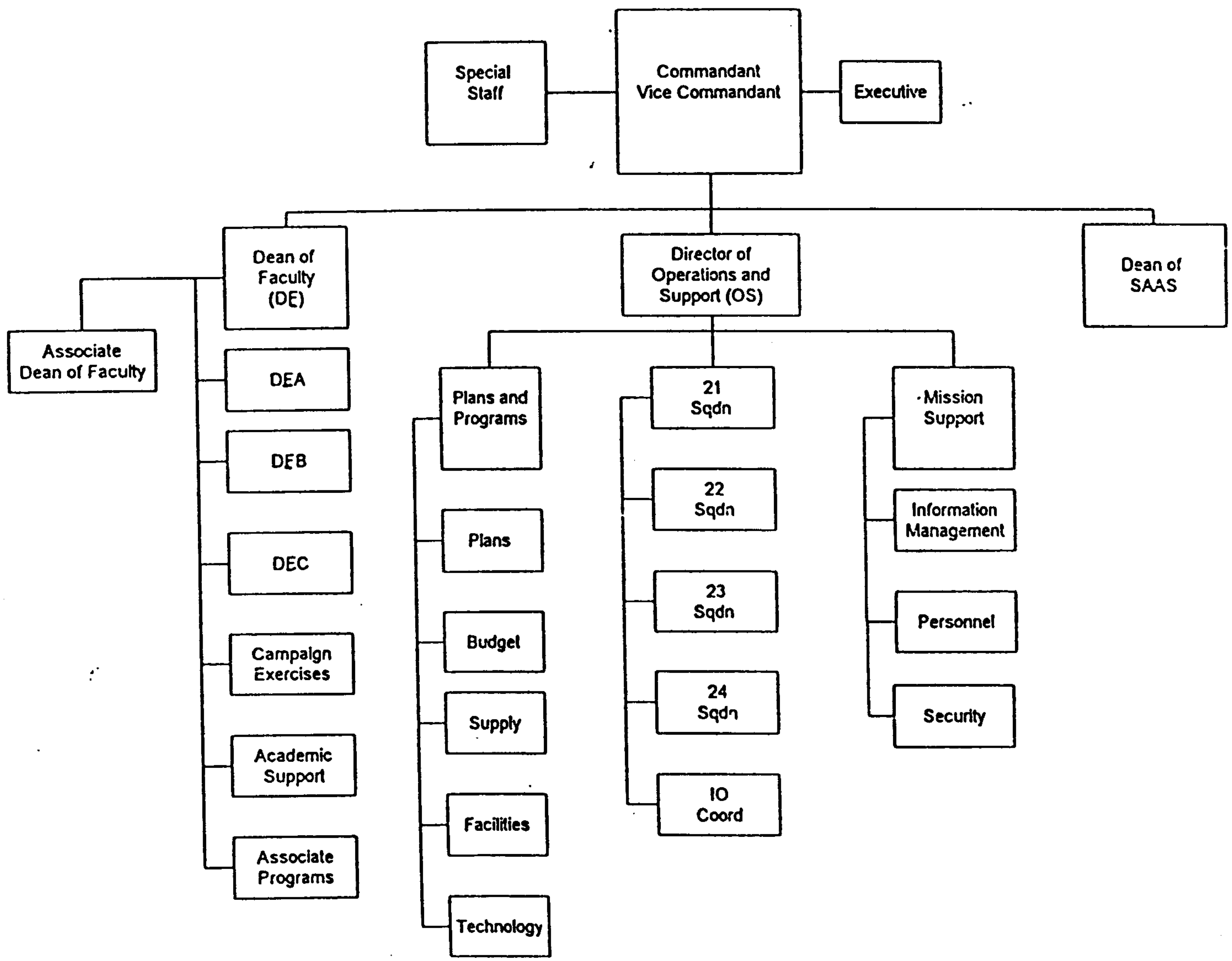
VISITING PARTY: Dr. John Palmer,
Professor of Engineering, Mercer University
Representing Dr. Allen Grum, Army Science Board

HOST OFFICER: Colonel Gary Krueger

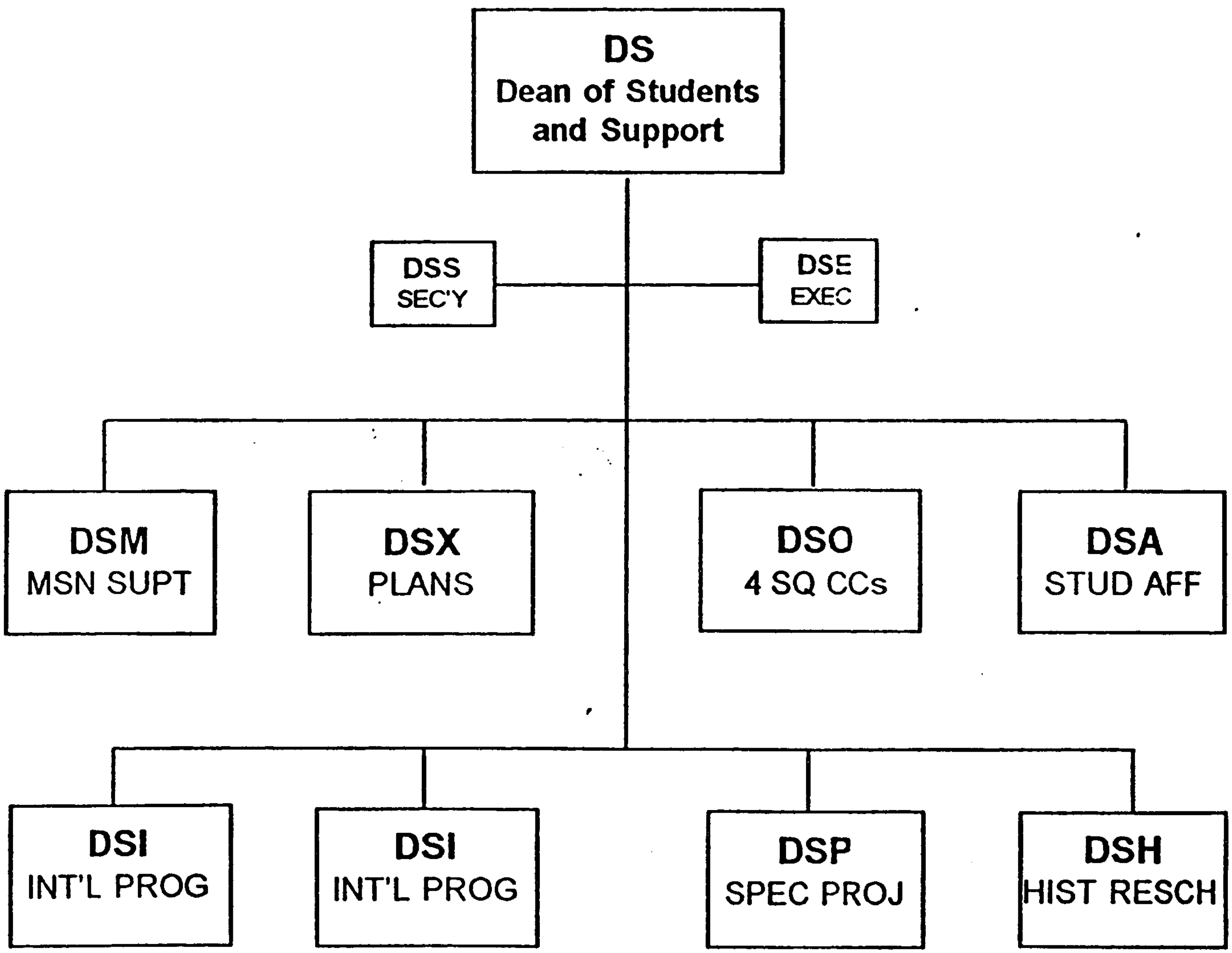
FRIDAY, 10 JUNE 94

0900 - Arriver POV	
0900 - ACSC Mission	CC Conference Room (POC: Col Warden)
1000 - Space Applications Lab	Space Lab (POC: Maj Jeanes)
1020 - Army Orientation	Col Krueger's Office
1100 - ACSC Technology Applications	Barnes (POC: Lt Col Morgan Lt Col Stepko)
1200 - Lunch	Officers Club
1300 - Army Students View	Col Krueger's Office
1430 - Facilities Tour ACSC Facilities AU Library	(POC: Col Krueger)
1530 - depart	

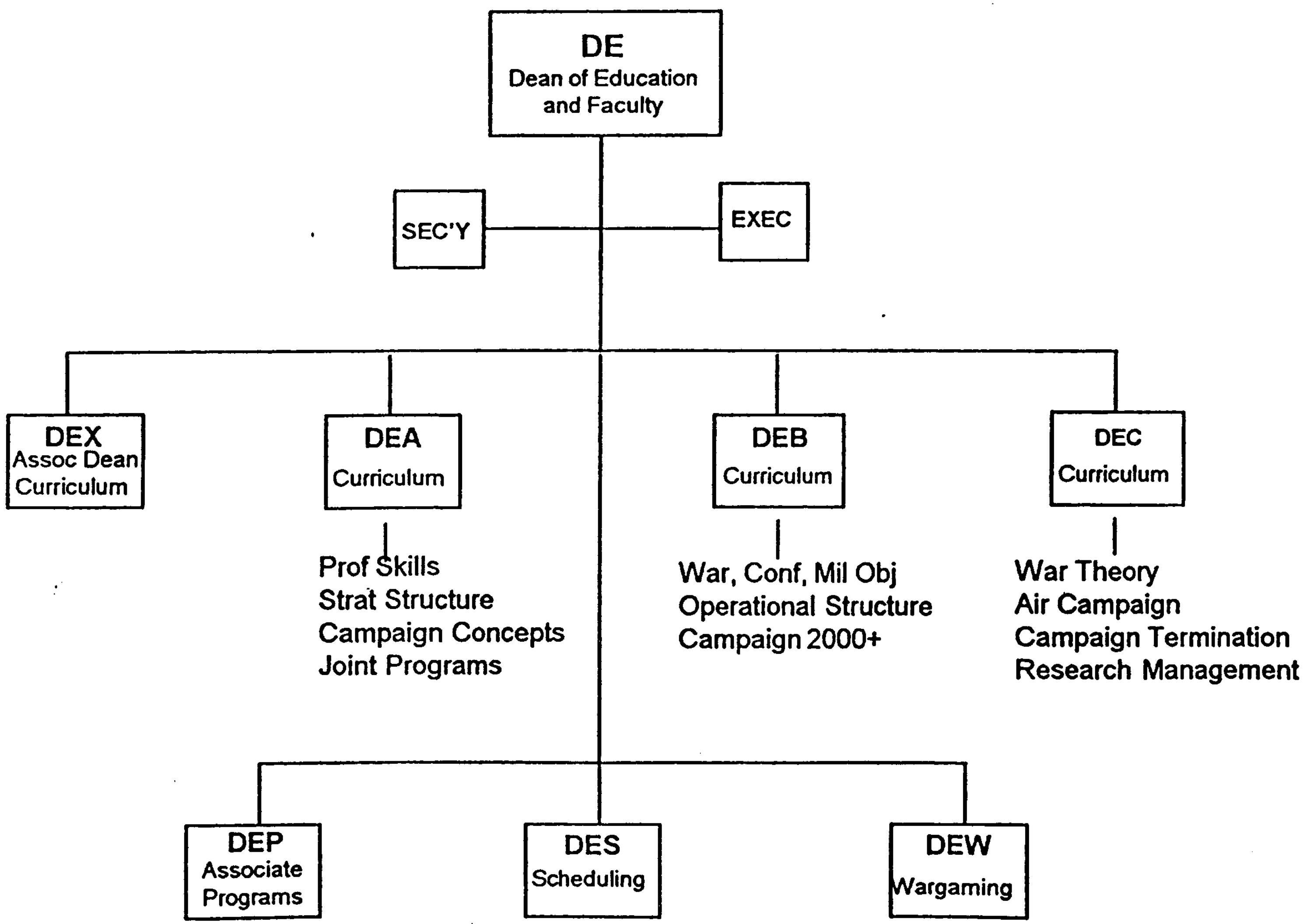
ACSC Organization Chart



DEAN OF STUDENTS



DEAN OF EDUCATION



Current As Of: 3

Air Command and .aff College
AY 94 Curriculum Summary

Hours By Block	Lecture	Informal Lecture	Seminar	Eval	Block Total	Class Days	Weeks
Overview	3.00	3.00	3.00		9.00	3.00	0.60
Professional Skills @6hr/day	29.25		73.50		102.75	17.13	3.43
War, Conflict and Objectives	10.00		14.00		24.00	8.00	1.60
War Theory	30.50		24.00		54.50	18.17	3.63
Strategic Structures	36.50	14.50	29.25		80.25	26.75	5.35
Operational Structures	54.50		46.00	3.00	103.50	34.50	6.90
Campaign Concepts	15.00		28.50	3.00	43.50	14.50	2.90
Air Campaign Planning	15.00	11.00	78.00	4.00	108.00	36.00	7.20
Campaign Termination	7.50	1.00	10.00		18.50	6.17	1.23
Campaign 2000 +	24.00		15.00		39.00	13.00	2.60
Campaign Exercises @4	6.00		74.00		80.00	20.00	4.00
Totals:	231.25	29.50	395.25	10.00	663.00	197.21	38.84

	Days	Weeks
Total Planned Contact Academics:	197.21	38.84
USARAF, GAF, CANUSA, GOE	12.00	2.40
Contact Hrs Available for Other Activities:	(10.21)	(1.44)

Standards and Variables

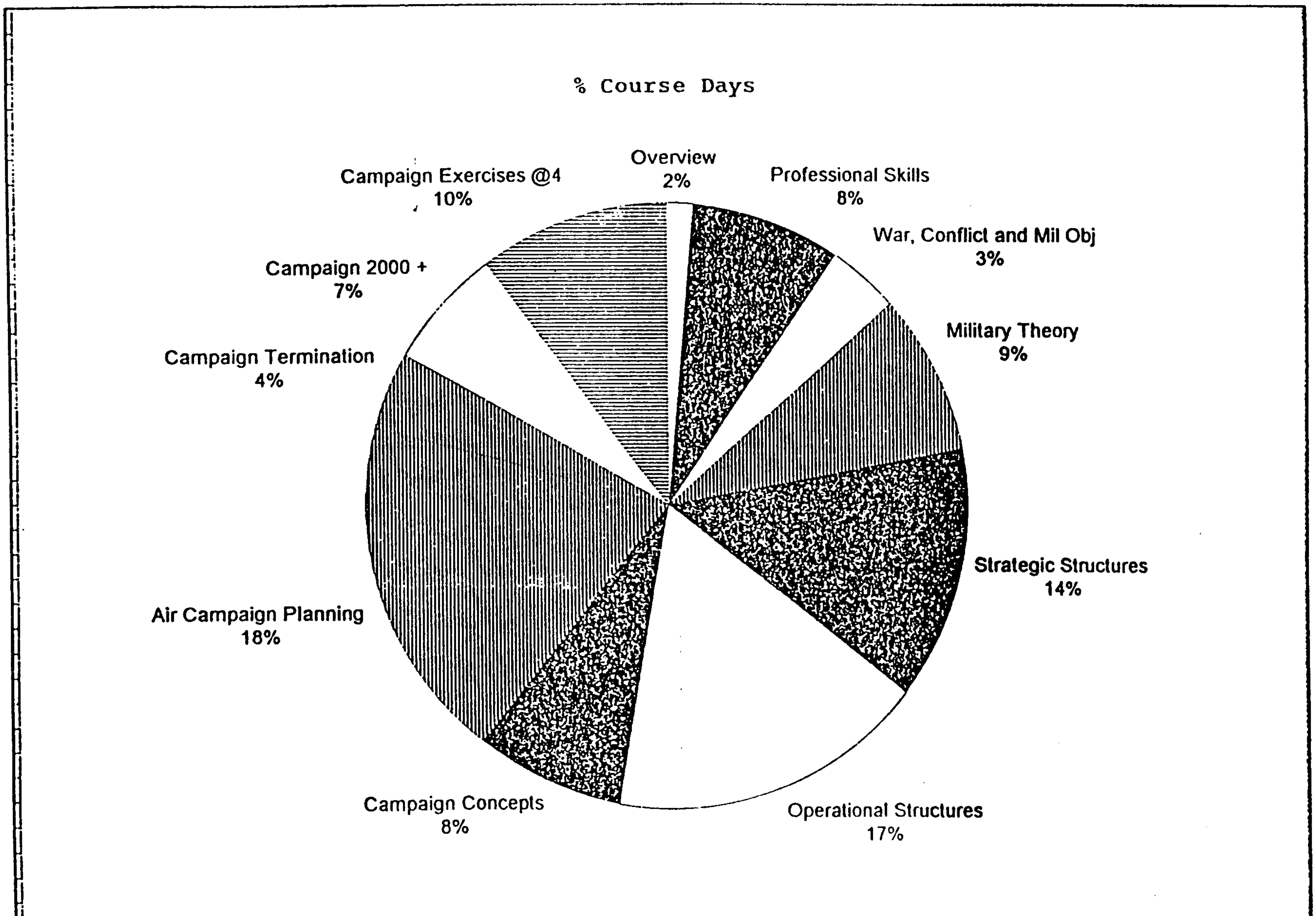
AY94 Start Date:	17-Aug-93
AY94 Grad Date:	16-Jun-94
Total Days Available:	303
Total Number of Holidays:	104
Total Class Days Available:	199
Contact Hour/Day Standard:	3.00
Reading Pages/Hr Standard:	50.00

Keys Points of Analysis

Lecture	Inf Lect	Seminar	Eval
35%	4%	60%	2%

Lesson Percentages

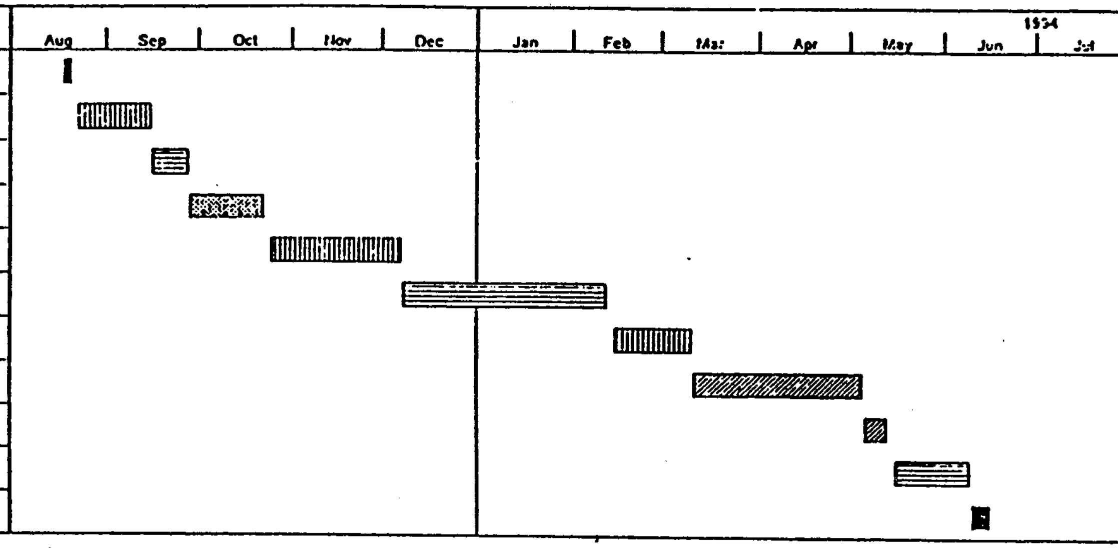
PIEDF2.XLS



% Course Days
Overview 2%
Professional Skills 8%
War, Conflict and Mil Obj 3%
Military Theory 9%
Strategic Structures 14%
Operational Structures 17%
Campaign Concepts 8%
Air Campaign Planning 18%
Campaign Termination 4%
Campaign 2000 + 7%
Campaign Exercises @4 10%

ACSC AY94 CURRICULUM FLOW

ID	Name	Duration	Scheduled Start	Scheduled Finish
1	Overview	3d	8/18/93	8/20/93
2	Professional Skills	17d	8/23/93	9/15/93
3	War Conflict and Mil Missions	8d	9/16/93	9/27/93
4	Military Theory	15d	9/28/93	10/22/93
5	Strategic Structure	29d	10/25/93	12/7/93
6	Operational Structure	37d	12/8/93	2/11/94
7	Campaign Concepts	18d	2/14/94	3/10/94
8	Air Campaign	40d	3/11/94	5/5/94
9	Campaign Termination	6d	5/6/94	5/13/94
10	Campaign 2000+	18d	5/16/94	6/9/94
11	Terminal Exercise	5d	6/10/94	6/16/94



Note: Wargame/exercises are included in the course days above. Estimated days are as follows:

Overview	1 day
Strategic Structure	2 days
Operational Structure	2 days
Campaign Concepts	3 days
Air Campaign	4 days
Campaign 2000	3 days
Terminal Exercise	5 days

Project: AY94Flow
Date: 4/5/93

DFA DFB DFC DFW

Student Daily Workload

- In-Class Time - 3 hours
- Class Preparation - 1 hour
- Reading - 5 hours (200 pages per day @ 300ppm)
  91 Books plus other government publications and manuals
- Research - 2 hours
- Total: 10 hours per day
- Social Activities - Optional
- Sports Program - Optional

Class Schedule

- 2 Sessions
  - 0830-1130 and 1330-1630 (3 Contact hr Day)
  - 22 Seminars Each Session
  - Seminar Room is available for student use during their off-session
- 2 Mixes
  - Second Mix begins after Op Structures Course (7 Feb)
    - » First Mix = 5½ months (102 contact days)
    - » Second Mix = 4½ months (95 contact days)

Faculty Roles

- Course Instructor - Develop and deliver instruction, evaluate student performance, and remediate
  - Course Director (Division Chief) - leads faculty preparation training for his/her course
- Faculty Advisor - Provides academic counseling and continuity, writes training report
- Research Advisor - Directs and/or participates in student research.
- Squadron Commander - Provides personal counseling and disciplinary actions if necessary

APPENDIX 5

BRIEFING
ON THE
AIR FORCE RESERVE HEADQUARTERS'
USE OF THE
ARMY TNET NODE

TALKING PAPER

ON

AIR FORCE RESERVE TELETRAINING NETWORK (TNET)

- To provide information on initiative to provide Video Teletraining/Teleconferencing capability

- A cost effective, state-of-the-art, worldwide, satellite-based teletraining/teleconferencing network.

  -- TNET selected as the state-of-the-art video telenetworking training delivery system

  -- Provides versatile, responsive, inexpensive, effective, and mobile telecommunications

    --- Provides interactive 2-way audio/2-way video digitized connectivity

    --- Supports all multi-media applications

    --- Available upon request 24 hours per day, 365 days per year

- Currently being leased through Oklahoma State University in conjunction with the US Army

  -- No maintenance charges, with a 24 hour turn-around

  -- Technological upgrades at no additional cost

  -- All communications costs included

  -- 24 hour per day Network Control Center (NCC) support

- 46 AFRES TNET Sites

  -- Establishes command and control

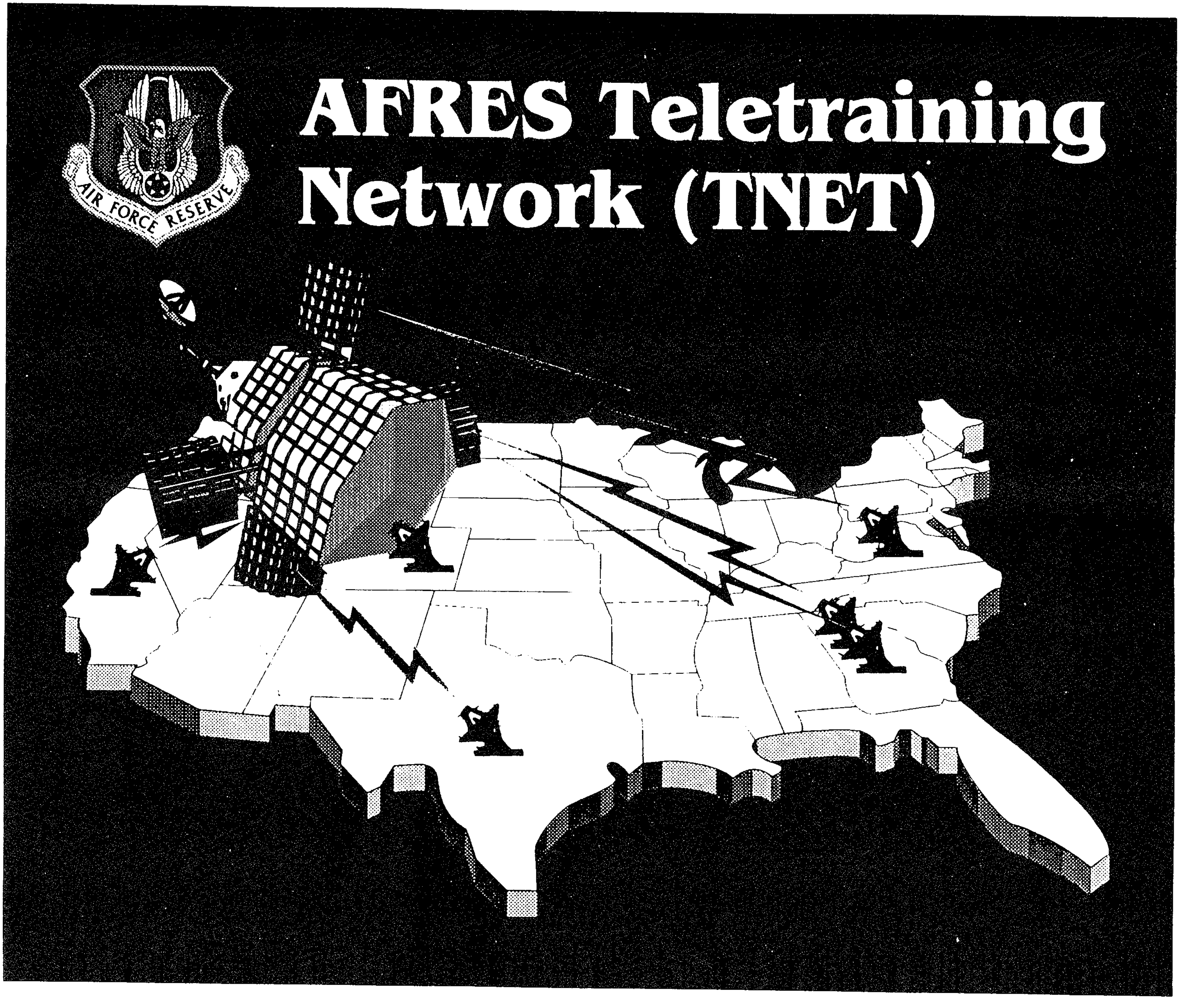
  -- Network provides full Distance Learning capabilities for all DOD

  -- Network supports all AFRES Wings and Groups

  -- Uplink/downlink capabilities at all locations

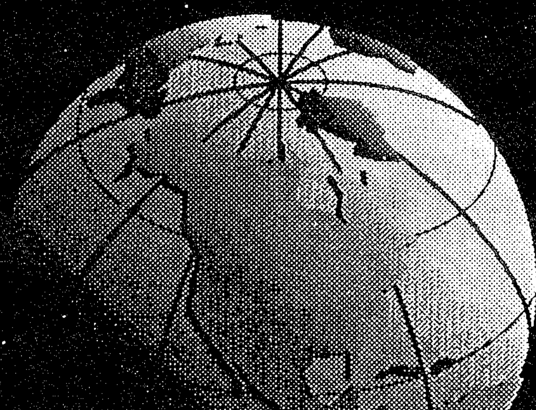
  -- User driven with no need for complex production facilities or staffing

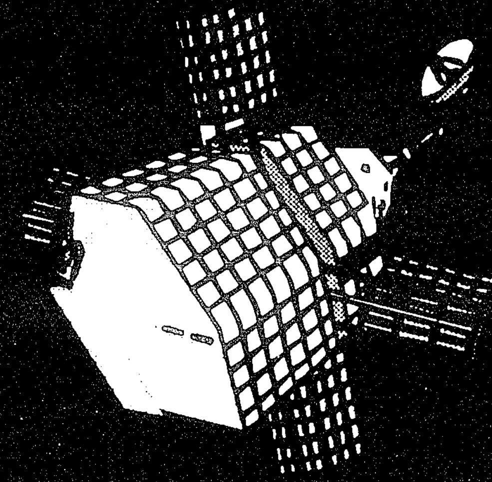
- Teletraining & Teleconferencing features
  - Functional area training
  - Formal/informal AFSC training
  - Ancillary training
  - Command-directed training
  - Face-to-face Interaction
  - Reduces TDY expenditures
  - Cost avoidance in man-hours


AFRES Teletraining
Network (TNET)
AIR FORCE RESERVE

DP0797.05-94

Overview





- What is TNET?
- TNET components
- TNET capabilites
- TNET features

DP079701-94

WHAT IS TNET?

- State-of-the-art communication and teletraining system
- Digitized two way audio & video
- User driven
- Operational 24 hrs/day, 7 days/wk
- U.S. Army leased
- Prime contractor-OSU

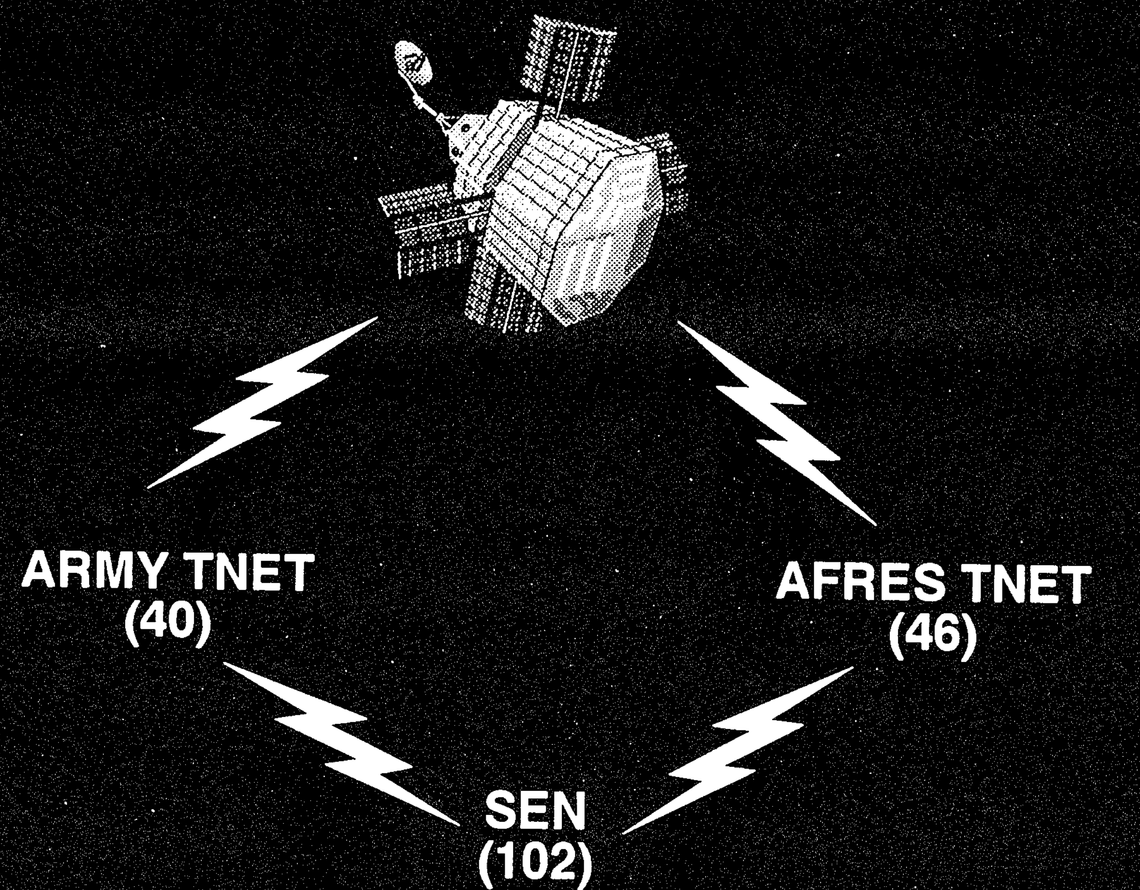
DP079702-94

TNET COMPONENTS

- Modular/transportable equipment
- VTEL BK235 system
- Multimedia workstation
- 2.4 meter satellite dish
- Connectivity through Hughes Satellite System

DP079104-94

TNET Capabilities



DP079703-94

TNET FEATURES

- Cost of lease includes:
  - Technology upgrades
  - Delivery and installation
  - Maintenance and training
  - Telenetwork equipment
  - Satellite segment lease
  - Network control center support

DP079704-94

AIR FORCE RESERVE

SUMMARY

- TNET is:
  - Leased
  - 100% available
  - Cost effective
  - State-of-the-art
  - Interconnective
  - Multimedia capable
  - Mobile/transportable

APPENDIX 6

THE
UNITED STATES AIR FORCE ACADEMY'S
"CLASSROOM OF THE FUTURE"

A Visit to the United States Air Force Academy Center for Educational Excellence:

Observations and Impressions of the "Classroom of the Future"

December 9, 1994

Dr. Aaron R. Byerley
Associate Professor
Mercer University
Department of Mechanical and Aerospace Engineering

1. Introduction

While serving as a Visiting Researcher at the United States Air Force Academy during the Summer of 1994, I had the pleasure of spending an hour with Lt.Col. Chris Litherland of the Center for Educational Excellence (CEE). He took me on a tour of the **Network Classroom Laboratory** (originally called the "Classroom of the Future") and the **Computer Resource Room**. This is a report of my observations and impressions based on this brief visit. I have also attached the latest USAFA Network Classroom Lab Annual Report which goes into greater detail.

2. The Network Classroom Laboratory ("The Classroom of the Future")

a.) The Concept

The Network Classroom Laboratory (NCL) was designed in 1991 to help define how future classrooms and multimedia courseware will look and be used. The NCL opened for use in September 1992. The classroom is 28' x 43' and has 18 student work stations and a single instructor control console. The control console is based around an IBM PS/2 486 machine networked with the student workstations. The instructor has the capability for playing Laserdisk, CDROM, video, audio, and 35mm slides to two large screens and to the monitors on each of the student's desk. Additional technical details about the hardware and the classroom layout are shown in the attached NCL Annual Report.

b.) The Courseware

The courseware used in the NCL has come from both commercial and in-house sources. The commercial courseware used at the Academy spans the academic disciplines, from the humanities to the hard sciences and engineering. Examples are "Multimedia World History on CD" used by the History Department and *Mathematica* used by the Math Department to teach calculus including such advanced topics as 3D modelling and animation of complex equations. I found the integration of *Mathematica* into the Academy's curriculum to be particularly impressive. It is used in the follow-on core engineering courses to allow the cadets to perform "pseudo-research". Using *Mathematica* programs written by engineering instructors, the cadets are able to vary design parameters in an engineering system and then observe the simulated response. One example is the time response of the classic spring-mass system. When the cadet increases the viscous damping coefficient above zero, the effect is illustrated in an animated time response of the oscillating spring-mass system as it transitions from an underdamped response, to a critically damped response, and finally to an overdamped response. In my opinion, the animation illustrates the important link between calculus and engineering much better than the traditional method of plotting the mass position versus time. Not only does *Mathematica* extend the student's problem solving capability, it also helps to reinforce the fact that "calculus is the language of engineering".

Some of the NCL courseware has also been developed in-house and is part of an ongoing effort to be at the forefront of shaping the undergraduate "classroom of the future". The typical courseware development process begins with the teaming of the cognitive development experts from the CEE with individual department faculty members. The goal of this team is to develop department-specific courseware that will enhance or enrich a particular aspect of an existing course. The individuals from CEE are also experts in the use of *Tool Book*, a courseware authoring package. This seems like a rational approach to overcome the learning curve and reduce the time costs associated with courseware development. An example of in-house courseware is a multimedia package which helps cadets enrolled in a core thermodynamics class to learn about the turbojet engine cycle. The package includes pictures of jet engines, thermodynamic process representations, and an interface which allows the cadets to perform a design optimization.

c.) Assessment of the NCL / Courseware Effectiveness

The CEE personnel are performing assessment studies to measure the effect of providing these new academic experiences. These studies have not yet been published but the early indication is that the results are mixed. In a comparison with control groups, the NCL cadets scored about the same on standard exams (those that are sometimes oriented towards memorization). However in oral or written exams that tested understanding or synthesis of ideas (essay questions), the NCL cadets seemed to do better. The NCL is also equipped with a one-way mirror for candid observation of cadet activity. Anecdotal evidence suggests that the NCL experience is enjoyable for both instructor and student. However, instructors report that the time required to prepare for a presentation in the NCL is much greater than for a typical classroom presentation.

3. The Computer Resource Room

While the main reason for my visit was to learn more about the NCL, I was able to see another first-rate facility available to Faculty who have innovative ideas for course enrichment. The Computer Resource Room had just about every piece of hardware and software imaginable which might be useful in an educational setting. Hardware included Multimedia PC's, MAC's, Scanners, Plotters, and Color Printers. Software included all types of applications packages for both the PC and the MAC platforms. While my visit was during the summer time, the room was still getting a lot of use.

4. My Impressions

a.) An Exciting Testing Ground for Educational Technology

I was extremely impressed by the NCL and the possibilities for innovative presentation of college level material. The Academy is spending a lot of time and money to develop this new educational concept. We should follow their progress closely and adopt those elements which they find extremely beneficial. While it might not be practical to match the NCL's layout, hardware and software (as well as the two full time technicians), developing a scaled down version that accomplishes the high value activities probably is practical.

b.) "Doing Means Understanding"

When the assessment results are published, I expect the value of the courseware will be proven. With the multimedia courseware that I saw, the cadets were able to interact in a very real way which supports the cognitive notion that "doing means understanding". I think that it is important to remember that the NCL is intended as an "enrichment" supplement rather than a replacement for traditional classroom instruction. Perhaps in the future, the percentage of time spent in the NCL type of classroom will increase.

Moving in the direction of the Academy's NCL will be made easier with the continued development of courseware products by the commercial sector such as Wiley/Smart Books' *CD Calculus for Windows* and *Schaum's Interactive Outline of Fluid Mechanics*. According to Schaum's literature, their program "provides students with both basic theory and a supply of solved problems with which to experiment and interact with the application of theory. The use of *Mathcad* and 'Live Math' allows every number, formula, graph, and equation to be available for experimentation." This sort of opportunity for course enhancement is exciting.

c.) A Platform for Teaching Advanced Applications Packages

Computer-based classrooms like the NCL are important for teaching advanced applications packages, as mentioned in the attached NCL Annual Report. According to one member of the Mercer's National Engineering Advisory Board who spoke at a recent faculty meeting, the environment of professional engineering practice has undergone revolutionary change. One very capable engineer is now doing the work formerly accomplished by four or five engineers. This cost-cutting measure has been made possible by the computer and sophisticated software. The "drudge work" performed in the past by lower level engineers is now performed by a single more talented engineer who is capable of using computers and application packages for drafting, solving math problems, creating slide shows, plotting technical graphs, performing finite element analysis, etc. The creative aspect of engineering practice is enhanced by the ease with which these computer tools can solve problems. An NCL-type classroom lends itself well as a teaching platform for advanced applications packages.

5. Summary

The Academy is doing some exciting exploratory work in the area of educational technology. The rest of us in academia should follow their progress carefully and look for ways of targeting our investments into the "high payoff" areas. We should also seek opportunities to use commercial courseware packages that enrich the learning process. Finally, we should continue to seek improvement in how we teach the important engineering-related computer applications packages such as word / equation processing, spreadsheets, drafting, math solvers, etc. This includes the appropriate integration of these computer tools into the curriculum. We can use the insight gained from observing groups like the CEE to develop our own enhancement objectives.

6. For More Information

For more detailed information, please see the attached Annual Report, particularly the Executive Summary on page 3. This attachment describes the hardware, software, management, support, and evaluation of the effectiveness of the NCL.

NETWORK CLASSROOM LAB

THE UNITED STATES AIR FORCE ACADEMY
DEAN OF THE FACULTY

NETWORK CLASSROOM LABORATORY
1992-1993 ANNUAL REPORT

APRIL 1994

Prepared By:
The Directorate of Education

PREFACE

This report covers the first full year of use of the United States Air Force Academy (USAFA) Network Classroom Laboratory (NCL), Fall 1992 through Fall 1993. It is written to provide the USAFA faculty and staff with information on what was done in the NCL during the year, but more important, what has been learned from the use of the NCL to experiment with different learning and teaching situations.

To provide information to the educational community in general, this report is also available to anyone interested. The USAFA Directorate of Education (HQ USAFA/DFE) welcomes comments and questions pertaining to this report or the NCL. Inquiries can be made to the address, phone number, or Internet address given below.

The Directorate of Education gratefully acknowledges the support and assistance of the following organizations and individuals within these organizations for helping acquire, install, and operate the NCL. They helped make this first year a success and we look forward to continuing our work with them.

The Dean of the Faculty
USAFA Academic Departments and Staff Agencies
USAFA Contracting Offices
54th Civil Engineering Squadron
USAFA Education Visuals
IBM Federal Systems Company

HQ USAFA/DFET
2354 Fairchild Drive, Suite 4K25
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EXECUTIVE SUMMARY

This report documents the first year of operation of the USAF Academy Network Classroom Lab. Those readers desiring descriptive information on the NCL and lessons learned on software, hardware, and network management should review Sections II, V, and VI. Those interested in educational activities conducted in the NCL and observations made should concentrate on Sections III and IV.

In developing and installing the NCL, it was anticipated that this advanced technology-based learning environment would be beneficial in providing instructors and students the opportunity to learn how to use hardware and software in classrooms. It was also anticipated the NCL would facilitate the achievement of higher levels of cadet learning involving visualization, problem solving, and cooperative/collaborative work. In general, these assumptions were confirmed during the period covered by this report. Section IV relates information on these areas.

The NCL has been used on a variety of levels, from basic instruction on software to employing specially developed multimedia courseware, including network applications. At least anecdotally, the NCL has proven effective across this range. Specific evaluation of these areas is underway at this writing and will be reported on in the future.

Several courses employed software in the NCL to provide visualization of complex concepts, calculations, and relationships. These also were easily accomplished and well received by the faculty and students. *Mathematica* software used in teaching calculus, employed three-dimensional modeling and animation of complex equations. Although final analysis of the success of these courses is incomplete, faculty and student feedback is positive. Instructors and students generally reported working harder than in conventional classes. Engineering and other technical courses reported positive experiences in using the NCL for visualization to enhance learning when using computer aided design, analysis, and simulation software.

Problem solving applications employed in the NCL were successful, although the specific courseware and instructor techniques seemed to be the primary factors for this success. The NCL provided a comfortable and efficient environment to use courseware designed for problem solving. The instructor's physical access to students and ability to give clearly projected, easy to read examples on the NCL projection screens were noted.

Several collaborative/cooperative learning situations were employed in the NCL, with the courseware and instructor again being the primary factors in reported successes. Collaborative efforts such as group discussions, peer editing, and team writing exercises were done in English literature and writing courses. Instructor feedback cited improved class participation, thought processes, and writing skills as benefits of the capability to monitor and save the students' interactions on the network. Team problem solving in engineering classes also proved successful, with the software applications providing the stimulus and forum for the team approach. In these uses, the NCL again seemed to contribute a comfortable, efficient environment.

The NCL has definitely provided a unique and successful environment for learning, but its uniqueness has slightly detracted from the learning process in a few situations. The first time a section met in the NCL, students were distracted by the new environment, slightly inhibiting lesson completion time. The more an instructor or section of students used the NCL, the less negative effect the uniqueness had.

Instructors using the NCL reported more preparation time required versus conventional classroom lessons. Extended use of the NCL reduced this effect, but not completely. The added workload seems appropriate when undertaking any new learning method, and may be offset with the efficiencies and additional capabilities available in the NCL.

More detail on instructor and student experiences will be found in Section IV.

Future documents will report on evaluations of courseware, teaching methods, and technology employed in the NCL.

OVERVIEW OF THE NETWORK CLASSROOM LABORATORY

PURPOSE:

The NCL, which was initially called "The Classroom Of The Future," is a laboratory for the faculty to develop and apply a variety of teaching and learning types, employing technology where appropriate. Efforts conducted in the NCL will help define how future classrooms and courseware will look and be used. The future may include the use of notebook computers, interactive multimedia, and networks in many more classrooms. What is learned from evaluating the experiences in the NCL will be used to make decisions about future hardware and software buys and also for faculty development to meet the educational systems and methods of the future.

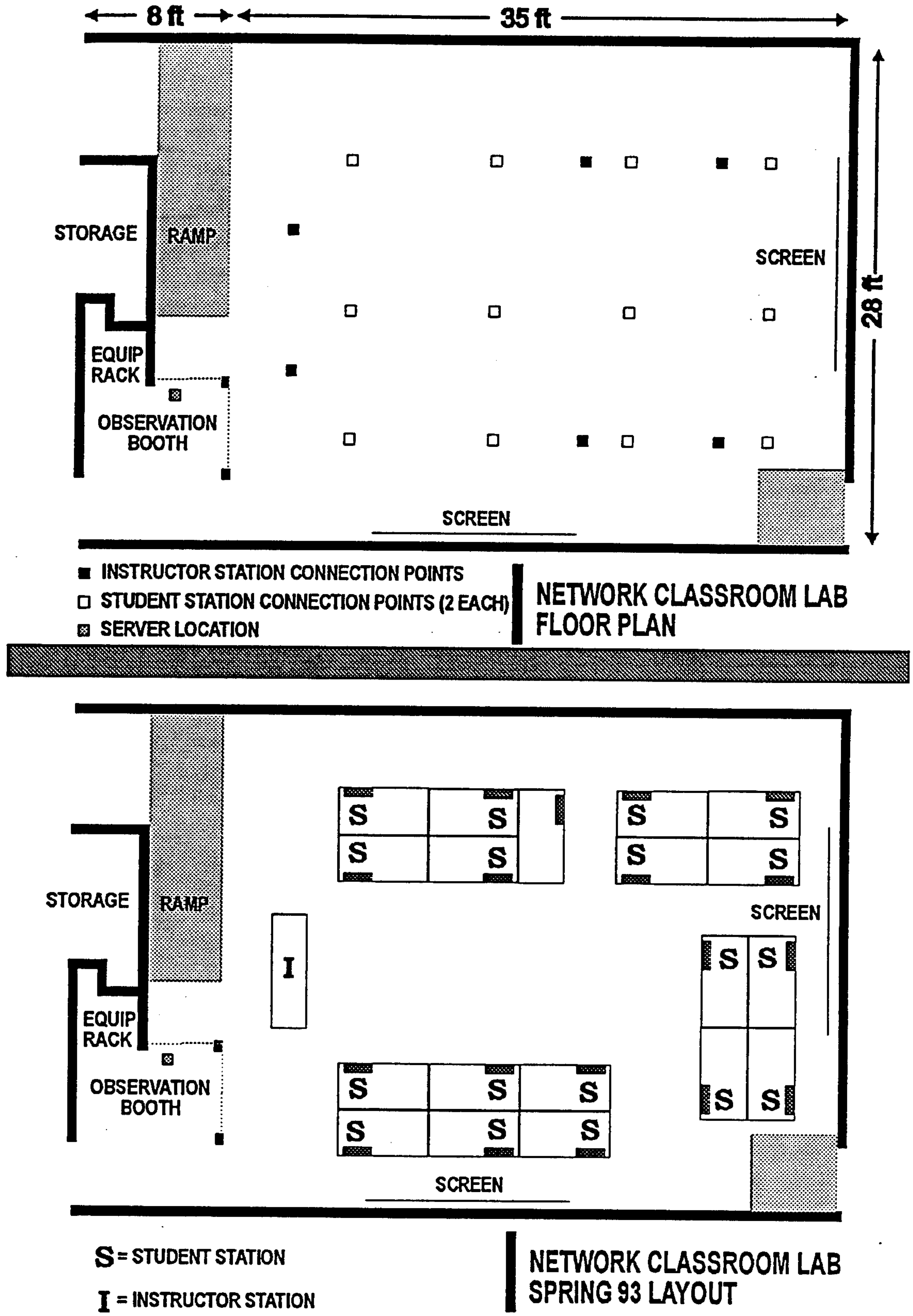
HISTORY:

The concept for the NCL was developed during 1991-1992 through literature and advertisement research and discussions with corporate venders. Contract definitization and award occurred in the first half of 1992, with IBM Federal Systems Company the prime contractor. Classroom modification and installation started in mid-July 1992 and concluded within three weeks. Software and hardware de-bugging and final acceptance were completed in September 1992. Classes first began using the NCL that same month.

NCL DESCRIPTION:

The NCL, room 4J17, Fairchild Hall, includes twenty IBM PS/2 386 Ultimedia Student Stations networked with an IBM PS/2 486 instructor station and another 486 server. Multimedia projection (two three-gun projectors) of a variety of video sources to large screens and distribution to student monitors is possible. Installed MS-DOS, OS/2, and *Windows* software, in combination with the physical flexibility and capability of the room, allow employment of a variety of courseware and learning environments. *Windows* applications such as *Word, Excel, Mathematica,* and *PowerPoint* are currently installed. The NCL has an observation booth which houses the electrical and electronic equipment and can be entered from the hallway without disturbing the class in session. The observation booth has one-way glass panels looking into the classroom.

The floor plan for the NCL and the current layout of the student and instructor stations is shown in Figure 1. This most used layout was developed for the Spring 93 semester. The arrangement of student stations allows space for the instructor to move freely behind the students to observe or assist. The instructor can also direct the students' attention to the center of the room or to the two screens, either of which can be seen from any of the student stations. The instructor station was moved nearer to one of the screens on a trial basis during the Fall 93 semester, and it has been effectively used there. Additional rearrangements are planned to optimize the functional arrangement of the NCL.


8 ft
35 ft
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RAMP
EQUIP RACK
OBSERVATION BOOTH
SCREEN
SCREEN
INSTRUCTOR STATION CONNECTION POINTS
STUDENT STATION CONNECTION POINTS (2 EACH)
SERVER LOCATION
NETWORK CLASSROOM LAB FLOOR PLAN
STORAGE
RAMP
EQUIP RACK
OBSERVATION BOOTH
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SCREEN
S = STUDENT STATION
I = INSTRUCTOR STATION
NETWORK CLASSROOM LAB SPRING 93 LAYOUT

FIGURE 1

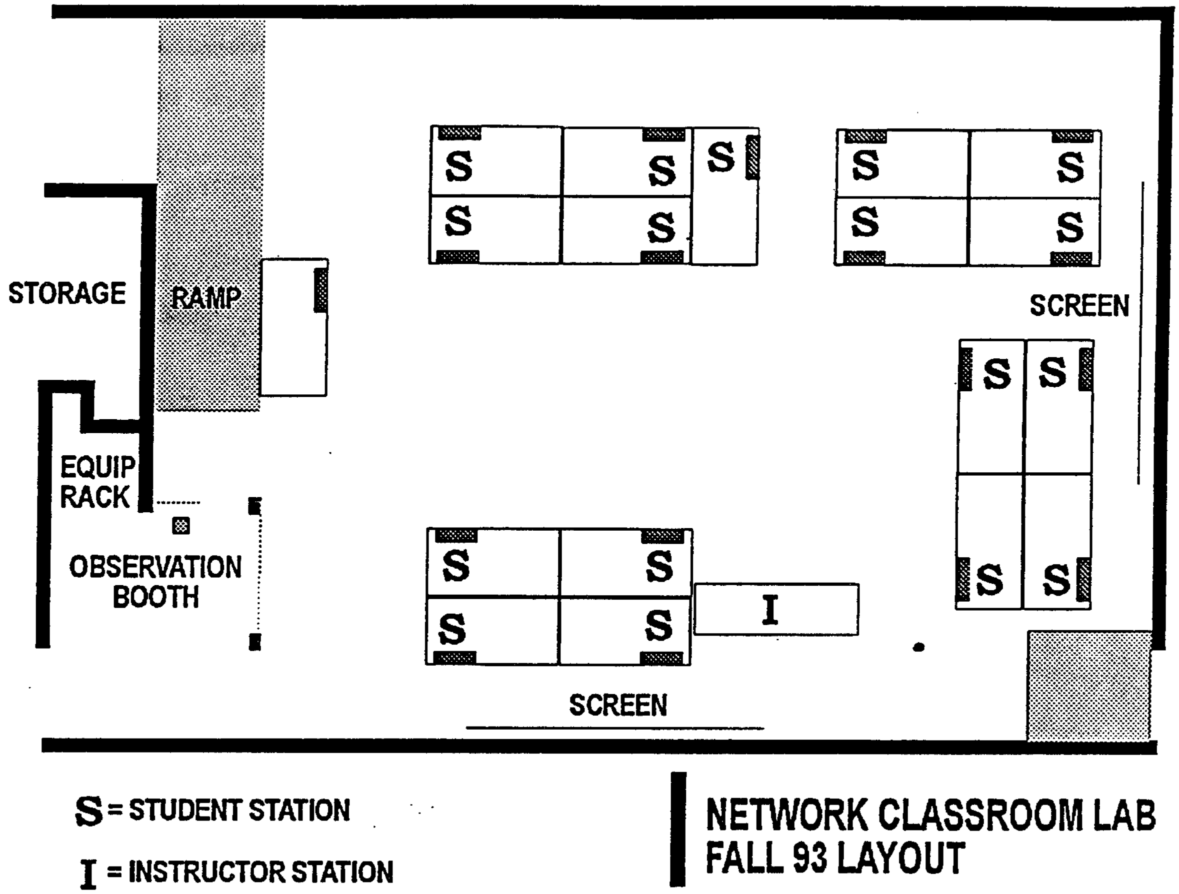


FIGURE 1 (continued)

EDUCATIONAL ACTIVITIES CONDUCTED

DESCRIPTION OF CLASSES INVOLVED

The following USAFA departments have conducted classes (one or more sessions) in the NCL during its first year of operation:

Political Science	Engineering Mechanics
Management	Civil Engineering
Law	Astronautics
Economics & Geography	Physics
History	Aeronautics
Foreign Languages	Computer Science
English	Mathematical Sciences
Behavioral Sciences/Leadership	

The classes conducted by these departments range from a single class session to multiple full semester-long courses. Many of these were experimental sessions testing software for wider application in the curriculum.

Additionally, the following non-class activities have been conducted in the NCL:

- Several departments have used the NCL to give training sessions or presentations on various software packages to their faculty members

- The Physics department hosted two summer workshops presented by University of Nebraska teams which taught collegiate Physics instructors how to use digitized video and computer algebra software to teach undergraduate physics.

- The Directorate of Education held strategic planning sessions in the NCL, using some of the word processing and conferencing software.

- An end-of-semester discussion on the NCL experiences of instructors was conducted in the NCL using the *Daedalus* conferencing software.

BASIC NCL USES:

The basic uses of the NCL were single-period sessions conducted by several departments. These were usually sessions where department-developed or acquired software applications were presented to the students from the instructor station on the large screens. The students were able to try the same software on their stations reinforced by directed performance exercises, with the instructor roaming the room to assist them. In some cases, use of the software was taught at a familiarization level, but in other cases, the goal was to have the students learn the software to be able to use it in departmental courses throughout the students' time at the academy.

Another basic use of the NCL which grew rapidly during the final weeks of the Spring 93 semester was student multimedia presentations. History, Engineering, and Management classes held such sessions. These presentations included the integrated use of document camera, videotape, and digitized still pictures, and were mainly final project reports. The Management classes had students brief their peers on common types of software (word processing, spreadsheet) which they might encounter on the job in the USAF or a civilian career.

ADVANCED NCL USES:

The more advanced uses of the NCL employed DFE developed or department acquired software for several lessons or more, including full semester use. Examples of such uses were:

- English Literature and Writing classes used *Daedalus* software throughout the semester for networked peer editing, collaborative work, and discussion sessions which were monitored or actively joined by the instructors from the instructor station. These sessions were saved on disk so students could retain copies for studying or preparing other assignments. The instructors also could save these sessions for portfolio-type grading and feedback to students on writing skills and class participation.

- Economics classes used network software that simulated various economic scenarios such as retail markets, stock markets, and monopolies to test the effects of these simulations on learning. Students working in these simulations were either interacting with the computer or each other.

- Engineering courses employed locally developed computational enhancement software to put student teams in problem solving scenarios aimed at improving understanding of engine cycles and open-ended problem solving skills.

- History classes used locally developed and commercially acquired software in teaching the history of Air Power in World War I. This included videotape, a data base of articles and photographs, and aircraft simulation software.

- Freshman and sophomore level calculus classes used the commercial software package *Mathematica*. This powerful software enabled three-dimensional visualization and animation of graphs. The students will be able to use this software in advanced courses in math, physics, and engineering.

- The Aeronautical Engineering Department conducted experimental sections of a design course using *PowerPoint, Quattro Pro, Panda* (airfoil analysis and graphing), and two locally developed software packages for designing and analyzing airfoils and aircraft. These software packages were employed by both instructors and students in problem solving, class demonstrations, and graded presentations.

- The History Department used the *Air Power* multimedia database software developed on contract for USAFA. This collection of 45 multimedia articles and 250 text articles, with its unique navigation and support tools, was used by senior-level students studying World War I. All capabilities of this software application, including the digitized audio and video, were delivered over the NCL network to multiple student stations using software decompression.

OBSERVATIONS BY THE DIRECTORATE OF EDUCATION

To date, the activities conducted in the NCL have provided valuable information on the management of the NCL or similar classrooms. Experiences of faculty members and DFET staff have confirmed our pre-NCL beliefs that such a classroom would provide improved or innovative opportunities in the areas of visualization, cooperative and collaborative learning, and problem solving in group or individual exercises. The instructors and students who have used the NCL and visiting educators who have toured the facility have been enthusiastic about its capability.

To better analyze the value of this type of classroom or elements of it, the USAFA Directorate of Education is developing short and long range plans to conduct structured evaluations of as much of the NCL operations and learning situations as possible. Evaluation is in progress and will be reported on in future documents.

EDUCATIONAL LESSONS LEARNED:

The following qualitative appraisals of the activities conducted in the NCL to date have been garnered from DFET's management of the NCL and discussions with instructors and students who have used it.

BASIC NCL USES:

For basic class lessons taught in the NCL, such as the training of students on how to use software packages:

- The NCL works very well in a software "training" role, where the instructor demonstrates the software on the dual large screens and the students can simultaneously use the software at their stations. The multimedia equipment, which has been previously used in IBM computer training environments, is well suited for this.

- There is a slight to moderate amount of lost time incurred the first time a class meets in the NCL, as the students are distracted by the new, comfortable environment, equipment, and furnishings. This can be even more detrimental if the NCL use is only one period long and the instructor plans a lot of content. To minimize such losses, DFET attempts to have the instructor and student machines completely up and running, with network log in done in advance (if needed) to shorten administrative time and immediately start the lesson on the particular software involved.

- The NCL has been used very effectively by students to do software demonstrations (management classes) and multimedia briefings (senior projects and history courses). The students very quickly learned to make and present high quality *PowerPoint* briefings, interwoven with document camera, videotape, graphics, scanned images, hand-drawn diagrams, and clip art. The demand for use of the NCL grew rapidly at the end of the spring semester, as students who were working on *PowerPoint* briefings needed a place to develop their briefings as well as present them. As more students and instructors learn the ease and quality of this software, computer display capability in other classrooms and lectinars will be needed.

- General comments on critiques and in discussions with students and instructors showed positive experiences in the basic training or multimedia presentation use of the NCL.

ADVANCED NCL USES:

For more advanced use of the NCL, such as employing the network for discussions, collaborative work, economic simulations, and semester-long NCL use:

- Students and instructors quickly assimilate the routine procedures of logging into the network, accessing software and files from the server, and controlling the multimedia sources. We have refined the procedures, automated some, and conveniently posted checklists to minimize the time involved in these tasks, not because they are difficult, but because any time taken from a 50 minute period for non-lesson related activities can be detrimental. The two Educational Technology airmen who manage the daily operations of the NCL have been instrumental in making the instructor and student access and control activities in the NCL more efficient.

- Students and instructors who use the NCL frequently contact the NCL managers with ideas or questions on more advanced uses of the NCL equipment and software, especially those who are more familiar with the *Windows* environment. Students have begun importing graphics and text from one set of software to another, prompting questions on how to perform such operations more efficiently. Instructor inquiries about accessing the document camera or videotape more easily resulted in DFET finding effective hardware or software solutions. The result has been a simple "**ALT-TAB**" switching from software applications such as *Mathematica* to the document camera, videotape, or CD audio.

- In summary, good critiques have been received about the NCL environment, the courses taught there, and software use in learning. In at least one English class which used the NCL for about half of the semester lessons, a clear majority of the students answering a mid-term critique open-ended question listed the NCL as the thing they liked most about the course.

PEDAGOGICAL APPLICATIONS:

- The NCL greatly benefited problem solving exercises. Several classes employed the NCL to do a range of team and individual problem solving. In these instances, software was a tool and the instructor became a coach helping the students use that tool.

- The NCL also proved beneficial in collaborative or cooperative learning situations. This was proven true in such uses as the English classes and the Engineering 310 courses.

-- Using *Daedalus*, the English classes had students discuss questions about such things as novels, paintings, USAF regulations, and music videos in small and large groups.

-- These classes also did peer editing of cadet papers on the student stations.

-- The engineering software developed by DFET also worked well in the NCL for small (2 to 3 person) team work. The NCL provided a convenient and efficient environment to use this software. Analysis of exam results show benefits from the software and methods used in these classes.

-- The NCL did provide better quality projection and ease of instructor movement about the classroom than conventional computer labs.

- A third area that the NCL met early expectations was in simulations. From using commercial flight simulator software to augment and personalize the study of Air Power development in World War I and Aeronautical Engineering; to economics and motion simulations, the NCL proved it could make instruction more student centered, visual, and efficient.

-- Engineering Mechanics classes used ASDEQ (differential equation solver) to model dynamic pendulum and mass spring motion. The instructor started the lesson by showing a video of a test flight of the YF-22 to exemplify the need for simulation. The ease of switching between the video, software, and physical demonstrations in the NCL was evident.

-- Economics classes used interactive simulations to give students a realistic picture of how different market structures operate. For example, students had to decide as an independent firm in a perfectly competitive environment how many units of their output they needed to produce and what price they could charge in order to maximize profit. The NCL network allows these simulations to be monitored by the instructor and individual student results to be easily presented to the rest of the class.

- The NCL was used by the English departments for technical writing, basic writing, and literature. Data collected from these classes is being analyzed, including blind scored essay comparisons with non-NCL classes. Reports will follow.

- Most classes held in the NCL, from one time sessions to full-semester use, resulted in favorable comments from the students. They liked the differences from conventional classrooms, the use of technology, and the software applications.

INSTRUCTOR EXPERIENCES:

Concerning the experience of instructors using the NCL, DFET has learned the following from discussions and feedback:

- The instructors apparently have easily learned and operated the systems of the NCL, as no criticisms concerning complexity or difficulty have been heard. Those questioned have commented that everything has been going well in this regard.

- Instructors who have used the classroom frequently ask to use it again in the same or following semester or to bring other sections they teach into the NCL.

- The NCL schedule rapidly filled for the Fall 93 term. Instructors who wanted to use the NCL all semester filled 11 of 14 available periods. This made it difficult to honor requests from potential 1 or 2 lesson users. We attempted to resolve any such conflicts to the best benefit of all requesters, as is done with other limited classroom, lectinar, or laboratory assets.

- Instructors who teach in the NCL report increased preparation time for each lesson. Some instructors have observed that the increased preparation time is similar to teaching a new course or lesson. To take full advantage of the NCL capabilities would logically require some additional planning and practice. Also, preparation time should decrease with the number of lessons taught in the NCL, especially repeat lessons using the same software. One area of NCL evaluation which could be pursued would be to weigh any efficiency gained by using the technology available in the NCL against this increased preparation time. More material might be covered in certain disciplines by employing computation enhancing or other software applications.

- After more than a year of use, DFE has received many suggestions for more such teaching environments. Many instructors wish they had at least a computer with a large monitor or projection display in more classrooms. USAFA instructors are getting more capable computers (486s) in their offices and therefore access to *Windows* and *Windows* applications, such as *Mathematica* and *PowerPoint*. As the instructors get more advanced machines and the resultant access to better software and the campus-wide USAFAnet, the demand for computer displays in the classroom should grow. Also, the desire may increase for USAFA cadets to have notebook computers to carry into all classrooms. The NCL is designed to prepare for this future.

NETWORK USES:

- The NCL network can be used to quickly load a file from any station to the server and thus have the file accessible to all other stations. This allows the instructor to download a lesson plan so the students can see it on their terminals during class or take it with them for homework or studying purposes. The instructor can have the students transfer a completed assignment and collect them electronically.

- The *Daedalus* software allows an extension of this file sharing benefit. In *Daedalus*, all of the discussion which took place during the period can be downloaded onto disk by all the students so that they can review everything which was "said" during class, including discussions from groups other than their own. The instructor can likewise save these files and use them for grading purposes. One instructor using *Daedalus* in an English class, developed *Word* macros to sort the comments and conversations by student to have portfolios for grading, measuring lesson goal accomplishment, and assessing class participation.

INSTRUCTOR LESSONS LEARNED:

- Those instructors who conducted trial classes in the NCL in advance of teaching a block or full semester in the NCL were able to identify pitfalls and benefits to capitalize on in their subsequent efforts. This was seen in all areas, such as software, teaching techniques, operating the instructor station, and timing.

- Conversion from non-computer based lesson plans to NCL lesson plans was apparently not too difficult, but did require more time to prepare for classes.

- Some English instructors noted that the students having to type comments (rather than have oral discussions) seemed to make the students think more about their responses during discussions.

- English instructors found that the network discussions stimulated participation of some students. Those who might have been timid about discussing things orally may have been drawn into the electronic conversations because they could write their comments, proof them, and then send them into the discussion. The *Daedalus* software also allows anonymous conversation capability, with even the instructor not knowing who made which comments.

- The Economics instructors noted that using the NCL 4 or 5 times during the semester provided a good mix with conventional classroom instruction, because it created a sense of adventure coming to the lab without sacrificing needed chalkboard and regular classroom time.

- Some of the English department use of the NCL and *Daedalus* showed that the instructor input during the class sessions was less than in a conventional class. They found it harder to monitor the quality of discussion while that electronic discussion was in progress. This was also found during the post-semester discussion DFET conducted using *Daedalus* in the NCL with some of the NCL users.

- One comment made by an English department user of the NCL was that it "democratized" the classroom by making the boundaries between student and teacher "fuzzier," because student participation increased.

- In using computer based courseware in the NCL, the instructor's role seems to evolve to being a coach, walking around the NCL asking and fielding questions. Engineering Mechanics also noted that software use allowed each student to control how fast they learned or at least saw the material, as well as to what depth they desired to go into the material. This relates to a vision in DFE of how the future of education may be, where technology can help students navigate the vast amount of knowledge that will be available to assimilate and apply.

- One instructor noted that software such as *Daedalus* changed the way students communicated and simulation software changed what the students could talk about in the classroom.

- An observation from some English instructors was that the *Daedalus* conference mode did have some advantages as mentioned above, but in some cases was a poor substitute for face-to-face discussions. It does have advantages in peer editing and collaborative work and would definitely be an asset for conducting classes over USAFAnet.

- Another implication of USAFAnet access in the NCL or other classrooms would be the wealth of information available through Internet and other such networks.

- Collaborative work in the NCL versus a conventional classroom is slightly different. In a conventional classroom, the students can be divided into groups to discuss a topic and then report their conclusions orally or by hard copy to the teacher or class. In the NCL, using *Daedalus*, all the students can get a file of all the conversations. The use of electronic discussions also seems to slow group discussion progress, but the discussions seem to be more in depth than those of conventional classrooms.

- The Economics Department envisions more extensive use of the NCL or similar facilities to conduct even more involved simulations. Student inputs to a scenario would effect the data and decisions of other students--a more dynamic situation.

- Instructors who have used the NCL, and the DFE staff, are concerned about the scheduling of the NCL in the future, as more instructors wish to use it and more computer based courseware is developed or purchased. Methods and policies may need to be developed to ensure equitable distribution of NCL use.

CLASSROOM MANAGEMENT

Management of the NCL is the responsibility of the Directorate of Educational Technology (HQ USAFA/DFET). One officer director and two enlisted programmers perform the duties needed for daily operation, training of faculty, direct or call-in maintenance tasks, conducting tours, installing and managing software, and all other related items. Maintenance on most components was covered by warranty the first year after installation, and is now included in standard computer and audio-visual systems contracts or internal maintenance arrangements.

Normal daily operations and maintenance workload is minimal, requiring approximately 10 to 20 minutes startup and shutdown time, and only a few minutes between some classes to switch certain software.

The DFET team learned much about all levels of managing the NCL during its initial year of operation. Some of the more significant items are described below.

SCHEDULE:

The NCL schedule was developed by sending out a request each semester for departments or instructors to provide proposals for using the NCL during the next semester. The periods requested in these proposals were de-conflicted and established on the master schedule (Appendix 1). During the semester, instructors could sign up for any vacant periods. The schedule became full at the end of the Spring 93 semester, particularly due to senior projects and design classes doing final presentations. The schedule for Fall 93 was rapidly and almost completely filled by requests to use the NCL for full-semester course offerings. No solicitation was made for summer academic use of the NCL, but it was used extensively by two Physics Workshops and several summer courses. Solicitation will be made for summer use in the future.

HARDWARE MANAGEMENT:

Few maintenance problems were experienced with the computer equipment. One three-gun video projector needed focusing several times during the year due to a component deteriorating, and the component was eventually replaced.

The computer units (not the monitors and keyboards) were moved below the desks during the first few months of use to make it easier for the students and instructor to see each other.

The need to upgrade the RAM or 386 processors was identified by the performance experienced when using multimedia and complex software applications. Funding was secured to double the student station RAM to 16 MB and increase the instructor station RAM to 24 MB. This was installed in the Fall 93 semester, with noticeable performance improvement.

SOFTWARE MANAGEMENT:

The NCL computers were initially loaded with DOS, *Windows*, and OS/2 in a dual-boot arrangement allowing either operating system to be used. At the end of the spring semester, OS/2 was removed from the student machines to allow more disk space for higher demand *Windows* applications such as *Mathematica*. If the newer versions of OS/2 fully support *Windows*, the *Educator 2* presentation software loaded on the instructor station, and software used by the departments, we plan to reinstall OS/2 to re-explore the video, networking, and multi-window capability available. If there are difficulties, we will look for or develop *Windows* applications which can perform some of these functions.

We had only a couple of very minor occurrences of viruses in the NCL--especially considering the number of students who bring in diskettes to copy their work. Viruses were quickly removed with anti-virus software.

NETWORK MANAGEMENT:

Because we have learned more about using the LAN Manager capabilities, we have begun placing software applications on the server rather than the individual student hard drives. This can decrease the number of copies of software that must be purchased, since some classes do not have twenty students. Sections of the server hard drive are partitioned for each course and passwords for 20 students and an instructor are set up. Student stations access the particular application and associated files from the server. We have not found any significant degradation in speed of using an application with this arrangement. It has freed hard disk space on the student stations and has made loading new applications or updates easier. The Fall 93 semester provided a thorough test of this arrangement, and it performed well, even with digitized video and audio being transmitted over the network to multiple stations.

The NCL was connected to the USAFA campus-wide USAFAnet over the Christmas 93 break. The Banyon-VINES network management software replaced the IBM LAN Manager software. Activation of all USAFAnet capabilities is being completed as of this writing. E-Mail, Internet access, and capabilities to access instructor and student personal and departmental drives are already in use.

MULTIMEDIA DISPLAYS:

The NCL has been a valuable testing ground for the projection of multimedia, including computer screens, digitized video, videotape, laser disc, document camera, and CD-ROM.

When the video projection equipment was installed in the NCL, we found the size of the three-gun projected image (so that every student could see the full image) was limited by the ceiling and the height of the students' heads when seated near the screen. This determined the location of the three-gun projectors. These projectors have proven better than large screen monitors because as big a picture as possible is needed when displaying tables of numbers and graphs.

Another aspect of projection in the NCL is the classroom lighting. The current fluorescent lighting does not hinder use of the student terminals, but because of the standard pattern of light fixture location, all but one of the eight sectors are usually turned off to provide best viewing of both large screens. Light in the room is still adequate to see all the students in this situation, but we installed desk lamps to give the students more light to take written notes or reference their texts when the room lights are out. The lighting on the white boards in this same situation limits the number of boards usable for easy viewing. We are looking at wall-directed and other lighting to remedy these minor problems.

FUTURE PLANS

Based on our experiences during this first year of operating the NCL, we have several areas of improvement, evaluation, and experimentation we plan to undertake in the short and long range future. Some of these have been mentioned previously in this report.

HARDWARE AND SOFTWARE UPGRADES:

HARDWARE:

If funding becomes available, a 486 processor upgrade or new computers for the student stations will be purchased.

A cabling and switching means to allow the two projectors to display different sources is being explored. The cost and ease of making such a modification versus the benefits of the additional capability needs to be analyzed.

SOFTWARE:

The latest version of OS/2 has been tested in the NCL and appears to support most *Windows* applications. If testing continues fruitful, we will try installing it on all machines and ask instructors to experiment with conducting class under OS/2 to take advantage of some of the additional audiovisual control and transfer capability and the questioning/polling functions. If these tests prove the capability too unwieldy, DFET will explore other software packages to gain more instructor station capability.

EVALUATION:

To date, evaluation of the NCL has been at a fairly superficial level. Discussions with instructors and inputs from student critiques have been reported in previous sections of this report. A visiting professor and graduate degree candidate have been brought into DFE to help plan and conduct evaluation efforts in the NCL as well as the other areas of USAFA curriculum.

Evaluation efforts in the NCL will be in keeping with the overall objective of the NCL, that is, to provide the faculty with information on how all the elements of the NCL environment, individually and in concert, effect the learning process. DFE is looking for specific areas to evaluate in addition to the feedback which will be gathered from the normal critiques and discussions.

Results of any evaluation efforts will be published to the faculty, not just as lessons which can be learned about the NCL, but items which are relevant to technological applications that can be applied to the USAFA learning and teaching processes as a whole.

EXTRAPOLATION TO THE FUTURE:

The lessons learned and faculty inputs derived from operating, maintaining, and evaluating the NCL activities will be applied to recommendations for future cadet computer buys, software acquisition and development, and multimedia equipment installations in the classrooms, labs, and instructor offices at USAFA. Familiarization and training of faculty and cadets on hardware and software in general could also benefit from what is learned in the NCL about specific applications of interactive multimedia and computer based education.

CONCLUSION

The aim of this report has been to provide the reader with a variety of information on the USAF Academy Network Classroom Laboratory, from basic description of the NCL to pedagogical lessons which could be applied to similar environments and to the future of education in general.

Future reports will deal with the results of specific evaluations of activities in the NCL.

This facility is truly a laboratory which can help prepare this institution and its faculty and staff to make decisions about employing technology to benefit education, while recognizing that using such technology may not always be appropriate, economical, or practical.

If there are any questions or suggestions about this or future reports or the NCL, please contact DFET.

SCHEDULE EXAMPLES

The following are example schedules from the past semesters of NCL use. They show the variety of courses and extent of use of this facility.

NETWORK CLASSROOM LAB

JANUARY 93 SCHEDULE

as of: 20-May-93

TIME	PERIOD	Mon Jan 4	Tue Jan 5	M-1 Wed Jan 6	T-1 Thu Jan 7	M-2 Fri Jan 8	PERIOD	T-2 Mon Jan 11	M-3 Tue Jan 12	T-3 Wed Jan 13	M-4 Thu Jan 14	T-4 Fri Jan 15
0630-0750	GR						GR					
0800-0850	1			LAW		LAW	1		LAW		LAW	LAW
0900-0950	2						2				POLI SCI	TOUR
1000-1050	3				ENGLISH		3	ENGLISH		ENGLISH		ENGLISH
1100-1150	4				ENGLISH		4	ENGLISH		ENGLISH		ENGLISH
1300-1350	5						5	EM PREP?	Math Tour	EM PREP?		
1400-1450	6						6	EM PREP?		EM PREP?		PHYSICS
1500-1550	7						7	EM PREP?		EM PREP?	POLI SCI	
1600-????	AFTER						AFTER	EM PREP?		EM PREP?		

TIME	PERIOD	Mon Jan 18	M-5 Tue Jan 19	T-5 Wed Jan 20	M-6 Thu Jan 21	T-6 Fri Jan 22	PERIOD	M-7 Mon Jan 25	T-7 Tue Jan 26	M-8 Wed Jan 27	T-8 Thu Jan 28	M-9 Fri Jan 29
0630-0750	GR						GR					
0800-0850	1	H	LAW		LAW		1	LAW	DFEM	LAW		LAW
0900-0950	2	O	LAW			ASTRO	2	ECON PREP	DFEM	ECON		CE
1000-1050	3	L		ENGLISH	ASTRO	ENGLISH	3	ECON PREP	ENGLISH		ENGLISH	
1100-1150	4	I	DFEM PREP	ENGLISH		ENGLISH	4		ENGLISH	CE	ENGLISH	ECON
1300-1350	5	D					5	MATH PREP			ECON	
1400-1450	6	A				ASTRO	6	MATH PREP			ECON	GEN ROYER
1500-1550	7	Y					7	CE TOUR	DFEM			DFBL
1600-????	AFTER						AFTER	CE TOUR	ECON PREP			

NOTES: ENGLISH: Two 111 and two 211 sections will alternate use (English Department to de-conflict)
LAW: Four 320 and one 340 sections will alternate use (Law Department to de-conflict)

NETWORK CLASSROOM LAB — FEBRUARY 93 SCHEDULE

NETWORK CLASSROOM LAB

as of: 20-May-93

TIME	PERIOD	T-9 Mon Feb 1	M-10 Tue Feb 2	T-10 Wed Feb 3	M-11 Thu Feb 4	T-11 Fri Feb 5	PERIOD	M-12 Mon Feb 8	T-12 Tue Feb 9	M-13 Wed Feb 10	T-13 Thu Feb 11	M-14 Fri Feb 12
0630-0750	GR						GR					
0800-0850	1	ECON	LAW		LAW	DFBL	1	LAW		MATH243	Gen Royer	LAW
0900-0950	2	DFBL PREP			DFBL		2			MATH243	MATH243	
1000-1050	3	ENGLISH		ENGLISH	DFBL	ENGLISH	3		ENGLISH	MATH243	ENGLISH	
1100-1150	4	ENGLISH		ENGLISH		ENGLISH	4		ENGLISH		ENGLISH	
1300-1350	5			GEN ERDL		CONTR TOU	5	MATH PREP	UC TOUR		MATH243	
1400-1450	6			GEN ERDL	DFBL	DFBL	6	MATH PREP	MATH PREP		MATH243	
1500-1550	7			GEN ERDL			7					
1600-????	AFTER						AFTER					

TIME	PERIOD	Mon Feb 15	T-14 Tue Feb 16	M-15 Wed Feb 17	T-15 Thu Feb 18	M-16 Fri Feb 19	PERIOD	T-16 Mon Feb 22	M-17 Tue Feb 23	T-17 Wed Feb 24	M-18 Thu Feb 25	T-18 Fri Feb 26
0630-0750	GR						GR					
0800-0850	1	H	MGT	LAW		MATH243	1		LAW	JSACC	LAW	ASTRO STUDENT
0900-0950	2	O	MGT			MATH243	2	MATH243		JSACC		ASTRO STUDENT
1000-1050	3	L	ENGLISH		ENGLISH	MATH243	3	ENGLISH				ENGLISH
1100-1150	4	I	ENGLISH		ENGLISH		4	ENGLISH	ASTRO STUDENT	ENGLISH		
1300-1350	5	D		MATH PREP			5	MATH243				
1400-1450	6	A		MATH PREP			6	MATH243	ASTRO STUDENT			
1500-1550	7	Y					7					
1600-????	AFTER				OSR TOUR		AFTER					

NETWORK CLASSROOM LAB — MARCH 93 SCHEDULE

as of: 20-May-93

TIME	PERIOD	M-19 Mon Mar 1	T-19 Tue Mar 2	M-20 Wed Mar 3	T-20 Thu Mar 4	M-21 Fri Mar 5	PERIOD	T-21 Mon Mar 8	M-22 Tue Mar 9	T-22 Wed Mar 10	M-23 Thu Mar 11	Fri Mar 12
0630-0750	GR						GR					
0800-0850	1	LAW	ASTRO STUDENT	LAW	EM 320 PREP	EM-320	1	EM-320			LAW	S
0900-0950	2		ASTRO STUDENT			EM-320	2	EM-320	CE 485		CE 485	Y
1000-1050	3			ALO TOUR			3	ENGLISH	CE 485	ENGLISH	ENG 310	N
1100-1150	4			ALO TOUR	ENGLISH		4	ENGLISH		ENGLISH	CE 485	A
1300-1350	5						5	SPACE TOUR		CE 485	DEAN TOUR	P
1400-1450	6				EM 320 PREP	EM-320	6	CE 485 PREP	CE 485	CE 485		S
1500-1550	7		CDF TOUR			EM-320*	7	CE 485 PREP	CE 485	ENG 310 PREP		E
1600-????	AFTER						AFTER					

TIME	PERIOD	T-23 Mon Mar 15	M-24 Tue Mar 16	T-24 Wed Mar 17	M-25 Thu Mar 18	T-25 Fri Mar 19	PERIOD	Mon Mar 22	Tue Mar 23	Wed Mar 24	Thu Mar 25	Fri Mar 26
0630-0750	GR						GR					
0800-0850	1	SYNAPSE		DFEE	LAW		1	SPRING	SPRING	SPRING	SPRING	SPRING
0900-0950	2	SYNAPSE		DFEE			2	BREAK	BREAK	BREAK	BREAK	BREAK
1000-1050	3	ENGLISH	ENG310	ENGLISH	TOUR XP		3					
1100-1150	4	ENGLISH		ENGLISH			4					
1300-1350	5			DFEE			5					
1400-1450	6			DFEE			6					
1500-1550	7						7					
1600-????	AFTER		ENG310	ENG310		ENG310	AFTER					

NOTES: COMPSEI Tour 4 MAR 93 1200-1300

NCL NETWORK CLASSROOM LAB

NETWORK CLASSROOM LAB — APRIL 93 SCHEDULE

as of: 20-May-93

TIME	PERIOD	M-26 Mon Mar 29	T-26 Tue Mar 30	M-27 Wed Mar 31	T-27 Thu Apr 1	M-28 Fri Apr 2	PERIOD	T-28 Mon Apr 5	M-29 Tue Apr 6	T-29 Wed Apr 7	M-30 Thu Apr 8	T-30 Fri Apr 9
0630-0750	GR						GR					
0800-0850	1				DFP Tour		1	ECON		ENG 410	LAW	EM 332
0900-0950	2	CE485 Pre		CE 485		ECON	2					
1000-1050	3	ENG310	ENGLISH	ENG310	ENGLISH		3	ENGLISH	ENG310		ENG310	EM 332
1100-1150	4	CE485 Pre	ENGLISH	CE 485	ENGLISH	ECON	4	ENGLISH	Carriedo	ENGLISH	EM 332	ENGLISH
1300-1350	5			CE 485	ECON Pre		5	ECON			US West	
1400-1450	6	CE 485 Pr	CE485 Pre	CE 485			6	ECON			EM 332	EM 332
1500-1550	7	TOUR VP	CE485 Pre	CE 485			7	Grantham				
1600-????	AFTER		CE485 Pre				AFTER					

TIME	PERIOD	M-31 Mon Apr 12	T-31 Tue Apr 13	M-32 Wed Apr 14	T-32 Thu Apr 15	Fri Apr 16	PERIOD	M-33 Mon Apr 19	T-33 Tue Apr 20	M-34 Wed Apr 21	T-34 Thu Apr 22	M-35 Fri Apr 23
0630-0750	GR					N	GR					
0800-0850	1				DFH	O	1					
0900-0950	2				DFH		2					ECON
1000-1050	3	French Tour			ENGLISH	C	3	ENG310	ENGLISH	ENG310	ENGLISH	
1100-1150	4		ECON		ECON	. L	4		ENGLISH		ENGLISH	ECON
1300-1350	5	Maintenance				A	5				ENG 410	NDU TOUR
1400-1450	6	Maintenance				S	6					
1500-1550	7	Maintenance				S	7					
1600-????	AFTER	ENG310	DFH Tour				AFTER			DFBL TOU		

NETWORK CLASSROOM LAB — MAY 93 SCHEDULE

NETWORK CLASSROOM LAB

as of: 20-May-93

TIME	PERIOD	T-35 Mon Apr 26	M-36 Tue Apr 27	T-36 Wed Apr 28	M-37 Thu Apr 29	T-37 Fri Apr 30	PERIOD	M-38 Mon May 3	T-38 Tue May 4	M-39 Wed May 5	T-39 Thu May 6	M-40 Fri May 7
0630-0750	GR						GR					
0800-0850	1	ECON					1		LG Moore			LAW
0900-0950	2		M472	ALO TOUR	ECON		2	M472		Mgt 472	Mgt 475 Prep	
1000-1050	3	ENGLISH		ALO TOUR	ENG 111		3	ENG 111		ENG 111	Mgt 475 Prep	ENG 111
1100-1150	4	ENGLISH		ENGLISH		ENGLISH	4	DFH TOU	ENGLISH		ENGLISH	
1300-1350	5	ECON					5			THAI TOUR		
1400-1450	6	ECON		OTC TOU			6			Mgt 475 Prep		
1500-1550	7						7					
1600-????	AFTER						AFTER					

TIME	PERIOD	T-40 Mon May 10	M-41 Tue May 11	T-41 Wed May 12	M-42 Thu May 13	T-42 Fri May 14	PERIOD	Mon May 17	Tue May 18	Wed May 19	Thu May 20	Fri May 21
0630-0750	GR	MGT 475		MGT 475	MGT 475		GR					
0800-0850	1		LAW	ENG 410	LAW	SR RELAT'L	1	ENG 410				
0900-0950	2	MGT 475		MGT 475	SYNAPSE	MGT	2	ENG 410				
1000-1050	3	ENGLISH	ENG 111	ENGLISH	DFET		3					
1100-1150	4	ENGLISH		ENGLISH	DEAN TOUR		4					
1300-1350	5	MGT 475	CS PREP	MGT 475		MATH TOUR	5	ENG 410	NCL DISC			
1400-1450	6			SR RELAT'L	EM 492	CS 110	6	ENG 410				
1500-1550	7			MGT PREP	EM 491	CS 110	7	ENG 410				
1600-????	AFTER				EM 492		AFTER					

TIME	PERIOD	Mon May 24	Tue May 25	Wed May 26	Thu May 27	Fri May 28
0630-0750	GR					
0800-0850	1					
0900-0950	2	*AUS AF TOUR				
1000-1050	3	*AUS AF TOUR				
1100-1150	4					
1300-1350	5		MATH			
1400-1450	6		WORKSHOP			
1500-1550	7		MATH			
1600-????	AFTER		WORKSHOP			

*0940-1040 Lt Gen Baker and Australian AF

NETWORK CLASSROOM LAB — AUGUST 93 SCHEDULE

as of: 10 Sep 93

TIME	PERIOD	Mon Aug 9	Tue Aug 10	Wed Aug 11	M-1 Thu Aug 12	T-1 Fri Aug 13	PERIOD	M-2 Mon Aug 16	T-2 Tue Aug 17	M-3 Wed Aug 18	T-3 Thu Aug 19	M-4 Fri Aug 20
0630-0750	GR						GR					
0800-0850	1				Aero 215	Math 243Z	1	Aero 215	Math 243Z		Math 243Z	Hist 101
0900-0950	2				Hist 495	Math 243Z	2	Hist 495	Math 243Z	Hist 495	Math 243Z	Hist 495
1000-1050	3				Hist 495	Math 243Z	3	Hist 495	Math 243Z	Hist 495	Math 243Z	Hist 495
1100-1150	4				Aero 215	Math 243Z	4	Aero 215	Math 243Z	Col Purks Tour	Math 243Z	
1200-1250										Projector	Tove	
1300-1350	5			Inst Meet			5			Maint		
1400-1450	6			SF Tour	Hist 101		6	Hist 101				
1500-1550	7						7					
1600-????	AFTER						AFTER	Tour USSF				

TIME	PERIOD	T-4 Mon Aur 23	M-5 Tue Aug 24	T-5 Wed Aug 25	M-6 Thu Aug 26	T-6 Fri Aug 27	PERIOD	M-7 Mon Aug 30	T-7 Tue Aur 31	M-8 Wed Sep 1	T-8 Thu Sep 2	M-9 Fri Sep 3
0630-0750	GR						GR					
0800-0850	1	Math 243Z	Aero 215	Math 243Z	Aero 215	Math 243Z	1	PS 449	Math 243Z	Aero 215	Math 243Z	DFSSA
0900-0950	2	Math 243Z	Hist 495	Math 243Z	Hist 495	Math 243Z	2	Hist 495	Math 243Z	Hist 495	Math 243Z	Hist 495
1000-1050	3	Math 243Z	Hist 495	Math 243Z	Hist 495	Math 243Z	3	Hist 495	Math 243Z	Hist 495	Math 243Z	Hist495
1100-1150	4	Math 243Z	Aero 215	Math 243Z	Aero 215	USNA BOV Tour	4	Law 420	Math 243Z	Aero 215	Math 243Z	
1200-1250					Tour						Col Stiles	Projector
1300-1350	5						5					Maint
1400-1450	6						6	PS 449				
1500-1550	7			Tour HRB			7	PS 449	Math 243F			
1600-????	AFTER			DFF AP			AFTER					

Aero 215Z: Col Stiles/4010
Hist 495: Capt Grumelli/2293
Hist 101: Capt Carrieda/3620

Math 243Z: Capt Sjoden/3886
English 211: Randy Welsch/2311
PS 449: Capt Peterson/2273

NETWORK CLASSROOM LAB

SEPTEMBER 93 SCHEDULE

as of: 10 Sep 93

TIME	PERIOD	Mon Sep 6	T-9 Tue Sep 7	M-10 Wed Sep 8	T-10 Thu Sep 9	M-11 Fri Sep 10	PERIOD	T-11 Mon Sep 13	M-12 Tue Sep 14	T-12 Wed Sep 15	M-13 Thu Sep 16	T-13 Fri Sep 17
0630-0750	GR	L					GR					
0800-0850	1	A	Math 243Z	Aero 215	Math 243Z	Aero 215	1	Math 243Z	Aero 215	Math 243Z		Math 243Z
0900-0950	2	B	Math 243Z	Hist 495	Math 243Z	Hist 495	2	Math 243Z	Hist 495	Math 243Z	Hist 495	Math 243Z
1000-1050	3	O	Math 243Z	Hist 495	Math 243Z	Hist 495	3	Math 243Z	Hist 495	Math 243Z	Hist 495	Math 243Z
1100-1150	4	R	Math 243Z	Aero 215	Math 243Z	Aero 215	4	Math 243Z	Aero 215	Math 243Z		Math 243Z
1200-1250												*Aero
1300-1350	5	D					5					
1400-1450	6	A					6	Eng 211		Eng 211		
1500-1550	7	Y			DFF		7					
1600-????	AFTER		Hist Tour		PLS Demo		AFTER					

*Aero/4010

TIME	PERIOD	M-14 Mon Sep 20	T-14 Tue Sep 21	M-15 Wed Sep 22	T-15 Thu Sep 23	M-16 Fri Sep 24	PERIOD	T-16 Mon Sep 27	M-17 Tue Sep 28	T-17 Wed Sep 29	M-18 Thu Sep 30	T-18 Fri Oct 1
0630-0750	GR						GR					
0800-0850	1	Aero 215	Math 243Z		Math 243Z	Aero 215	1	Math 243Z	Aero 215	Math 243Z		Math 243Z
0900-0950	2	Hist 495	Math 243Z	Hist 495	Math 243Z	Hist 495	2	Math 243Z	Hist 495	Math 243Z	Hist 495	Math 243Z
1000-1050	3	Hist 495	Math 243Z	Hist 495	Math 243Z	Hist 495	3	Math 243Z	Hist 495	Math 243Z	Hist 495	Math 243Z
1100-1150	4	Aero 215	Math 243Z		Math 243Z	Aero 215	4	Math 243Z	Aero 215	Math 243Z		Math 243Z
1200-1250												
1300-1350	5						5					
1400-1450	6		Eng 211		Eng 211		6	Eng 211		Eng 211		Eng 211
1500-1550	7	Tour Lectu					7					
1600-????	AFTER						AFTER					

Aero 215Z: Col Stiles/4010
Hist 495: Capt Grumelli/2293
Hist 101: Capt Carrieda/3620

Math 243Z: Capt Sjoden/3886
English 211: Randy Welsch/2311
PS 449: Capt Peterson/2273

NETWORK CLASSROOM LAB

OCTOBER 93SCHEDULE

as of: 10 Sep 93

TIME	PERIOD	M-19 Mon Oct 4	T-19 Tue Oct 5	M-20 Wed Oct 6	T-20 Thu Oct 7	M-21 Fri Oct 8	PERIOD	T-21 Mon Oct 11	M-22 Tue Oct 12	T-22 Wed Oct 13	M-23 Thu Oct 14	T-23 Fri Oct 15
0630-0750	GR						GR					
0800-0850	1	Aero 215	Math 243Z	Aero 215	Math 243Z	Aero 215	1	Math 243Z	Aero 215	Math 243Z		Math 243Z
0900-0950	2	Hist 495	Math 243Z	Hist 495	Math 243Z	Hist 495	2	Math 243Z	Hist 495	Math 243Z	Hist 495	Math 243Z
1000-1050	3	Hist 495	Math 243Z	Hist 495	Math 243Z	Hist 495	3	Math 243Z	Hist 495	Math 243Z	Hist 495	Math 243Z
1100-1150	4	Aero 215	Math 243Z	Aero 215	Math 243Z	Aero 215	4	Math 243Z	Aero 215	Math 243Z		Math 243Z
1200-1250												
1300-1350	5						5					
1400-1450	6		Eng 211		Eng 211		6	Eng 211		Eng 211		Eng 211
1500-1550	7						7					
1600-????	AFTER						AFTER					

TIME	PERIOD	T-23 Mon Mar 14	M-24 Tue Mar 15	T-24 Wed Mar 16	M-25 Thu Mar 17	T-25 Fri Mar 18	PERIOD	Mon Mar 21	Tue Mar 22	Wed Mar 23	Thu Mar 24	Fri Mar 25
0630-0750	GR						GR					
0800-0850	1	Aero 215	Math 243Z	Aero 215	Math 243Z	Aero 215	1	Math 243Z		Math 243Z	Aero 215	Math 243Z
0900-0950	2	Hist 495	Aero 310	Hist 495	Aero 310	Hist 495	2	Math 243Z	Hist 495	Math 243Z	Hist 495	Aero 310
1000-1050	3	Hist 495	Math 243Z	Hist 495	Math 243Z	Hist 495	3	Math 243Z	Hist 495	Math 243Z	Hist 495	Math 243Z
1100-1150	4	Aero 215	Aero 310	Aero 215	Aero 310	Aero 215	4	Math 243Z		Math 243Z	Aero 215	Aero 310
1200-1250												
1300-1350	5				Aero 310	AOC Reunion	5					Aero 310
1400-1450	6	Aero 310	Eng 211	Aero 310	Eng 211	Tour	6	Eng 211		Eng 211	Aero 310	Eng 211
1500-1550	7	Aero 310	Aero 310	Aero 310	Aero 310		7				Aero 310	Aero 310
1600-????	AFTER						AFTER					

Aero 215Z: Col Stiles/4010
Hist 495: Capt Grumelli/2293
Hist 101: Capt Carrieda/3620

Math 243Z: Capt Sjoden/3886
English 211: Randy Welsch/2311
PS 449: Capt Peterson/2273

NCL NETWORK CLASSROOM LAB

NETWORK CLASSROOM LAB — NOVEMBER 93 SCHEDULE

as of: 10 Sep 93

TIME	PERIOD	M-29 Mon Nov 1	T-29 Tue Nov 2	M-30 Wed Nov 3	T-30 Thu Nov 4	M-31 Fri Nov 5	PERIOD	T-31 Mon Nov 8	M-32 Tue Nov 9	T-32 Wed Nov 10	M-33 Thu Nov 11	T-33 Fri Nov 12
0630-0750	GR						GR					
0800-0850	1	Aero 215	Math 243Z	Aero 215	Math 243Z	PS 449	1	Math 243Z		Math 243Z	Aero 215	Math 243Z
0900-0950	2	Hist 495	Math 243Z	Hist 495	Math 243Z	Hist 495	2	Math 243Z	Hist 495	Math 243Z	Hist 495	Math 243Z
1000-1050	3	Hist 495	Math 243Z	Hist 495	Math 243Z	Hist 495	3	Math 243Z	Hist 495	Math 243Z	Hist 495	Math 243Z
1100-1150	4	Aero 215	Math 243Z	Aero 215	Math 243Z		4	Math 243Z		Math 243Z	Aero 215	Math 243Z
1200-1250												
1300-1350	5						5					
1400-1450	6		Eng 211		Eng 211	PS 449	6	Eng 211		Eng 211		Eng 211
1500-1550	7					PS 449	7					
1600-????	AFTER						AFTER					

TIME	PERIOD	T-33 Mon Apr 18	M-34 Tue Apr 19	T-34 Wed Apr 20	M-35 Thu Apr 21	T-35 Fri Apr 22	PERIOD	M-36 Mon Apr 25	T-36 Tue Apr 26	M-37 Wed Apr 27	T-37 Thu Apr 28	Fri Apr 29
0630-0750	GR						GR					
0800-0850	1	Aero 215	Math 243Z	PS 449	Math 243Z	Aero 215	1	Math 243Z	Aero 215	Math 243Z	THANKS	GIVING
0900-0950	2	Hist 495	Math 243Z	Hist 495	Math 243Z	Hist 495	2	Math 243Z	Hist 495	Math 243Z		
1000-1050	3	Hist 495	Math 243Z	Hist 495	Math 243Z	Hist 495	3	Math 243Z	Hist 495	Math 243Z	BRE	AK
1100-1150	4	Aero 215	Math 243Z		Math 243Z	Aero 215	4	Math 243Z	Aero 215	Math 243Z		
1200-1250												
1300-1350	5						5					
1400-1450	6		Eng 211	PS 449	Eng 211		6	Eng 211		Eng 211		
1500-1550	7			PS 449			7					
1600-????	AFTER						AFTER					

Aero 215Z: Col Stiles/4010
Hist 495: Capt Grumelli/2293
Hist 101: Capt Carrieda/3620

Math 243Z: Capt Sjoden/3886
English 211: Randy Welsch/2311
PS 449: Capt Peterson/2273

NETWORK CLASSROOM LAB — DECEMBER 93 SCHEDULE

as of: 10 Sep 93

TIME	PERIOD	M-38 Mon Nov 29	T-38 Tue Nov 30	M-39 Wed Dec 1	T-39 Thu Dec 2	M-40 Fri Dec 3	PERIOD	T-40 Mon Dec 6	M-41 Tue Dec 7	T-41 Wed Dec 8	M-42 Thu Dec 9	T-42 Fri Dec 10
0630-0750	GR						GR					
0800-0850	1	Aero 215	Math 243Z	Aero 215	Math 243Z	Aero 215	1	Math 243Z	Aero 215	Math 243Z	Aero 215	Math 243Z
0900-0950	2	Hist 495	Math 243Z	Hist 495	Math 243Z	Hist 495	2	Math 243Z	Hist 495	Math 243Z	Hist 495	Math 243Z
1000-1050	3	Hist 495	Math 243Z	Hist 495	Math 243Z	Hist 495	3	Math 243Z	Hist 495	Math 243Z	Hist 495	Math 243Z
1100-1150	4	Aero 215	Math 243Z	Aero 215	Math 243Z	Aero 215	4	Math 243Z	Aero 215	Math 243Z	Aero 215	Math 243Z
1200-1250					Tour							
1300-1350	5						5					
1400-1450	6		Eng 211		Eng 211		6	Eng 211		Eng 211		Eng 211
1500-1550	7						7					
1600-????	AFTER						AFTER					

TIME	PERIOD	FINALS 1&2 Mon Dec 13	FINALS 3&4 Tue Dec 14	FINALS 5&6 Wed Dec 15	FINALS 7&8 Thu Dec 16	FINALS 9&10 Fri Dec 17	PERIOD	Mon Dec 20	Tue Dec 21	Wed Dec 22	Thu Dec 23	Fri Dec 24
0630-0750	GR						GR					
0800-0850	1						1					
0900-0950	2						2					
1000-1050	3						3					
1100-1150	4						4					
1200-1250						Tour						
1300-1350	5						5					
1400-1450	6						6					
1500-1550	7						7					
1600-????	AFTER						AFTER					

Aero 215Z: Col Stiles/4010
Hist 495: Capt Grumelli/2293
Hist 101: Capt Carrieda/3620

Math 243Z: Capt Sjoden/3886
English 211: Randy Welsch/2311
PS 449: Capt Peterson/2273

NETWORK CLASSROOM LAB

JANUARY 94 SCHEDULE

as of: 14-Apr-94

TIME	PERIOD	Mon Jan 3	Tue Jan 4	Wed Jan 5	M-1 Thu Jan 6	T-1 Fri Jan 7	PERIOD	M-2 Mon Jan 10	T-2 Tue Jan 11	M-3 Wed Jan 12	T-3 Thu Jan 13	M-4 Fri Jan 14
0630-0750	GR						GR					
0800-0850	1				Aero 215Z		1	Aero 215Z	Math 495	Aero 215Z		Aero 215Z
0900-0950	2					DFE Mtg/	2	Math 495	Armstrong		PS 350	
1000-1050	3					Maint	3		Armstrong			
1100-1150	4				Aero 215Z	Math 243Fr	4	Aero 215Z	Math 243Fr	Aero 215Z	Math 243Fr	Aero 215Z
1200-1250								Armstrong				
1300-1350	5					VIP TOUR	5	Armstrong	Hist 351		Hist 351	Tour *
1400-1450	6						6	Armstrong	Armstrong			Tour *
1500-1550	7				Math 243Fr	Hist 352	7	Math 243Fr	Hist 352	Math 243Fr	Hist 352	Math 243Fr
1600-????	AFTER						AFTER					

* local educators/Litherland

TIME	PERIOD	Mon Jan 17	T-4 Tue Jan 18	M-5 Wed Jan 19	T-5 Thu Jan 20	M-6 Fri Jan 21	PERIOD	T-6 Mon Jan 24	M-7 Tue Jan 25	T-7 Wed Jan 26	M-8 Thu Jan 27	T-8 Fri Jan 28
0630-0750	GR						GR					
0800-0850	1	H		Aero 215Z			1		Hist		Aero 215Z	
0900-0950	2	O			VITAB tour		2		Demo			
1000-1050	3	L			VITAB tour		3					
1100-1150	4	I	Math 243Fr	Aero 215Z	Math 243Fr		4	Math 243Fr		Math 243Fr	Aero 215Z	Math 243Fr
1200-1250		D										
1300-1350	5	A	Hist 351		Hist 351		5	Hist 351		Hist 351		Hist 351
1400-1450	6	Y			Tour **		6					CS 110
1500-1550	7		Hist 352	Math 243Fr	Hist 352	Math 243Fr	7	Hist 352	Math 243Fr	Hist 352	Math 243Fr	Hist 352
1600-????	AFTER						AFTER					

** Focus on Family/Litherland

NETWORK CLASSROOM LAB

FEBRUARY 94 SCHEDULE

as of: 14-Apr-94

TIME	PERIOD	M-9 Mon Jan 31	T-9 Tue Feb 1	M-10 Wed Feb 2	T-10 Thu Feb 3	M-11 Fri Feb 4	PERIOD	T-11 Mon Feb 7	M-12 Tue Feb 8	T-12 Wed Feb 9	M-13 Thu Feb 10	T-13 Fri Feb 11
0630-0750	GR						GR					
0800-0850	1	Math 142	Math 142	Aero 215Z			1		Aero 215Z		BS 374	BS 374
0900-0950	2	Math 142	Math 142	ARINC			2		Tour*	NCL TRNG		BS 374
1000-1050	3	Math 142	Math 142	ARINC			3	ENGR 410	Tour	ENGR 410	BS 374	BS 374
1100-1150	4	Math 142	Math 243Fr	Aero 215Z	Math 243Fr		4	Math 243Fr	Aero 215Z	Math 243Fr	BS 374	Math 243Fr
1200-1250												
1300-1350	5	AETC Tour	Hist 351		Hist 351		5	Hist 351	Tour	Hist 351		Lith
1400-1450	6		Math 142		CS 110		6	CS 110		CS 110		BS 374
1500-1550	7	Math 243Fr	Hist 352	Math 243Fr	Hist 352	Math 243Fr	7	Hist 352	Math 243Fr	Hist 352	Math 243Fr	Hist 352
1600-????	AFTER						AFTER					

ARINC - 3 people/Litherland

* John Ziegler

TIME	PERIOD	M-14 Mon Feb 14	T-14 Tue Feb 15	M-15 Wed Feb 16	T-15 Thu Feb 17	M-16 Fri Feb 18	PERIOD	Mon Feb 21	T-16 Tue Feb 22	M-17 Wed Feb 23	T-17 Thu Feb 24	M-18 Fri Feb 25
0630-0750	GR						GR					
0800-0850	1	Aero 215Z		ENGR 410		Aero 215Z	1	H		Aero 215Z		Aero 215Z
0900-0950	2						2	O	PS 350			Math 495
1000-1050	3			ECON			3	L	Tour*	ENGR 410		
1100-1150	4	Aero 215Z	Math 243Fr		Math 243Fr	Aero 215Z	4	I	Math 243Fr	Aero 215Z	Math 243Fr	Aero 215Z
1200-1250								D				
1300-1350	5		Hist 351		Hist 351	Prep Sch**	5	A	Hist 351	ENGR 410	ENGR 410	
1400-1450	6		BS 374		CS 110		6	Y	BS 374		ENGR 410	
1500-1550	7	Math 243Fr	Hist 352	Math 243Fr	Hist 352	Math 243Fr	7		Hist 352	Math 243Fr	Hist 352	Math 243Fr
1600-????	AFTER						AFTER				ENGR 410	

1600-1700

** Col Meyer?, LtCol Capehart, Capt Marsha Wierschke/2578

* Lt Col Litherland

NETWORK CLASSROOM LAB

MARCH 94 SCHEDULE

as of: 14-Apr-94

TIME	PERIOD	T-18 Mon Feb 28	M-19 Tue Mar 1	T-19 Wed Mar 2	M-20 Thu Mar 3	T-20 Fri Mar 4	PERIOD	M-21 Mon Mar 7	T-21 Tue Mar 8	M-22 Wed Mar 9	T-22 Thu Mar 10	M-23 Fri Mar 11
0630-0750	GR						GR					
0800-0850	1	Math 495			Aero 215Z		1	Aero 215Z	Aero 361	Aero 215Z	BS 374	Aero 215Z
0900-0950	2	Tour*					2		Aero 361	BS 374	BS 374	Math 495
1000-1050	3	Tour*		ENGR 410			3		ENGR 410	BS 374	BS 374	BS 374
1100-1150	4	Math 243Fr		Math 243Fr	Aero 215Z	Math 243Fr	4	Aero 215Z	Math 243Fr	Aero 215Z	Math 243Fr	Aero 215Z
1200-1250												
1300-1350	5	Hist 351		Hist 351		Hist 351	5		Aero 361	Tour	Hist 351	
1400-1450	6	CS 110	Tour	CS 110			6				BS 374	
1500-1550	7	Hist 352	Math 243Fr	Hist 352	Math 243Fr	Hist 352	7	Aero 361	Aero 361	Math 243Fr	Hist 352	Math 243Fr
1600-????	AFTER			Tour			AFTER					

* Assessment Symposium

TIME	PERIOD	T-23 Mon Mar 14	M-24 Tue Mar 15	T-24 Wed Mar 16	M-25 Thu Mar 17	T-25 Fri Mar 18	PERIOD	Mon Mar 21	Tue Mar 22	Wed Mar 23	Thu Mar 24	Fri Mar 25
0630-0750	GR						GR					
0800-0850	1	Math 495	Aero 215Z	Math 495	Aero 215Z	Math 495	1	SPRING	SPRING	SPRING	SPRING	SPRING
0900-0950	2		Math 495		Math 495	Tour**	2	BREAK	BREAK	BREAK	BREAK	BREAK
1000-1050	3		Tour DLI	ENGR 410		Tour**	3					
1100-1150	4	Math 243Fr	Aero 215Z	Math 243Fr	Aero 215Z	Math 243Fr	4					
1200-1250												
1300-1350	5	Hist 351		Hist 351	VITAB	Hist 351	5					
1400-1450	6	BS 374			VITAB		6					
1500-1550	7	Hist 352	Math 243Fr	Hist 352	Math 243Fr	Hist 352	7					
1600-????	AFTER						AFTER					

TIME	PERIOD	M-26 Mon Mar 28	T-26 Tue Mar 29	M-27 Wed Mar 30	T-27 Thu Mar 31	M-28 Fri Apr 1
0630-0750	GR					
0800-0850	1	Aero 215Z	Aero 361	Econ 221	Math 495	Aero 215Z
0900-0950	2		Aero 361	Math 495	Jim	Econ 221
1000-1050	3			Tour*	Gail	Econ 221
1100-1150	4	Aero 215Z	Math 243Fr	Tour*	Math 243Fr	Aero 215Z
1200-1250						
1300-1350	5	Tour	Aero 361			
1400-1450	6					Econ 221
1500-1550	7	Aero 361	Aero 361	Math 243Fr	Hist 352	Econ 221
1600-????	AFTER					

** Ponderosa HS 14 Social Studies Teachers

* PWS Co - Mary, Jim, Lt Col Litherland

NETWORK CLASSROOM LAB

APRIL 94 SCHEDULE

as of: 14-Apr-94

TIME	PERIOD	T-28 Mon Apr 4	M-29 Tue Apr 5	T-29 Wed Apr 6	M-30 Thu Apr 7	T-30 Fri Apr 8	PERIOD	M-31 Mon Apr 11	T-31 Tue Apr 12	M-32 Wed Apr 13	T-32 Thu Apr 14	M-33 Fri Apr 15
0630-0750	GR						GR					
0800-0850	1		Aero 215Z		Aero 215Z	Math 495	1	Aero 215Z	Math 495	Aero 215Z	Math 495	Aero 215Z
0900-0950	2		Econ 221		Math 495		2	Math 495		Math 495	Math 142	Math 495
1000-1050	3		Econ 221		C1C Young		3		ENGR 410	Math 142	Math 142	
1100-1150	4	Math 243Fr	Aero 215Z	Math 243Fr	Aero 215Z	Math 243Fr	4	Aero 215Z	Math 243Fr	Aero 215Z	Math 243Fr	Aero 215Z
1200-1250			Tour*									
1300-1350	5	Econ 221	Tour*	Hist 351		Hist 351	5		Hist 351		Hist 351	
1400-1450	6	Econ 221	Econ 221	Econ 221	Tour**		6				Math 142	
1500-1550	7	Econ 221	Econ 221	Hist 352	Math 243Fr	Hist 352	7	Math 243Fr	Hist 352	Math 243Fr	Hist 352	Math 243Fr
1600-????	AFTER						AFTER					

* EP Foundation LtCol L

**Gen Yates

TIME	PERIOD	T-33 Mon Apr 18	M-34 Tue Apr 19	T-34 Wed Apr 20	M-35 Thu Apr 21	T-35 Fri Apr 22	PERIOD	M-36 Mon Apr 25	T-36 Tue Apr 26	M-37 Wed Apr 27	T-37 Thu Apr 28	Fri Apr 29
0630-0750	GR						GR					
0800-0850	1	Math 495	Aero 215Z	Math 495	Econ 221		1	Aero 215Z		Aero 215Z		
0900-0950	2	ECON 405	Math 495		Econ 221		2	Econ 221				
1000-1050	3				Econ 221		3	Econ 221		MGT 485		
1100-1150	4	Math 243Fr	Aero 215Z	Math 243Fr		Math 243Fr	4	Aero 215Z	Math 243Fr	Aero 215Z	Math 243Fr	
1200-1250												
1300-1350	5	Hist 351		Hist 351		Econ 221	5		Hist 351		Hist 351	
1400-1450	6				Econ 221	Econ 221	6	Econ 221	Econ 221	452 Brief*		
1500-1550	7	Hist 352	Math 243Fr	Hist 352	Econ 221	Econ 221	7	Econ 221	Hist 352	Math 243Fr	Hist 352	
1600-????	AFTER						AFTER					

Econ 405 - OLIGOP software

*Capt Lynch/2336 to BG Cubero

NETWORK CLASSROOM LAB

MAY 94 SCHEDULE

NETWORK CLASSROOM LAB

as of: 14-Apr-94

TIME	PERIOD	M-38 Mon May 2	T-38 Tue May 3	M-39 Wed May 4	T-39 Thu May 5	M-40 Fri May 6	PERIOD	T-40 Mon May 9	M-41 Tue May 10	T-41 Wed May 11	M-42 Thu May 12	T-42 Fri May 13
0630-0750	GR						GR					
0800-0850	1	Aero 215Z		Aero 215Z		Aero 215Z	1	Math 342	Aero 215Z		Aero 215Z	
0900-0950	2						2	Math 342				
1000-1050	3						3	Math 342				
1100-1150	4	Aero 215Z	Math 243Fr	Aero 215Z	Math 243Fr	Aero 215Z	4	Math 243Fr	Aero 215Z	Math 243Fr	Aero 215Z	Math 243Fr
1200-1250												
1300-1350	5		Hist 351		Hist 351		5	Hist 351		Hist 351		Hist 351
1400-1450	6						6					
1500-1550	7	Math 243Fr	Hist 352	Math 243Fr	Hist 352	Math 243Fr	7	Hist 352	Math 243Fr	Hist 352	Math 243Fr	Hist 352
1600-????	AFTER						AFTER					

TIME	PERIOD	FINALS 1&2 Mon May 16	FINALS 3&4 Tue May 17	FINALS 5&6 Wed May 18	FINALS 7&8 Thu May 19	FINALS 9&10 Fri May 20	PERIOD	Mon May 23	Tue May 24	Wed May 25	Thu May 26	Fri May 27
0630-0750	GR						GR					
0800-0850	1						1					
0900-0950	2						2					
1000-1050	3						3					
1100-1150	4						4					
1200-1250												
1300-1350	5						5					
1400-1450	6						6					
1500-1550	7						7					
1600-????	AFTER						AFTER					

APPENDIX 7

TRIP REPORT
DoD POLYGRAPHIC INSTITUTE
FORT McCLELLAN, ALABAMA
25 SEPTEMBER 1994

MERCER
UNIVERSITY

SCHOOL OF ENGINEERING
Mechanical & Aerospace Engineering

MEMORANDUM

DATE: 25 September, 1994

TO: Dr. Grum *al*

FROM: Dr. Palmer

SUBJECT: DOD Polygraph Institute Visit

This memo describes my 12 August visit to the DOD Polygraph Institute (DPI) at Fort McClellan, Alabama and includes personal observations on the use of technology in their programs.

The Visit

I spent the day with Mr. John Schwartz, Chief of the Instruction Division of DPI. He explained the Institute's mission and methods of instruction, gave me a tour of facilities, and introduced me to a number of his colleagues who were quite helpful in answering my questions. General information about the Institute and its curriculum are attached along with their 1993-94 catalog.

I observed several uses of technology in the delivery of instruction. Video plays a particularly prominent role with cameras located in all lecture rooms and laboratories to accomplish both live broadcasts and video tapes of formal presentations and practical exercises. People on the DPI network are free to observe live broadcasts and can borrow tapes for review of material. Students spoke very favorably about these capabilities and instructors acknowledged that being on camera had an impact on their presentations. One noted quite candidly that the fact that her supervisors, to include the DPI Director, could observe her instruction at any time prompted her to prepare differently after she learned that he tuned in frequently than she did prior to that.

Because a great deal of what is taught focuses on helping students improve their ability to conduct examinations (interrogations) utilizing psychophysiological detection of deception methods, each student is required to perform 80 practice examinations. Video taping each of these practice interrogations and then reviewing the tape with a faculty member is believed to be an invaluable aid to the learning process.

1400 Coleman Avenue • Macon, Georgia 31207-0001
(912) 752-2138 • FAX (912) 752-2166

Lecture rooms are also equipped with "electronic blackboards" which capture the notes and sketches written there. This material can then be printed and reproduced for distribution to the class, relieving some of the pressure to spend time taking notes rather than thinking about the concepts being presented.

Considerable effort is being invested in the development of hypertext/hypermedia presentations which are then made available to instructors and/or students. To the Institute's credit they are evaluating these efforts as they go, using educational psychologists, control groups, etc. Early findings seem to indicate that such presentations have advantages over "conventional" presentations in some areas (tasks which require synthesis and creativity) but offer little advantage in areas which simply involve recall of information. The people with whom I spoke about this note that their research is young and that they have no real data on costs vs benefits at this time. They do expect to continue the study, with one of their major efforts focused on development of material which can be sent to students preparing to attend DPI courses. Since these students come from such varied backgrounds it is hoped that such preparation will help them lower the slope of their learning curve once they begin their resident instruction.

DPI has access to a video conferencing center located at Fort McClellan, however, they apparently have made very little use of this facility. The Army Chemical School and the Military Police School are also located at Fort McClellan, but there appears to be little, if any, sharing of resources between DPI and these other schools.

Personal Observations

DPI appears to have taken a deliberate approach to integrating technology into their efforts. Maybe the fact that they have a "permanent" Director (Dr. Yankee) as compared to a "transient" (such as the Commandant at the Air Command and Staff College or the Army Command and General Staff College) provides the base for a longer ranged vision. Whatever the reason, they do seem to be making good use of technology in a number of areas. That said, I was surprised to find them making so little use of video conferencing, given the availability of such a capability. It also seems likely to me that there are opportunities to share resources at a post on which there are three major organizations with education and training missions. Among the candidates for such sharing are library facilities, a media center, educational psychology staff, video and computer networks, and technical specialists.

Because I have seen it so often I was not surprised to find people relatively uninformed about uses of technology in education at other places. Many of the problems associated with keeping abreast of what is happening have their roots in "limitations" - time limitations, fiscal limitations, ego limitations, etc. Addressing these limitations will not be easy, but failure to address them will continue to be costly. I believe that efforts to provide incentives to share ideas and resources and to provide mechanisms to accomplish that sharing will yield substantial payoffs.

Department of Defense Polygraph Institute
General Information

History

~ 1951-75	Provost Marshal School, Fort Gordon, Georgia
~ 1975-86	MP School, Fort McClellan, Alabama
~ 1986-Present	Department of Defense Polygraph Institute

Authority

~ DoD Directive 5210.78 Assistant Secretary of Defense for Command, Control, Communications and Intelligence (September 1991)

Mission

~ Education — Prepare professional examiners for all DoD and federal agencies (except CIA)

~ Research — Mandated by Congress in the Defense Authorization Act of 1986 (and all DAAs since then)

Specifically: Validity and Reliability
Countermeasures
Instrumentation and Automation

Research Activities: Internal Research (8-12 projects per yr)
External Research (8-12 contracts/grant per yr)

Students

~ Basic Program	40 to 60 students per year
~ Continuing Education	300 to 400 students per year

Faculty and Staff

~ Faculty	14
~ Research	12
~ Support	14
~ NSA Assignee	1
~ Army Enlisted Overfill	1
~ Director's Office	2
TOTAL	44

Examinees for Research and Training

~ Military Subjects	Average 4000 per year
~ Contract Civilians	Average 1500 per year

(Continued on reverse side)

Curriculum

- Master Degree Studies
  - Subject matter:
    - > Forensic Psychophysiology applied to:
      - Criminal Investigations
      - Intelligence
      - Counterintelligence
      - Screening

Facilities

Building	Sq.ft.
Building 3165	6,250
Operations (3165A)	1,950
Support Facility (3165B)	1,206
Storage	1,013
Building 3195	21,400

Building 3195

- Occupied July 6, 1989
- Construction Cost: $1,400,000
- Equipment Cost: $ 400,000

Special Features: Custom designed training laboratories
Custom designed research laboratories

Building 3165

- Renovated in FY 93
- Renovation Cost: $ 500,000
- Equipment Cost: $ 200,000

All Facilities

- Total Equipment Inventory Cost: $2,998,640.00

APPENDIX 8

A PARTIAL LISTING
OF
101 EDUCOM SUCCESS STORIES

Integration of Several Information Technologies in a General Education Course

The American University

Jack Child

This project applies several information and educational technologies to an interdisciplinary second-year college General Education course, "Latin America: History, Art, Literature." The project began with a selection of relevant literary texts and some 1,000 slides (35mm) that provided the written and visual "windows" into Latin American history. These slides, and summaries of the professor's lectures, were transferred onto videotape as supplements and review lessons, as well as resources for students with special learning problems. Later, the project expanded to include several HyperCard stacks that provided review exercises and sample exam questions. Finally, a Consensor Classroom (computer-based interactive system) session was held to present a lecture and review for the final exam.

Video Information System (VIS)

Ball State University

Ray L. Steele

The Ball State University Video Information System (VIS) is a university-based fiber optic multimedia distribution network that allows faculty to access film, videotape, slides/tape, videodisc and other media in a central location for display/control in 200 classrooms throughout the campus. VIS includes a production facility that allows faculty to quickly and professionally produce visuals and audio in various formats for use in classrooms equipped with VIS monitors and control panels. VIS improves student learning by helping faculty develop and use visually oriented lessons quickly and conveniently. This enriches the curriculum across campus by helping to develop and send timely materials into diverse classes. VIS, which can be used in any discipline, is increasing in use each semester.

Use of Interactive Video Technology

Boise State University

Nancy Otterness/Carol Fountain

Boise State University's Department of Nursing is developing interactive computer programs to provide: an alternate learning experience for students; more efficient use of faculty teaching time; and cost savings with skill-practice equipment. As a result of one program on injections developed by the nursing faculty, students demonstrated better preparation for clinical practice of giving injections to real patients.

CALLP Computerized Assistance in Layers for Laboratory Physics

Bradley University

Conley Stutz/John Sathoff

Bradley University's Department of Physics has established an interdisciplinary project to develop a networked laboratory measurements and computing environment throughout the respective laboratory programs. Students begin using computer-assisted laboratory facilities in the earliest freshman level courses and continue throughout their undergraduate curriculum. The computer-assisted laboratory instruction model consists of four major elements: data collection, data reduction with numerical and graphical analysis, experiment simulation, and report preparation. The implementation of computerized measurements for all courses in the first two years of basic physics has resulted in a doubling of laboratory performance by students.

MIDI-Studio

Brookdale Community College

Joseph Accurso

The increasing use of computers in the arts led to the founding of the computer music facility and accompanying curriculum at Brookdale Community College. The Brookdale program offers three sections of commercial composition concurrently with three sections of electronic music. As students gain proficiency in their compositional skills, they realize their original compositions in the electronic music lab, and experience many of the benefits that a "live" performance gives to a student composer of a completed work or a work in progress. The Brookdale facility includes 15 workstations at various levels of complexity. Equipment choices were made on the basis of which would best simulate and replicate a professional environment.

Using Software in the Teaching of Mathematics

Brookdale Community College
Teresa Healy/Elaine Klett/Virginia Lee

A mathematics computer classroom has been established in which each student has a computer to use during class. The first phase of computer integration targeted Calculus and Statistics, and in these classes students now use the computer routinely in class to examine graphs, explore different examples, perform calculations, and manipulate data. They can focus on the underlying concepts they are learning instead of the manipulations. In addition, more realistic examples can be studied and student-generated data can be used.

The Carnegie Mellon Proof Tutor

Carnegie Mellon University
Richard Scheines

The Carnegie Mellon Proof Tutor exploits the large-screen, multi-tasking abilities of the Unix workstation to create a proof construction environment that has an informative and manipulable graphic display as well as an "expert system" that provides strategic advice to students at any point in any problem. When compared to standard proof checkers in a controlled experiment, the tutor demonstrably improved student performance. The project is ongoing and now involves Carnegie Mellon's Software Engineering Institute, its Laboratory for Computational Linguistics, and the Istituto di Cibernetica del CNR in Naples, Italy.

The Independent Study Lab

Catonsville Community College
Stephanie Caravello-Hibbert

This unique laboratory uses technology to provide self-paced and competence-based multi-media instruction in Earth Science and Astronomy. Although the lab is open to all students who choose to enroll in it, its major successes and accomplishments are with students who have special needs. The courses offered in the lab are competence-based, therefore students are required to achieve 90 percent or better on the final test of each module before proceeding to the next one. One of the major factors that contribute to the success of this lab is that the videodiscs are repurposed, so the modules are always tailored to the needs of the students.

Computer Bulletin Board System for Psychology Courses

The College of Wooster
William Scott

A course-based Computer Bulletin Board System for Psychology Courses was developed on The College of Wooster's campus-wide information network (WoosterNet) to allow expanded access to and development of class discussions, class study materials, and expert responses to questions generated by class discussions. The system was developed as specific course-based discussion areas in a VAX bulletin board environment and is open to all members of the campus community. Course directors can engage outside experts such as the authors of the course textbooks via BITNET links.

The Center of Emphasis

Columbia State Community College
Stephen L. Stropes

The center's focus is on developing interactive video and computer-assisted instruction (CAI) programs that are interdisciplinary and are tailored to the specific educational requirements of Columbia State faculty. These programs are available to students in open labs located on- and off-campus as a supplement to traditional instruction. Center staff help faculty develop the programs, and faculty need not have technical knowledge or previous experience to do so. The center's three "high-tech" instructional laboratories and two off-campus locations house 41 computer CAI workstations and 33 interactive video workstations. All labs have been fully networked to allow easy student access to all available instructional programs as well as the capability to track and test users electronically.

Cornell University Beef Cow Herd Simulation Program (CUBEEF)

Cornell University
Michael L. Thonney

Cornell University's Beef Cow Herd Simulation Program (CUBEEF) allows students to practice managing beef cow breeding herds. With the CUBEEF program a student manages a herd of 50 cows and 5 bulls through three seasons of weaning, calving, and breeding. The students use the COWHERD spreadsheet (run under ASEASYAS, a

APPENDIX 9

TRIP REPORT
TO THE
NATIONAL TECHNICAL UNIVERSITY
27 JULY 1994

DEPARTMENT OF THE ARMY
U.S. ARMY COMMAND AND GENERAL STAFF COLLEGE
FORT LEAVENWORTH, KANSAS 66027-6900

REPLY TO
ATTENTION OF

ATZL-SWO-FD (351) 22 September 1994

MEMORANDUM FOR DR. A. GRUM

SUBJECT: After Action Report for Army Science Board (ASB) "Technology in Training and Education" ad hoc (technology) Committee Visit to the National Technological University on 27 July 1994

1. The ASB ad hoc Committee on "Technology in Training and Education" conducted a site visit to the National Technological University (NTU), Fort Collins, Colorado.

2. Participants:

Dr. LaBerge, Chair, ASB
Dr. Grum, Ad Hoc Committee Chair
Dr. Crystal Campbell, Ad Hoc Committee Member
LTG (RET) Collier Ross, Consultant, ASB

3. Information gained during the meeting.

a. The schedule followed by the ASB technology ad hoc committee is at enclosure 1. Materials describing NTU and discussing the courses offered through NTU are at enclosure 2. NTU offers two basic programs: Academic Program and Short Courses/Research Symposia.

(1) Academic Program. NTU is a graduate level, fully accredited university which does not maintain its own faculty. NTU offers a wide range of instructional television courses taught by the top faculty of 45 leading universities. The courses, at present, are primarily from engineering schools. A business program is now being offered. NTU will develop academic programs to meet the needs of the organization. Real-time and delayed interaction modes are available depending on the course requirements. Courses focus on current information to meet today's needs. They are not "canned" and are changed to reflect the latest information in the field.

(2) Short Courses/Research Symposia (ATMP). ATMP topics are developed to respond to the needs of the recipients and range from courses/workshops dealing with organization skills to state-of-the-art breakthroughs in technology.

b. Courses are nominated by the faculty, reviewed and evaluated by the NTU faculty committee, and selected for presentation by the faculty committee.

c. NTU students receive the same credit as the student taking the course on campus. NTU students receive significantly higher grades than those taking the course on the campus.

d. Small groups are involved though a cohort arrangement. Students in local areas get together for discussions and interaction. Additionally, videoconferencing interaction and "e-mail" are available for communication with group members and the professor.

e. Department of Defense/NTU sites are listed at enclosure 3. Currently there is much interface between the military (Air Force particularly) and NTU. For example, high achieving seniors at the Air Force Academy take NTU courses.

f. Cost information is at enclosure 4. The Air Force is committed to distance learning. They found that 60% of their training dollar was going to cover travel/rent/meals. Using distance learning reduces costs and allows more personnel to receive needed up-to-date training/education without loss of program quality. Costs for participating in the NTU program include:

(1) A one-time site decoder costs between $2.5K and $5K.

(2) A one-time association fee. Several Army installations participate with NTU. The NTU President, Mr. Baldwin, agreed to count the fees paid by the separate Army installations towards an overall Army fee. The balance would be somewhere between $100K to $150K. (This is a small cost for a program which offers quality educational opportunities through distance learning.)

(3) Course tuition and fees. Most course tuition and fees are set by NTU. Some universities have higher tuition and fees for the courses they teach. The NTU costs are $260 per credit.

4. The NTU program is not the total solution to the Army leader development issue, but could function as an important component of the total program. Contributions of a program such as NTU to a total Army leader development program could include: .

a. Education made available at any point in the country without the travel, per diem, etc. expenses allowing greater participation in education/training opportunities at a lower cost per student.

b. Continued workplace involvement of the student-leader as he/she would not have to be removed from the workplace on a full-time basis in order to participate.

c. Opportunities for educational experiences based on a "learning need" instead of an institutional calendar.

d. Work related educational experiences having immediate applicability.

e. Greater course variety enabling the student-leader to meet his/her educational needs more adequately.

f. Quality instruction using well-known experts.

g. A well educated/trained workforce.

Rebecca M. Campbell
REBECCA M. CAMPBELL
Staff Assistant
Army Science Board

PROPOSED AGENDA
WEDNESDAY, JULY 27, 1994
NTU HEADQUARTERS, 700 CENTRE AVENUE, FORT COLLINS, COLORADO

8:00	Introductions	Douglas M. Yeager Vice President
8:15	NTU Overview	Lionel V. Baldwin President
8:45	Academic Programs	Eileen Moree Director Admissions & Records
9:30	Advanced Technology & Management Programs	Douglas M. Yeager Vice President Diane Kunkel ATMP Program Director
10:15	Break	
10:30	The NTU Satellite Network	Andy Casiello Director NTU Satellite Network
11:15	Discussion	All
12:00	Lunch	
1:00	Tour of Studios and Uplink Facility at Colorado State University	
2:30	Discussion and Q&A Session	All
4:00	Adjourn	

NTU

National Technological University
700 Centre Avenue
Fort Collins, CO 80526-1842
303-484-0668 (FAX)
303-495-6400

A HIGHER Order of Education™

EXECUTIVE SUMMARY

The National Technological University (NTU) is a private, non-profit, accredited institution founded in 1984 to serve the advanced educational needs of today's busy, highly mobile engineers, scientists and technical managers. NTU is governed by a Board of Trustees consisting primarily of industrial executives. NTU offers a wide range of instructional television courses via satellite taught by the top faculty of 46 leading engineering universities. Each participating university that delivers courses has or will have an earth station or uplink. NTU's functions are to:

- **award master's degrees in selected disciplines;**
- **provide research seminars in each discipline;**
- **operate an instructional television network (ITV) via satellite for convenient, flexible, on-site service in North America;**
- **operate a videotape instructional service internationally;**
- **offer Advanced Technology & Management Programs in the form of non-credit short courses and workshops to introduce new advanced technology concepts to a broad range of technical professionals; and**
- **establish a sophisticated satellite network infrastructure between industry and the university community.**

NTU began regular satellite delivery of advanced technical education in August, 1985. During the 1992-93 year of satellite networking, NTU offered 22,702 hours of academic credit instruction and 2,980 hours of state-of-the-art Advanced Technology & Management Programs.

The network operates on TELSTAR 401 with one modern Ku-band transponder to provide up to 14 compressed digital video channels throughout the day and evening. The signal is received by subscribers through generally 2.4 meters or larger downlinks located near the professionals viewing the broadcasts.

NTU's vision is to enable technical professionals and managers to share premier educational resources globally via telecommunications.

NTU's academic programs (Master of Science) are available in the United States, Canada and Mexico:

CHEMICAL ENGINEERING
COMPUTER ENGINEERING
COMPUTER SCIENCE
ELECTRICAL ENGINEERING
ENGINEERING MANAGEMENT
HAZARDOUS WASTE MANAGEMENT
HEALTH PHYSICS
MANAGEMENT OF TECHNOLOGY
MANUFACTURING SYSTEMS ENGINEERING
MATERIALS SCIENCE AND ENGINEERING
SOFTWARE ENGINEERING
SPECIAL MAJORS PROGRAM

Over 1,100 courses from the participating universities are listed in the above curriculums. Undergraduate bridging courses for non-majors wishing to enter the M.S. Programs in Computer Engineering, Computer Science and Electrical Engineering are also available.

- Continued -

One Stop Shop...

- Fresh, live programming that is relevant and useful on the job presented by leading experts from a national pool.
- Broad range of topics and presenters with a rich mix of applications courses, theory, overviews, and hands-on training.
- High quality programs available at low cost because they are produced for a large network (economies of scale).
- Direct delivery to the worksite reducing lost time and personal inconvenience.
- Availability of programs live or on videotape thus maximizing individual and organizational flexibility.
- Existing system to supply videotape short courses to international sites.
- Availability of CEUs, certificates of attendance, and an automated evaluation system with individual site reports.

Access

Employees at one or more sites in the following organizations currently have access to NTU courses:

Advanced Micro Devices, Inc.
AG Communication Systems
Air Products and Chemicals, Inc.
ALCOA*
Alliant Techsystems Inc.
Allied Signal Aerospace Company
AMP Incorporated*
Analog Devices, Inc.
Argonne National Laboratory
ARINC
Armco Steel Co., L.P.
Atmel Corporation
AT&T*
The BDM Corporation
Bellcore
BNR Inc.
Boeing Defense & Space Group
Boeing Commercial Airplane Group
Booz Allen & Hamilton, Inc.
Bull HN Information Systems Inc.
Burle Industries, Inc.
College Center for the Finger Lakes
Compression Labs, Incorporated*
CTS Corporation
A Dallas Based Info. Mgmt. Company*
Datotek, An AT&T Company
David Sarnoff Research Center
Deere & Company
Delaware Technical & Community College
Digital Communications Associates, Inc.
Digital Equipment Corporation*
Eastman Kodak Company*
[illegible]
EG&G Rocky Flats
E.I. du Pont de Nemours & Company*
EMA Open Learning Pty Ltd
E Systems, Inc.
Ericsson GE Mobile Communications
Evans & Sutherland
Exxon Corporation*
FAA Technical Center
Finger Lakes Regional Education Center
General Dynamics Corporation
General Electric Company*
General Instrument Corporation*
Georgia Institute of Technology
Glenayre Electronics Corporation
GTE Corporation*
Hamilton Standard
Harris Corporation
Hartford Graduate Center
Hawkeye Community College
Hewlett-Packard Company*
Honeywell, Inc.*
HRB Systems
IAHE Consultants Pte Ltd
IBM*
Illinois Institute of Technology
Instituto Tecnologico y de Estudios Superiores de Monterrey
Integrated Device Technology, Inc
Intel Corporation*
Los Alamos National Laboratory
Magnavox Electronic Systems Company
Magnavox Electro-Optical Systems Company
Martin Marietta Corporation*
Mason & Hanger
McDonnell Douglas Aerospace East
Mead Data Central, Inc.
Metrum Information Storage
Michigan State University
Micron Technology, Inc.
Middle Georgia Technology Development Center
Milliken & Company*
The MITRE Corporation*
Motorola Inc.*
NASA*
National Semiconductor Corporation*
NCR Corporation*
New Jersey Institute of Technology
Norand Corporation
North Carolina State University
Occidental Chemical Corporation
Oklahoma State University
OSU/University Center at Tulsa
Pacific Bell*
Perkin-Elmer Corporation
Philips Display Components Company
Polaroid Corporation*
Pratt & Whitney
PSE&G Nuclear Training Center
Rochester Community College (IBM)
Rockwell International Corporation
ROLM Company
Texas Instruments, Inc.*
3M Company
The Travelers Insurance Company
Universidad Politecnica de Madrid
The University of Arizona
University of Florida
University of Houston, Center for Applied Technology
University of Kentucky
University of Missouri Rolla
University of Washington
University of Wisconsin-Madison
U.S. Air Force*
U.S. Army
U.S. Bureau of Mines
U.S. Department of Energy
U.S. Mine Safety & Health Administration
U.S. Navy
Vitacom Corporation
Westinghouse Electric Corporation
Whirlpool Corporation
Winona State University (IBM)
Xerox Corporation

Interconnected Networks

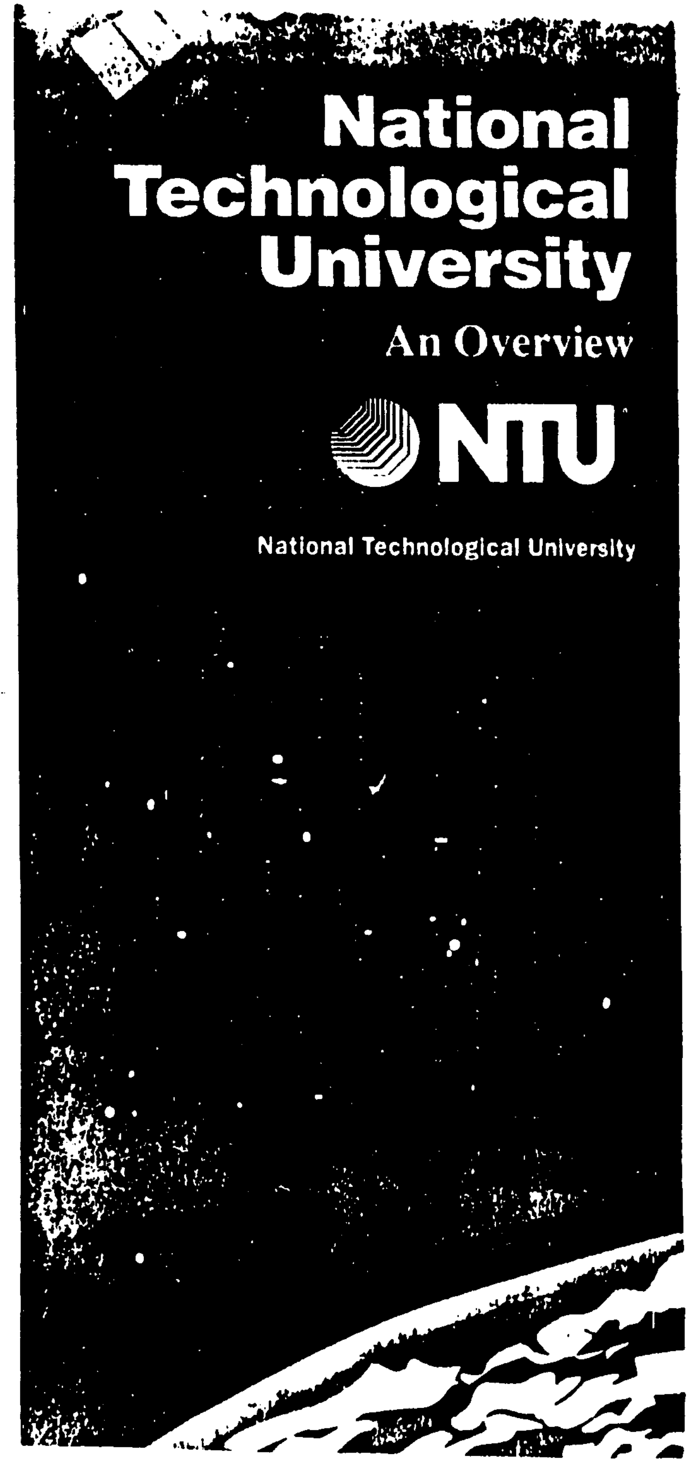
Alliance for Higher Education
Industry Education Council of Santa Clara County*
Michigan Information Technology Network, Inc.*
Purdue University
Stanford Information Television Network
The University of Maryland College Park
University of Minnesota

*Corporate-wide, agency-wide or state wide subscription

For Additional Information Contact:

Douglas M. Yeager
Vice President of Marketing
National Technological University
700 Centre Avenue
Fort Collins, CO 80526-1842
(303) 495-6414 FAX (303) 484-0668

National Technological University admits students of any race, color, national or ethnic origin.



NTU

Background

National Technological University (NTU) is a private, non-profit institution founded in 1984 to serve the advanced educational needs of today's busy, highly mobile engineers, scientists and technical managers. NTU is accredited by the Commission on Institutions of Higher Education of the North Central Association of Colleges and Schools. On a nationwide basis, NTU offers a wide range of instructional television courses taught by the top faculty of 45 of the nation's leading engineering schools and other organizations and institutions selected because of their special expertise.

Participating Institutions

- Arizona State University
- Boston University*
- Colorado State University
- Columbia University
- Cornell University
- The George Washington University
- Georgia Institute of Technology
- GMI Engineering & Management Inst.
- Illinois Institute of Technology
- Iowa State University
- Kansas State University
- Lehigh University
- Michigan State University
- Michigan Technological University
- New Jersey Institute of Technology
- New Mexico State University
- North Carolina State University
- Northeastern University
- Oklahoma State University
- Old Dominion University
- Purdue University
- Rensselaer Polytechnic Institute
- Southern Methodist University
- University of Alaska at Fairbanks
- The University of Arizona
- University of California at Berkeley
- University of California, Davis
- University of Colorado at Boulder
- University of Delaware
- University of Florida
- University of Idaho
- University of Illinois at Urbana-Champaign
- University of Kentucky
- The University of Maryland College Park
- University of Massachusetts at Amherst
- The University of Michigan
- University of Minnesota
- University of Missouri-Rolla
- The University of New Mexico
- University of Notre Dame*
- University of South Carolina
- University of Southern California
- The University of Tennessee, Knoxville
- University of Washington
- University of Wisconsin-Madison

*Contribute solely to Advanced Technology and Management Programs

Functions

NTU's functions are to:

- **Award Master's degrees** in selected disciplines
- **Provide research seminars** in each discipline
- **Offer Advanced Technology and Management Programs** in the form of non-credit short courses and workshops to introduce new advanced technology concepts to a broad range of technical professionals
- **Operate an instructional television network** (ITV) via satellite for convenient, flexible, on-site service nationwide
- **Establish a sophisticated satellite network infrastructure** between industry and the university community

Current Academic Programs

NTU's Master's of Science programs are as follows:

- Computer Engineering
- Computer Science
- Electrical Engineering
- Engineering Management
- Hazardous Waste Management
- Health Physics
- Management of Technology
- Manufacturing Systems Engineering
- Materials Science and Engineering
- Software Engineering
- Special Majors Program

As of August 1993, 435 M.S. degrees had been awarded to individuals successfully completing their program of study.

NTU currently has more than 1,000 courses available from its participating universities in the above curriculums. Undergraduate bridging courses for non-majors wishing to enter the M.S. programs in Computer Engineering, Computer Science, Electrical Engineering and Software Engineering are also available.

At the beginning of the 1993-94 school year, 1,832 working professionals and managers were admitted to NTU degree programs.

Faculty-student interaction is accomplished by telephone, fax, electronic mail, teleconferencing, express mail and regular mail.

Satellite Delivery

NTU began regular satellite delivery of advanced technical education in August, 1985. During the 1992-93 school year of satellite broadcasting, NTU offered 22,702 hours of academic credit instruction and 2,980 hours of state-of-the-art non-credit Advanced Technology and Management Programs. Participating universities have earth stations installed to uplink courses from their campuses. Many of the courses are offered live and interactively, and the others on a tape-delayed basis.

The network operates on one modern Ku-band transponder to provide up to 10 compressed digital video channels 24 hours a day. The signal is received by subscribing organizations through downlinks located near the professionals and managers viewing the broadcasts.

Short Courses and Research Symposia

Advanced Technology and Management Programs (ATMP) topics range from organizational skills to state-of-the-art breakthroughs in technology.

Rapid technological changes, worldwide economic pressures, and demand for integration of changing work styles with changing technologies serve as a basis for ATMP's live and interactive satellite broadcasts. More than 300 programs are presented annually by leading academic, industrial and government experts from around the world.

During the last school year, ATMP programs were viewed by over 100,000 technical professionals and managers.

Benefits

Master's of Science degree programs:

- Convenient, flexible, on-site M.S. degree programs for technical professionals and managers.
- Access to multi-university academic curriculums taught by outstanding faculty from over 40 participating universities.
- Programs of study relevant to the needs of the organization and the individual.
- Recruiting tool for attracting top B.S. graduates.
- Geographic transfers can occur without interrupting part-time graduate study.

APPENDIX 10

THE
INFORMATION TECHNOLOGY
LABORATORY'S
VIEW OF THE FUTURE

Distance Learning: The Continuing Evolution of the Digital Army Classroom

Prepared by:

Information Technology Laboratory
USAE Waterways Experiment Station

Prepared for:

Army Science Board Study
BG (Ret.) Allen F. Grum, Chairman

October 5, 1994

Preface

This white paper was prepared by the Information Technology Laboratory (ITL), USAE Waterways Experiment Station (WES), for an Army Science Board Study chaired by BG (Ret.) Allen F. Grum.

Dr. Louis H. Turcotte, IPA-ITL/WES, was responsible for coordination and preparation of this paper. Mr. Michael G. Ellis, ITL/WES, served as co-author with Dr. Turcotte. Mr. Luciano J. Iorizzo, Jr. of the US Army Armor School, Ft. Knox, provided significant comments and provided several of the case studies contained in this paper. Mr. Frank Flavell, US Army Armor School, also provided review and comment. Dr. Donald Trotter, Professor/Mississippi State University, provided material on distance learning activities in academia.

The work was monitored at WES by Dr. N. Radhakrishnan, Director, ITL.

During preparation of this paper, Dr. Robert W. Whalin was Director of WES. COL Bruce K. Howard, was Commander and Deputy Director.

Contents

1 Introduction

The Army, and DoD, continue to be under tremendous economic pressures. This trend is expected to continue for the foreseeable future. Reduced federal budgets are necessitating that the Army maintain their capabilities of training the most highly skilled personnel with less funds. The reduction in force structure also requires that each individual be better trained and educated to ensure that the Army can fulfill missions and maintain readiness. Additionally, standardized training is essential to support both the active and reserve components using the same tasks and standards and necessitates the use of alternatives to conventional training methods. The Army needs to continue to evaluate how emerging technologies may be leveraged to accomplish these requirements; particularly technologies which can facilitate better trained and educated personnel while simultaneously reducing the associated costs.

Existing and emerging digital technologies are rapidly changing the way the Army maintains its battlefield superiority. The deployment of high-speed long haul networks (sometimes referred to as the Information Superhighway) are radically affecting the capacity to remove the "significance of place [22]." These networks, in conjunction with state-of-the-art computers and video systems, are providing the necessary infrastructure to realize effective distance learning programs today. However, the rate of advancement in digital technologies will cause the distance learning methods employed to become almost totally unhindered by geographic location of teacher and student. Therefore, distance learning is one solution to the dilemma of how to optimize the use of shrinking resources to meet today's increased training demand. This white paper reviews the current status of distance learning in the Army. Additionally, a projection of anticipated future environments is presented and the advances which are necessary to remove the "significance of place" from distance learning programs are discussed.

2 Distance Learning for the Army

Academicians [11] have provided the following definition for distance learning:

> "The objective of distance learning is to integrate computer-based teleconferencing with fully integrated computer applications running over computer networks, thus achieving at reasonable cost the benefits of bi-directional teleconferencing, on-line multimedia instruction material, and ready access to local or the World-Wide Web information for variable time access by the students."

This definition can be extended to address the goals of the Army. For the Army, distance learning implies the capability to deliver training to all soldiers (soldiers in residence schools, soldiers at home, soldiers located at armories, soldiers who are mobile in units using wireless communications — active and reserve components), whether it be at or near home or duty station, instead of bringing the soldier to the institution for 100% resident instruction.

One of the primary motivations for distance learning results from the proliferation of information within our working environment. The Gartner Group [14] estimates that 15% of all documents were available digitally in 1993 and that 54.6% will be available by 1996. One example of the effect of this explosion in information has recently been reported [42]. Twenty years ago (1974) an automobile technician needed to understand approximately 5,000 pages of service manuals to maintain any automobile on the highway. In 1994 that same technician needed to understand approximately 500,000 pages of service manuals to accomplish the same job. By the year 2000 the technician will need to understand 1,000,000 pages of documentation. This same phenomenon is pervasive within the Army and DoD.

The Army has used distance learning for a number of years in the form of the Army Correspondence Course Program (ACCP) and the Defense Activity Non-Traditional Educational Services (DANTES). Each of these programs is primarily print based. However, some course development may be moving towards CD-ROM. While these programs are beneficial, neither ACCP nor DANTES has been able to take advantage of emerging technologies.

One Army answer is to leverage current needs against emerging technologies. As a result, today's distance learning is a logical mix of hands on training with printed material, video tape, computer assisted instruction, interative video disc, and two-way video and data networks. Additionally, numerous peripheral benefits of distance learning have been reported [27], including

- access to more current information,
- access to more factual information,
- familiarization of teachers and students with computing and communication technologies, for both education and job-preparation,
- development of collaboration among students and strengthening the sense of belonging to one or more communities,
- ability to enable more active (as opposed to passive) acquisition of information and learning, and
- reinforcement of basic skills of reading, writing, locating information, and structuring and solving problems,

Distance learning represents a major paradigm shift in the way that soldiers will be trained in the future. The Classroom XXI project [40] incorporated a powerful concept:

> "Train leaders **How** to think – not **What** to think ..."

William H. Graves of the Institute for Academic Technology, University of North Carolina, has also provided a succinct vision of the radical change which distance learning technologies will present:

> "The old yardstick, **ownership** (of reference materials, etc.) will give way to a new measure, **access** (to shared regional and national electronic information sources). The focus will be on the tools to access, interpret, and share it, whether it is in traditional forms or in new multimedia formats."

The potential benefits of distance learning strategies are pervasive. Higher education degree programs for civilians and soldiers, dual use with research laboratories, small businesses and industry, academia, disaster preparedness, and telemedicine are some examples. Another benefit of distance learning is that it facilitates education equalization, meaning that location is eliminated as a disadvantage towards professional achievement. Additionally, advances in distance learning which integrate virtual reality technologies could provide improved methods for rehabilitation of injured soldiers.

3 Expectations for the Future

The Army envisions the widespread use of distance learning environments which are characterized by the following technologies:

- 2-way video,
- full duplex audio,
- interactive multipoint, concurrent whiteboarding,
- digital video-on-demand servers,
- wireless, cellular connectivity, and
- long haul networked personal computers and workstations with network connections costing the equivalent of a local phone call.

These technologies will be used to deliver the following forms of distance learning:

- two-way interactive television,
- traditional one-way television (e.g. cable, satellite, wireless),
- live interactive multimedia lectures from distant locations, utilizing the high resolution display of the computer,
- interactive lectures in real time with the presence of the distance instructor through a video window combined with the shared display from a functioning computer application,
- live distributed group sessions (e.g. collaborative learning, team building, problem solving), and
- desktop simulations using virtual environments technology.

Distance learning environments will be supported by information infrastructure services [28]. These services and interfaces, along with the underlying technical conventions and standards, will provide universal access from geographically distributed locations to on-line information servers containing different types of multimedia materials. The basic services and standards include:

- data formats and object structures,
- methods for managing distributed databases,
- services that provide access to electronic libraries and databases,
- methods of exchanging data and integrating data,
- services to search and retrieve data and objects,
- protocols and processes such as "digital signatures" needed to obtain appropriately secure and legal access to information,
- usage metering mechanisms, and
- protocols and processes needed to obtain the appropriate communications speed and bandwidth.

Utilizing information systems built on this set of services, students will be able to access a variety of multimedia materials, including:

- multimedia reference material (from libraries),
- television and multimedia lectures by master teachers or experts, which are stored in a computing system (information server) and are available on demand at anytime from anywhere,

- on-line instructional material which is electronically linked (hyperlinked) to other reference material, perhaps for remedial or advanced learning,
- interactive instruction which is individualized to the particular needs of the student, i.e. multimedia computer-based delivery which automatically adapts to the learning style and level of the individual (intelligent tutoring),
- interactive instruction which teaches physical phenomena through computer simulations and graphical visualization of the results (e.g. virtual experiments),
- classroom lectures which have been captured for on-demand access,
- on-line case studies (e.g. design projects, etc.), and
- interactive workbook or "drill" type exercises for remedial or reinforcement instruction.

It is important to recognize that distance learning environments will serve two distinctly different class of users: instructors and students. From the instructor's perspective, a distance learning environment will provide the following:

- simple and efficient means of capturing instructional material,
- tools to embody the experiences of the best teachers in systems which others can use,
- flexibility in terms of delivery media options and modes (e.g. class, distance, or individual),
- means to effectively monitor the quality and quantity of learning by the students,
- the capability to produce instructional material that is presented in context and in ways in which students can relate and be motivated,
- more effective means of capturing real world situations and problems, and
- means to effectively deliver concurrently a large number of different tasks and courses.

Students participating in distance learning programs will expect the following:

- variable usage time at any time,
- interactive access without location restrictions,
- links to remedial material and other reference material, and

- active monitoring, evaluation, and guidance from instructors in their cognitive learning processes, and adaptive instructional presentations and sequences dynamically suited to each student's needs.

Distance learning environments also serve training designers and developers (collaborative engineering concept) by providing:

- subject matter expertise shared across various branches,
- database of tasks, conditions, and standards readily available,
- easier means to effect doctrinal updates, and
- larger cross section of population to validate training effectiveness.

3.1 Networks

Distance learning environments will necessitate the deployment of advanced, high-bandwidth networks if they are to be successful. Table 1 [29] summarizes the bandwidth requirements for various qualities of audio. It can be easily recognized that audio can be readily accommodated by present network technologies. However, video (especially two-way) can require significant bandwidth requirements. The Office of Technology Assessment [39] has summarized the future demands for video transmission. Consider a video signal with a 2000 by 2000 pixel resolution with 24 bits of information required to designate the color per pixel. A single video frame will require 96 million bits of information. It would take 25 minutes to transmit this image using today's 64 Kbps voice links. However, this same image could be transmitted in a tenth of a second using the gigabit networks which will be common in five years. Additionally, compression algorithms are cabable of reducing the bandwidth requirements by a factor of twenty or more (these methods compress VCR quality video to a few megabits per second). Table 2 summarizes the performance of present and future networking technologies which will be used to support distance learning. It should be noted that IDREN (Interim Defense Research and Education Network) is already operating at T3 (45 Mbps) speeds and anticipates OC-12 (622 Mbps) speeds within three years.

The networks which are used to deliver future distance learning programs will most likely use ATM (Asynchronous Transfer Mode). ATM is a suite of communications protocols designed to support integrated voice and data networks [29].

While classes are presently delivered using only 384 Kbps lines, bandwidth capabilities are insufficient for delivering concurrent classes. Both synchronous and asynchronous computer based networks will be used to support two-way video transmission. These networks will be economically practical due to the emphasis resulting from the President's National Information Infrastructure initiative [28].

Type of Audio	Bandwidth (Kbits/s)
Telephone speech	16
Audioconferencing speech	32
Near-CD quality audio	64
CD-quality audio	128

Table 1: Bandwidths for Various Types of Audio

Industry Designation	Transmission Rate (Mbps)
OC-1	51.84
OC-3	155.52
OC-12	622.08
OC-24	1244.16
OC-48	2488.32
T1	1.544
T3	45 (28 T1s)

Table 2: Bandwidths for Present and Future Networks

3.2 Classroom Infrastructure

One of the benefits of distance learning is that programs can be delivered to the individual. However, there will still be situations for which having students in a common classroom will be preferred. These classrooms will include LAN-connected computers which support individual users and small group conference presentation requirements. These groups will be involved in collaborative training exercises at the collective task level. A classroom will support 16-60 students and have instructor/facilitator systems to help minimize operational overhead.

The most frequent use of distance learning will be from individuals at their local duty station or home. These individuals will be able to participate in most categories of training without leaving their office or home. Therefore, students will be able to maximize their participation in these classes because they will be able to choose the best time to participate and should have more time since the logistics of attending are eliminated.

4 Distance Learning Today

Systems which would support distance learning began to appear about three years ago. These systems are still evolving and present systems still lack many of the features which are anticipated in future distance learning environments. Distance learning systems presently have the following characterizistics:

- point-to-point whiteboarding only,
- one- and two-way video via satellite and/or terrestrial lines,
- utilize PCs and workstations, and
- video tape broadcast services.

Network bandwidth offered by today's networks are inadequate when simulations are included in a distance learning strategy. For example, during the DoDDS (DoD Dependent Schools) project, 2-way desktop video had to be downgraded from color to black and white (in some cases video windows had to be eliminated altogether) in order to provide enough bandwidth to support simulations conducted over networked workstations.

It is important to discern the fundamental difference between the predominantly passive medium of video tape (most commonly used method today) and the interactive environment supported by two-way teleconferencing. During two-way video, students participate in small group activities. Students across remote sites are actively engaged through a collaborative process. Students actually generate and exchange ideas in real time. Active participation helps to sustain a learning environment because students receive feedback as they apply skills and knowledge. By comparison, even well designed "interactive video tape" lacks real time feedback from subject matter experts. Although useful for generic repetition, video tape cannot provide specific responses tailored to individual questions.

Another distinction is made between Video Teletraining (VTT) and Video Teleconferencing (VTC). VTT is characterized by pre-determined outcomes. As individuals and small groups go through a particular set of events as established by an instructional strategy, each acquires skills and knowledge. Well designed training is based on a progressive and sequential set of events. When designed properly, outcomes are independent of the number of students who receive training. All students who complete the same training based on the same tasks demonstrated to the same standard should achieve the same pre-determined outcomes. VTC is based on a pre-determined agenda. Although one can anticipate desired outcomes, outcomes are not normally known until the end of the conference. Also, outcomes of VTC are dependent on the participants.

4.1 Hardware Systems: Three Examples

4.1.1 PictureTel

The PictureTel distance learning product [7] is a videoconference system designed for use by instructors, presenters, and meeting moderators, and aimed primarily at the growing distance learning market. The product, named Socrates, lists at prices as low as $19,500 and has been available since July 1994.

Socrates is based on the company's System 4000 and includes peripherals controlled by a touchscreen interface. The screen is mounted inside an expandable teaching podium, which also houses optional VCRs, slide projectors and other video devices. it can link to any system compliant with the H.320 standard, including PictureTel's own System 1000 and PictureTel LIVE products. It can also work with H.320 compliant equipment from such competitors as Compression Labs and VTEL.

4.1.2 Homeworks

Zenith Electronics Corp. recently announced [35] a new interface for personal computer and cable television systems that uses the cable pipeline, fiber optic, or coaxial, to send data to PCs. The system, called Homeworks, is being tested by Tele-Communications, Inc. and Utah Valley Community Network in cooperation with Zenith.

Homeworks is designed for home office computing, electronic resource services and distance learning applications that require large amounts of data to be sent over a network. Zenith hopes the technology will be adopted for use by business, in particular the finance, legal and medical communities, as well as schools.

Before consumers or businesses can access any cable-PC services, Zenith must convince cable companies to dedicate a portion of their conduit to the system. The system is being marketed to cable companies primarily as a way to expand their revenue and increase their service offerings.

With Homeworks, a single cable TV channel can be split to carry four subchannels of data that can operate at 500 kilobits per second. Its performance is faster than a 9,600 baud modem or even ISDN[1] at 56 Kbps. In addition, data can exist alongside regular cable TV channels without interference to either transmission.

In the home, Zenith's new Homeworks gateway product was used to provide access from a personal computer to a Novell-based learning server located in the business office. The learning server contained files and data provided by schools and institutions involved in the test. For example, BYU used the system to allow its 30,000 students to access the school's file server outside the overcrowded on-campus computer lab.

[1]Integrated Services Digital Network: The services commonly provided by the telephony industry which are based on fixed bandwidth circuits.

A Homeworks PC gateway card and RF modem are expected in early 1995 for $495.00. A high-end system called LAN 4000, which is capable of operating at 4 Mbps, will also be available. This system is projected at $895.00 and intended for commercial applications.

4.1.3 InSoft Network Television

InSoft Network Television (INTV) markets software [33] which allows live or recorded television programming to be accessed on demand throughout the network. INTV is based on InSoft's Digital Video Everywhere (DVE) architecture for enterprise-wide audio and video, and is the latest in a line of DVE-based products that includes Communique, the company's desktop videoconferencing solution.

While desktop offerings like Communique are available from InSoft competitors such as Invision Systems and Compression Labs, InSoft's real advantage may be that the new INTV is a network-based solution. With the rise of ATM networks and desired applications such as telemedicine and video learning, INVT seems to be a product designed with the future network in mind.

INTV runs on any TCP/IP based network and supports ATM, frame relay, ISDN, SMDS, and switched 56 Kbps for WANS. Presently INTV supports the graphical user interface for Sun's Solaris operating system with version 1.x or above required on the client end, and 2.x or above for the TV station server. The use of a 16-bit Sun Video board creates the high-resolution TV quality picture, and users access video without having video capture boards in their computers. InSoft plans to expand its support to Hewlett-Packard and IBM platforms.

4.2 Select Software Systems

4.2.1 Person to Person/2

IBM's $280 Person to Person/2 network-based workgroup software [13] lets users work together in real time, but it doesn't have audio support: you're expected to use another telephone line for audio. The software includes screen sharing and file-transfer capabilities but works only with ISDN rather than ATM.

4.2.2 ProShare Personal Conferencing

The $299.00 Premier Edition of ProShare Personal Conferencing [18] allows users to annotate images of documents, spreadsheets, and other static information. Users can connect via modem or over a LAN and simultaneously work on word processors, spreadsheets, and other Windows applications. ProShare includes application sharing and shared whiteboard features.

4.2.3 Vistium Personal Video System

The Vistium Personal Video System 1200 [38] gives users real-time desktop videoconferencing and allows users to work collaboratively on shared windows applications. Because this system is based on established international standards, users can hold videoconferences with anyone using standards-based videoconferencing room or desktop systems.

4.3 Case Studies

4.3.1 Army Teletraining Network (TNET)

VTEL corporation has been selected as the teletraining standard by the United States Army to provide long-distance training capabilities to Army personnel nationwide, including Schofield Barracks in Hawaii [34]. The VTEL standard is already proven by VTEL's installations of over 50 percent of the interactive distance learning systems in higher education and the cost effective use in the United States Navy and other government installations, in addition to the selection of the MediaConferencing equipment by the Army.

The United States Army Training and Doctrine Command (TRADOC) faced increasingly expensive training and travel costs nearly three years ago. At that time Oklahoma State University's Institute for Telecommunications presented a low-cost digital, interactive, multi-site videoconferencing by satellite solution to their communications needs. The program was implemented and TNET was formed.

After an extensive program evaluation with National Guard armories in Kentucky, videoconferencing was determined to be an efficient and effective method for training soldiers. VTEL was chosen over other videoconferencing suppliers to fill the needed equipment requirements. VTEL's PC-based open architecture platform allows quick, low-cost upgrades as needs and requirements change, which is a key factor in today's budget-conscious environment.

The Army has optimized the maximum student load per instructor with videoconferencing and has reduced travel and per diem costs. Furthermore, with the teletraining network, soldiers are provided with more time at their parent facility and a wider availability of programs. TNET was also applied during the Persian Gulf crisis to provide Arabic language teaching by the Unites States Defense Language Institute at The Presidio in Monterey, California and for tactical training of troops stationed in Ft. Hood, Texas and Ft. Huachuca, Arizona, among other combat-ready units, as they prepared for deployment overseas.

4.3.2 Fort Knox Classroom XXI – Classroom Without Walls

An example of how distance learning enhances resident or traditional classroom training is the Classroom XXI initiative led by Fort Knox. Classroom XXI is not an actual place, Classroom XXI is an environment.

One purpose of Classroom XXI is to electronically link students, small group leaders, small group instructors and subject matter experts. The concept has been demonstrated with the Armor Officer Advanced Course (AOAC) on three separate occasions.

The AOAC prepares Lieutenants and Captains to be Company Commanders and battalion/brigade staff officers. Part of the training involves preparing courses of action for battalion or brigade exercises in a combined arms scenario.

Company commanders and staff officers need to consider a number of factors. What information and support is available from the Intelligence Officer (S2), the Combat Engineer Officer, and the Fire Support Officer (FSO) are only some of the company commander's concerns.

Currently, some officers who the Company Commander might interact with are located at service schools respectively: Intelligence, Ft Huachuca, AZ; Combat Engineer, Ft Leonard Wood, MO; Field Artillery, Ft Sill, OK; Air Defense, Ft Bliss, TX. Such a geographic dispersion makes it impossible for the student company commander to include the actual personnel in the resident classroom setting when preparing courses of action. Consequently, students enrolled in AOAC role play Intelligence, Combat Engineer, and Field Artillery Officers.

All major U.S. Army branches conduct Officer Advanced Courses (OAC) which run concurrently with other service schools. It is possible to synchronize courses and plan a series of joint classes and exercises culminating in a combined maneuver OAC. Using two-way video, interactive whiteboarding, and constructive simulations, an Armor officer at Ft Knox can plan, interact and execute with actual Intel, Engineer and FSOs, instead of role playing within a classroom.

The benefit of this electronic environment is multifold. Up-to-date doctrine, refined communication and briefing skills, and greater awareness, understanding and appreciation for Combined Arms Forces are only a few benefits. Classrooms without walls are especially significant when conducting long-haul virtual simulations exercises. Two-way video between Ft Knox and Ft Rucker has been used to deliver Operations Orders in preparation for these exercises.

Most recently an Observer/Controller from the desert floor of the National Training Center (NTC) was linked with OAC students at Ft Knox, Ft Huachuca, Ft Sill, and Ft Lee. One purpose of the link was to show how experience and expertise can be leveraged to benefit leadership training. Training developers at Ft Benning, Ft Knox, Joint Readiness Training Center (JRTC) Ft Polk, and the NTC used the same link to collaborate on Mission Training Plans. These enhancements to leadership and training development are a result of leveraging existing technology by fully exploiting a distance learning strategy.

4.3.3 19K Advanced Non-Commissioned Officer Course (ANCOC)

The 19K ANCOC is an Armor crewman platoon sergeant's leader development program. The Noncommissioned Officers Academy, U.S. Army Armor School conducts 19K ANCOC in residence over a twelve week, two day period. While active component soldiers attend the course, few reserve component soldiers are available for a contiguous three month period. As a result, many reserve component soldiers attend United States Army Reserve (USAR) Schools.

Course materials for USAR schools are generated by proponent institutions. In some cases it is difficult to maintain currency of USAR materials. As a result, materials are sometimes two, three, or four iterations old when compared to active, resident instruction.

Further, USAR courses are conducted during Inactive Duty Training (IDT) and Active Duty for Training (ADT) periods. An IDT is one weekend a month. An ADT is usually two weeks. The USAR Schools offer three 19K ANCOC options ranging from six IDT's and a twenty-one day ADT to nine IDT's and two, twelve day ADT's. Thus, it takes between one to two years to complete a course using outdated materials.

Fort Knox began the distance learning 19K ANCOC in December 1992. The course takes place over six IDT's and one ADT. The course is taught by the same instructor, using the same materials for the same tasks and standards as the resident course. Soldiers graduate with the same diploma as if attending the resident course. The difference is with delivery media.

During the IDT phase, students use a combination of self-paced programmed text, videotape, and computer assisted instruction materials. Once students complete the self-paced materials, they apply acquired skills and knowledge during live, small group, two-way video interactive training sessions which take place during the IDT weekend. The combination of self-study and live interactive training during inactive duty training prepares students for collective performance training and evaluation via simulations, situational (STX) and field training exercises (FTX), during annual duty training. Finally, students demonstrate their skills and knowledge during the ADT.

Thus far, application of the self-paced, small group, collective strategy, using the model of train, apply, demonstrate has resulted in student evaluations within four points of full resident instruction.

Each class enrolls eighty students and currently reaches soldiers in Vermont, Montana, Idaho, and Pennsylvania using the Army Teletraining Network or TNET.

The 19K ANCOC demonstrates a number of benefits. Soldiers are trained to the same tasks and standards which yields standardized training. Actual dollar savings is about 55% when compared to a resident course. The time it takes to train reserve component soldiers is significantly reduced. Savings in time is especially important because there is an approximate backlog of 1200-1400 soldiers waiting to receive 19K ANCOC. It would take over forty years to meet the backlog if soldiers had to go through the proponent resident course.

Leveraged technology is pivotal to the success of 19K ANCOC. For example, Vermont operates a two-way video network known as Vermont Interactive Television (VIT). The Vermont network has nine sites. By placing a TNET at the VIT headend, the Army achieves an economy of scale by receiving nine remote site small group classrooms for the cost of one TNET. Without the benefit of leveraged technology, distance learning between Ft Knox and the Vermont Army National Guard would be cost prohibitive.

Computerized testing also proved successful. Instead of paper based tests, some modules use PC's to generate tests and record student responses. Currently, students save responses to 3.5 inch disks. Test proctors mail the disks to course managers. Use of computers could be exploited by establishing a file server at the Noncommissioned Officers Academy and issuing laptop PC's to students. In addition to facilitating student access to a file server for testing, laptops would eliminate the need for voluminous, difficult to update, print materials.

The logical progression is, via distance learning, to use a combination of TNET and ISDN or ATM services to deliver constructive and virtual simulations to remote sites. Fort Knox is home to a premier virtual Simulation Network (SIMNET). Fort Knox also uses constructive simulations such as JANUS. Soldiers from remote locations could participate in preplanning and preparing courses of action, observe the commander's or stealth view of the simulation taking place at Fort Knox, and interact during the After Action Review. In some cases, units at remote sites could actually participate as Semi Automated Forces (SAFOR) from networked workstations. Ultimately, distance learning technology will allow remote maneuver units to train via SIMNET and JANUS. Distance learning will help enable remote units to get the feel of maneuver with larger units, training which is generally unavailable.

4.3.4 National Technological University (NTU)

The National Technological University (NTU)[3] provides a wide range of instructional television courses on a national basis. NTU is an accredited institution supported by many universities across the country. Courses are taught by the top faculty from over 45 of the nation's leading universities/organizations. NTU's functions are to:

- award master's degrees in selected disciplines,
- provide research seminars in each discipline,

[3]National Technical University, 700 Centre Avenue, Fort Collins, CO 80526-1842.

- operate an instructional television network via satellite for convenient, flexible, on-site service in North America,
- operate a videotape instructional service internationally,
- offer advanced technology and management programs in the form of non-credit courses and workshops, and
- establish a sophisticated satellite network infrastructure between industry and the academic community.

NTU has been providing satellite delivery of education since 1985. In the most recent academic year (1992-93) NTU offered 22,702 hours of academic credit instruction and 2,980 hours of advanced technology and management programs.

4.3.5 MBone

A series of Internet node operators have collaborated to create the Internet Multicast Backbone, or MBone [23, 30, 37]. Eventually, multicasting will be built into routers (software exists that turns a Proteon router into a multicast node), but today the MBone consists mostly of workstations in a mixed mesh and star topology running multicast IP routing software (about 900 subnets participate at various times). Sites that want to join the MBone communicate with local nodes and agree on how to route the traffic. The multicast is more like radio than an e-mail broadcast in that it has no complete list of destinations. Instead, an interested site can tune in to the data stream and participants can listen or watch, as the case may be, without being on a specific destination list.

4.3.6 California Public Schools

At a joint press conference [36] with California Governor Pete Wilson, Phil Quigley, the president of Pacific Bell, announced that Pacific Bell will offer linkage for computer communications and videoconferencing - the first lane of the superhighway - to each of the nearly 7,400 public K-12 schools, public libraries, and community colleges in Pacific Bell service territory by the end of 1996. Components of Pacific Bell's education initiative include: switched digital service, allowing telecomputing and interactive telelearning capability, will be made available to all public schools. Subject to regulatory approval, each institution can get free installation of four ISDN lines for these applications, and Pacific Bell will waive the usage charges for the first year after installation.

Pacific Bell president Phil Quigley will spearhead a public/private consortium to ensure that every California classroom and library is wired and equipped for full access to the communications superhighway by the year 2000.

4.3.7 NEEDS

NEEDS (National Engineering Education Delivery System) is an instructional database system being developed by the National Science Foundation Engineering Education SYNTHESIS Coalition. A prototype system is now in operation, providing on-line database service (Gopher) for the distribution of instructional materials to all the participants, and incorporating a catalog system modeled and administered by professionally trained librarians. The present prototype system, primarily based on standard "card catalog" functionality with ftp retrieval, will likely evolve into distributed database servers with a control catalog system for hyperlinking to the distributed material. Instruction modules developed at different universities within the various coalitions, as well as those developed locally, can be used to aid teachers to illuminate complex concepts.

5 Open Issues

Distance learning represents a major transition in the way educational opportunities and training will be delivered in the future. It requires a fundamental shift in the way we conduct business – a change in attitude. The Army should not approach work force training/retraining by simply maintaining the status quo. This approach will not satisfy the challenge of supporting the Army's training needs within the present restricted resource environment. The Army must anticipate that these new methods are dependent on many factors, of which workers and technology are two of the most important. Workers will be required not only to adapt to continuous changes in the workplace (which cause anxiety since equilibrium is disrupted) but must accept responsible and ownership of their contributions to this changing environment. Technology must be continually leveraged to achieve the necessary economies of scale which are found at the crossroads of information technology. It is fundamental in any aggressive effort to merge humans and technology that the individuals involved assume ownership of this process. Several factors and goals must be considered in the process of this merger, including:

- the development of the human factor,
- the use of humanizing techniques,
- the transition of instructors to facilitator/mentor role,
- the need to place emphasis on learning rather than teaching,
- the need to generate student centered instruction,
- the benefits of allowing the student to assume responsibility for learning,

- the benefits of empowering the workforce by integrating training with actual products employees are responsible for managing,
- the need to reward employees who accept change, and
- the need to acknowledge innovators as equally beneficial as caretakers.

There are many benefits of distance learning. However, it is of primary importance that suitable metrics be defined to assess benefits. Distance learning will allow the Army to reach the same number of students for less, or a greater number of students for the same cost. Quantitative methods need to be established to measure distance learning environments with traditional instruction approaches. There are other benefits of distance learning which should also be measured and evaluated, including lower costs, reduced time for individual training allowing improved overall job productivity, more standardized training, improved and enhanced training, and a more pleasurable, and therefore successful, training environment for the student.

High-speed networks are of paramount importance if distance learning is to achieve its promises. The availability of these high-speed connections seems evident. However, access to these networks must be economically practical (i.e. similiar to the cost of a local phone line connection). Cost evaluations must recognize the fact that network access costs should be amoritized over the entire catalog of course offerings rather than against a single course. Additionally, these networks will most likely be used to carry other services to sites (such as email). This means there are other parameters of consideration which should be included in cost analysis.

The transition to technology-based distance learning can only be accomplished by addressing factors which presently restrain its widespread adaptation and acceptance. Some of the issues which need to be addressed are:

- greater availability of broadband networks,
- more robust implementation of multicasting,
- greater use of mobile cellular technologies,
- incorporation of multipoint, concurrent whiteboarding capabilities,
- need for software vendors to provide APIs (Application Programming Interfaces) so customized courseware can be developed using these software environments,
- vendor independent standards for distance learning infrastructure,
- improved, standardized tools for instructors to produce material,
- deployment of information servers with links to distributed materials,

- development of proper policies and maintenance administration for information servers,
- further research and development, particularly in software to support distance learning and effective courseware implementation methods,
- the need to establish an "electronic instruction development center" to support instructions with the creation of instruction material,
- the definition of a standard electronic classroom for originating and receiving distant learning, and
- the need to provide the resources to support and coordinate distance learning initiatives.

The deployment of new solutions for training should not be considered successful based simply on the use of technology. There are significant issues related to human factors which must also be considered. Electronic based training necessitates a change in attitude and approach for students. In particular, more discipline and independence is imposed on the student which requires the student to be much more self motivated. Instructors, familiar with the status quo instruction methods, must also transcend from traditional approaches to digitally-based instruction environments. Finally, the entire concept of how workforce training/retraining is approached must be changed in order to utilize these new distance learning methods.

6 Conclusions and Recommendations

Acceptance and implementation of distance learning technologies will radically alter the methods used to educate, train, and retrain present and future soldiers. The inherent benefits of commvergence [5] (the convergence of information services and information delivery systems — a consolidation of communication, computer, and broadcasting technologies) will mean that the "significance of place" will ultimately be eliminated. It is evident [9] that educational trends point towards videoconferencing, interactive services, and self-paced instruction.

Two-way, interactive, multi-participant environments supporting a robust set of tools (whiteboarding, shared applications, etc.) will be commonly available. High-speed networks will be widespread in and outside DoD — evident from the fact [41] that telephone companies expanded their fiber optic infrastructure from 113,213 miles of fiber in 1989 to 212,128 miles by 1992. Information servers will be widely available from libraries, federal agencies, universities, and industry. These servers will provide practically boundless access to materials for use in hyperlinked education materials.

It is important that the Army adequately evaluate technologies for distance learning during this early stage of technological evolution. This will insure that informed decisions and actions are taken when planning for future distance learning programs. A pilot program involving the Information Technology Laboratory at the USAE Waterways Experiment Station and the US Army Armor School at Ft. Knox could address both the technological capabilities and training elements necessary to more comprehensively evaluate both the pros and cons of distance learning technologies. Results from this pilot project could then be used to determine the long range requirements and expectations for Army's use of distance learning.

The investments which the Army allocates towards implementing distance learning environments will not only affect the Army but will become models with dual-use benefits. Knowledge and experience gained from effective execution of a distance learning initiative will be leveraged by other federal agencies, industry, and academia. Industry, with its recent commitment to "life-long" educational benefits for workers, will no doubt utilize the successful models employed by the Army. In the end, Army's investment in distance learning is paramount to achieving a more capable and productive workforce which ensures Army's continual leadership.

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APPENDIX 11

LEAVENWORTH EXPERIENCES
WITH
CLASSROOM XXI

WHAT DMR MIGHT SAY ABOUT CGSC CLASSROOM 21!

MAJ FRANCIS A. FINELLI

Section 10C

A716: New Perspectives in Leading the Army Through Change

LTC Zak

Disclaimer: DMR is the leading international provider of information technology services to businesses and public enterprises. Both Dan Tapscott and Art Caston, authors of Paradigm Shift: The New Promise of Information Technology, are employed with DMR. This analysis is based solely on their work, interviews with key individuals throughout the College, and my personal assessment of the resident CGSOC process. Parenthetical references in the text are to Paradigm Shift.

LIST OF ILLUSTRATIONS

Introduction

The application of information technology (IT) in CGSC Classroom 21 will have little more impact on student learning than the substitution of slide rules with hand-held calculators in the early 1970s, unless the institution undertakes a three part strategy to change the student learning process. First, the integration of hardware and software is nothing more than a retooling effort. It will have minimal impact on those students who already know how to take advantage of office automation. Unfortunately, those students, faculty, and administrators with poor automation skills may be literally unaffected by retooling alone. Second, the organizational position of information system operations and support within the organization must be realigned. This realignment will ensure a robust operating environment with adequate user support to build confidence and reliability in the retooled technology architecture. Third and most importantly, the organizational process of teaching students at CGSC must be reengineered to motivate the use of automation applications. The outgrowth of an effective reengineering would be increased user demand-pull for new automation technology. At present though, CGSC appears to be primarily reacting to technology-push phenomena.

This analysis will concentrate on reengineering the organizational process for CGSC resident course students.[1] As such it will focus on process change in the interaction of the faculty, students, and administration. The following question places this task in perspective: How can we change the organization so that the students and faculty gain the same utility from using the computer network, as they currently do using a telephone? This is the culture or paradigm shift that is being sought under the Classroom 21 initiative. This study will also briefly address the requirements for hardware, software, and network retooling; as well as the information system realignment needed to make the reengineered student process a success. It will assume that developing automation familiarity and application literacy is key to the professional development of future military leaders. After reading TRADOC PAM 525-5 and General Sullivan's "America's Army" National Security Paper No. 14., it is clear that the warfighting requirements for the "little 'a'" Army are becoming more information intensive. Furthermore, the use of automation applications in support of the "Big 'A'" Army's execution of Title 10 service functions have significantly increased.[2]

In Paradigm Shift: The Promise of Information Technology, Don Tapscott and Art Caston hypothesize that we are entering a second era in information technology based on integrated network systems. This advance is the catalyst for paradigm shift in organizational process. This hardbound consulting pitch synthesizes the Era I to Era II transition requirements in one model; depicted in Figure 1. Tapscott and Caston present a three shift structure: (1) reengineering the corporate process; (2) retooling the corporate capital; and, (3) realigning the information systems function. In addition, they identify the four plateaus that must be overcome within each of these shifts to implement an Era II paradigm based on integrated network systems. First, the corporation must reimage--set a vision for an overall strategy and be committed to it.

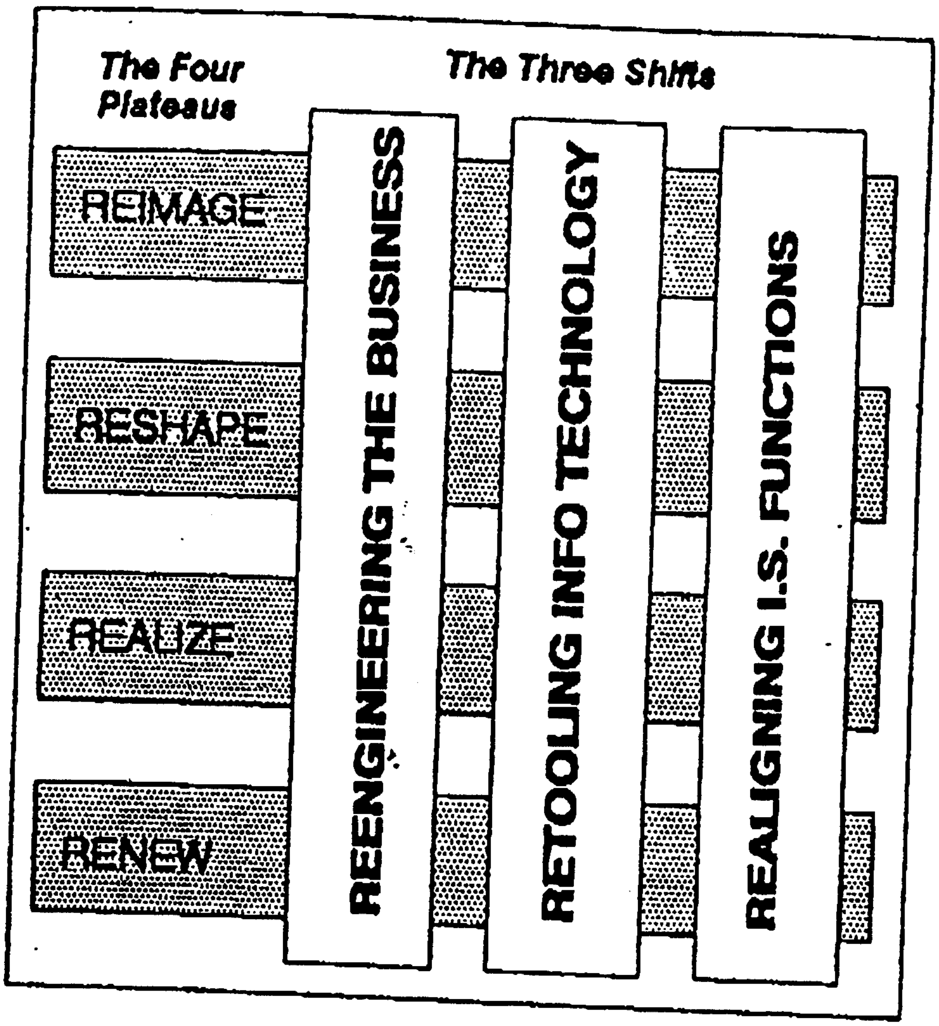

Fig. 1. The Paradigm Shift Framework. Source: Dan Tapscott and Art Caston, Paradigm Shift (New York: McGraw Hill, 1993), 187.

Second, it must reshape--structure the solution in terms of resources, locations, and relationships. Third, it must realize--develop and deploy the planned changes in people, process, and capital. Fourth, it must renew--solicit and capture feedback, and integrate it into continuous refinements in the process. A detailed discussion of the background for Era I and Era II systems is included in the Appendix.

Era I began with the introduction of office automation technology into organizations. It was initially characterized by Management of Information Systems (MIS) when dumb terminals were linked, often with clumsy interfaces, to mainframe host computers. MIS evolved into Decision Support Systems (DSS) when dumb terminals were replaced with personal computers that could emulate terminals when on-line with the host, and process applications with internal software separately. DSS was characterized by four phases: (1) early development; (2) rapid growth; (3) mature growth; and (4) decline. CGSC may currently be in the latter phase characterized by declining productivity.

The Era II system is characterized by three critical changes in the application of information technology to new organizational paradigms. First, Era II systems shift from personal to work group computing (WGC). Automated work processes should mirror communications processes--talk as a group, work as a group, compute as a group. Second, system islands, that were application or product specific, are now linked in open systems architectures to broader integrated systems. Third, internal networks are expanding to support inter-enterprise computing whereby processes are horizontally and vertically integrated across different, geographically dispersed organizational units.

WGC facilitates the parallel, as opposed to serial, processing of applications within a horizontal staff or hierarchy. When properly implemented, WGC makes walls go away--the office is no longer a place, it is an interactive system. It leverages information from networked, multifunction workstations to create redesigned work processes and organizational structures; as summarized in Figure 2. This shift should enhance the efficiency of staff communications, improve the collaborative development of products, and provide a more effective and encompassing environment for decision support. In short, WGC drives better marginal productivity in our staffs because of increased access to shared information and a steeper applications learning curve due to increased worker interaction. WGC can revolutionize the CGSOC staff group process.

Modern technology facilitates integrating systems and mediums across an organization. Data, functions, and applications can be processed and maintained wherever they are necessary; yet, all users may be able to access disparate elements through a common interface available at their workstation. Therefore, integrated systems can remove the isolation of functions within an organization.

Stand-Alone Personal Computers	Work-Group Systems
Stand-alone word processing and presentation graphics.	Shared document creation, multi-user idea processing, application sharing, EDI, and computer conferencing.
Desktop database.	Shared information handling of knowledge bases.
Spreadsheet.	Multiuser decision support and modeling environments.
Diaries	Time & Resource Management, scheduling, process mgmt, group project mgmt, and procedure automation.
Tutorials	Computer-aided learning; support from work-group.

Fig. 2. The shift from personal to work-group computing. Source: adapted by author from Tapscott and Caston, Paradigm Shift (New York: McGraw Hill, 1993), 49.

Individuals and teams can operate in a network of client-servers, where clients task servers and servers answer taskers. This internal corporate system can be further networked to inter-corporate systems to make an expanded set of data, applications, and functions accessible to a broader universe of clients. In the limit, this extended enterprise can make geography irrelevant from a work perspective. Consider the efficiency of direct electronic client-server relationships between CGSC administration, faculty, students, and the broader Army. All agencies, given security considerations, could use interoperable systems with standard applications and network protocols to access virtually the universe of Army data, software, and models.

CGSOC '93-94: Era I in Decline?

The typical CGSOC classroom is depicted in Figure 3. This system probably reflects the declining productivity stage of the Decision Support System model addressed in the Appendix. Classrooms have nothing more than antiquated desktop computers linked through a less-than-state-of-the-art network, to a backbone system with little utility for the student. Further, there is no organizational requirement for the student to ever use the system. In fact, the CGSOC process would literally remain unchanged if there were absolutely no computers in the CGSOC classrooms. The process flow for student requirements does not employ classroom automation and may be simply depicted as in Figure 4. It is characterized by the verbal or paper transmission of inputs to, and outputs from the learning process. There is also no link from the classroom PC through the network to a student's home computer. Finally, there is no means to facilitate work group computing in the learning process because there is no student, to staff group, to faculty automated interaction.

Organizationally, each staff group has a unique system identification/password and mailbox in the CGSC network. All individuals within the staff group must share this common identification/password and mailbox.

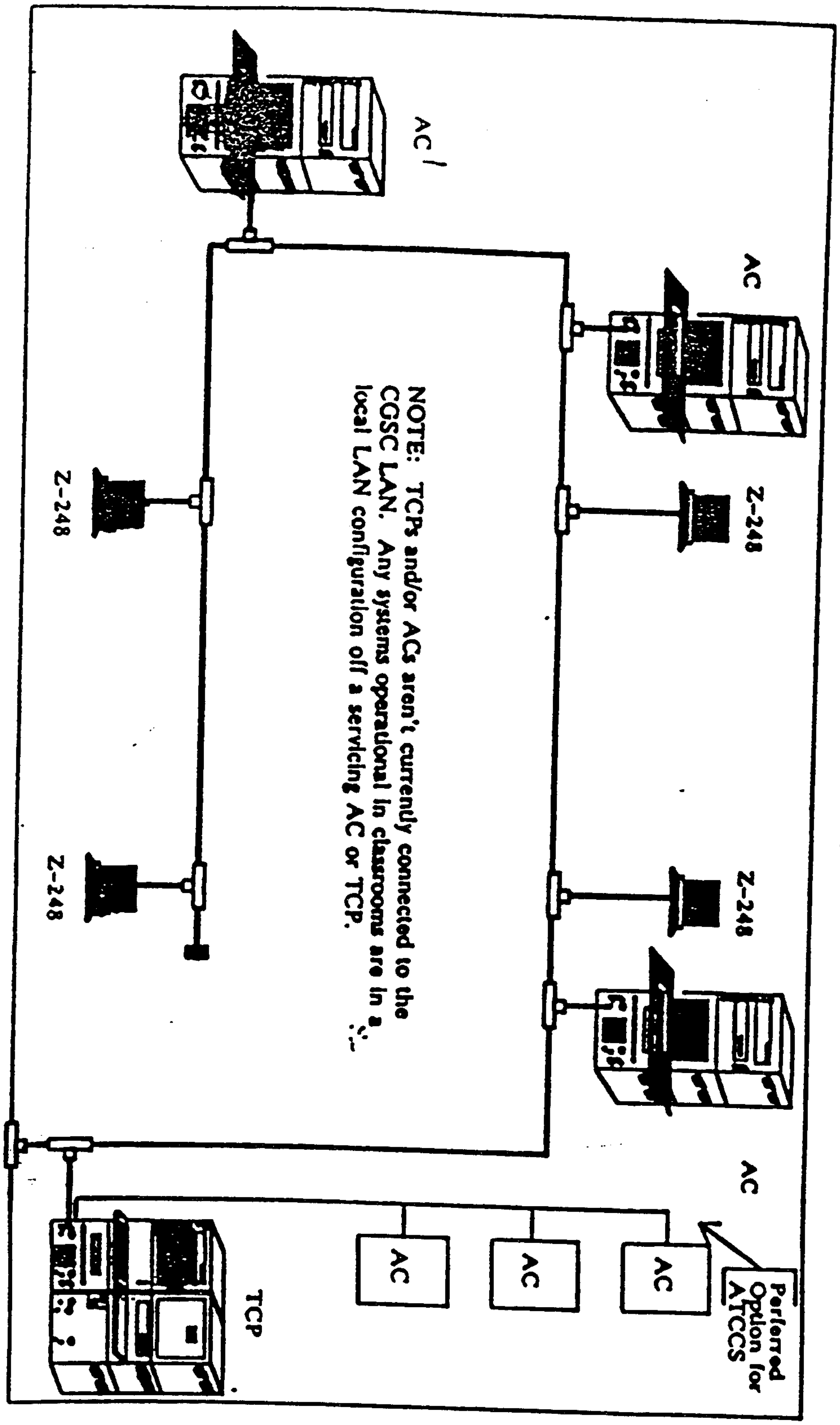

Fig. 3. Typical CGSOC Classroom AY93-94.

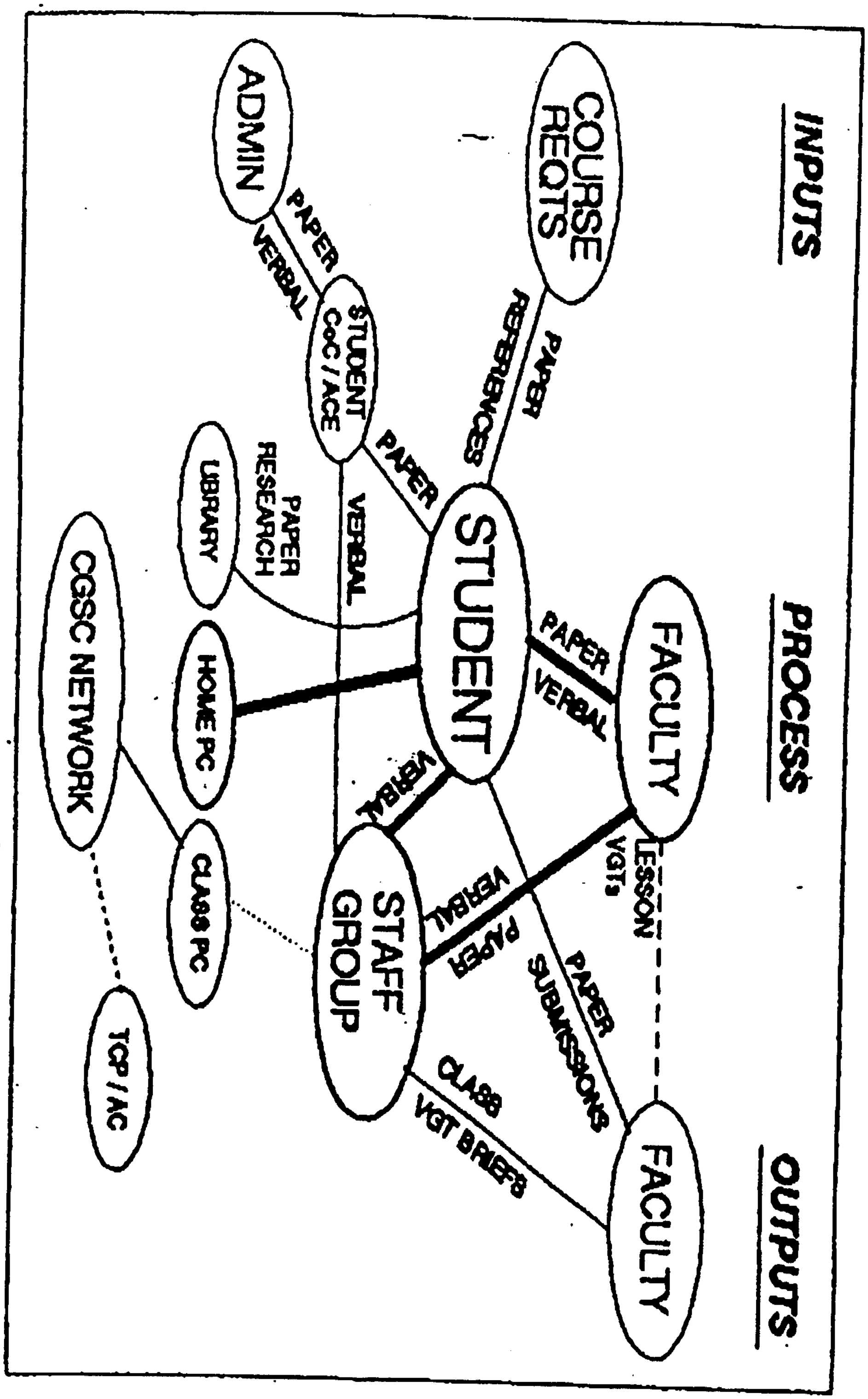

Fig. 4. The AY93-94 CGSOC Student Work Process Flow

confidence in the reliability and robustness of automated information systems for student administration. Consequently, the College operates redundant paper, verbal, and electronic dissemination channels. Several section leaders admit going months without ever checking their E-mail boxes for information because they know that any important information will be disseminated manually anyway. Ensuring that all mediums are consistent is a tedious, mundane, and inefficient use of human resources. Academic counselors, since they have no electronic access to their students, are forced to use either direct verbal communications or paper products to convey administrative information to their staff groups. Automation may have actually increased administrative inefficiency. For example, the course registration process could have been as effectively run on manual course ledger sheets. Every student received at least 6 copies of term II and III printouts; regardless of whether they individually made any changes. Further, "decision rules" within the registration software apparently caused unnecessary changes in student schedules. These required the additional commitment of ACEs, students, and the registrar staff to correct.

The average resident student graduates from CGSOC without every having had to exhibit proficiency in any computer-based application and without ever having used the ATCCS devices. This creates two problems. First, those students being assigned to tactical units have not increased their familiarity with the ATCCS. Whether you like MCS or not is irrelevant--it is the Army tactical command, control, communications, and computer (C4) backbone system at Corps level and below. Therefore, it is certainly prudent to develop MCS-based skills in the field grade tactical leadership. Furthermore, the proliferation of automation into tactical units is increasing rapidly; and with it is the expectation that tactical leaders will produce more advanced products using presentation graphics, spreadsheets, document processing, and database analysis. The current CGSOC classroom and curriculum does little to provide the resident graduate a comparative advantage in this environment. Second, those students being otherwise assigned to TDA positions are entering the "land of a computer on every officer's desk." This environment has even greater expectations of application-familiarity for presentation graphics, electronic mail, and document processing. Again, the CGSOC classroom and curriculum fails to inherently prepare students for success in this environment.

The bottom line is that the automation process for CGSOC AY93-94 creates a declining growth in productivity for two reasons. Students who are literate in application skills probably own hardware and software platforms that are far more advanced than that available in the classroom. They are therefore motivated to prepare all their products at home. This decreases student interaction on group projects. More importantly in some cases, their skills have gotten too advanced to be helpful in teaching other students, who lack application skills, with the classroom systems. For example, it is hard for someone who uses Power Point with mouse and windows to teach Harvard Graphics Version 2.3 without a mouse. Finally, those students who previously lacked automation skills, and learn them in the CGSOC classroom, are learning antiquated versions of no-longer industry standard systems. Unfortunately, most students who enter CGSOC as application illiterate, leave CGSOC application illiterate unless they invest their own personal resources in a computer system. This may not be a problem if it is the intent of the CGSOC learning process. If so, then applications development is not a part of the resident CGSOC process and the College should forego any investment in classroom automation because there is no strategy for its use. In conclusion, CGSOC creates three segments of students: (1) those who enter as application literate and continue to use their own systems; (2) those who enter illiterate, purchase their own systems and leave semi-literate; and, (3) those who enter application illiterate, do not acquire skills due to antiquated classroom systems, and leave application illiterate. This staff group process may therefore embody what Peter Senge, in The Fifth Discipline, terms the myth of teamwork: "The consequence is . . . 'skilled incompetence'--teams full of people who are incredibly proficient at keeping themselves from learning."[4]

Retooling for CGSC Future: Era I still?

A system proposal for Classroom 21 is depicted in Figure 5. It embodies many of the technical characteristics of an Era II system. In essence, the student will be faced with a windows-based, 486 platform with access to greatly increased network capabilities. This facilitates applications being processed wherever they are most efficient, client software and data being portable across a more-vendor-neutral hardware network, digitized graphics transfer, multi-media applications, and a mouse-driven common graphical user interface (GUI) with pull-down / click-on menu to enhance user friendliness. Additionally, the network technically integrates students, faculty, and administration into a common backbone. It furthermore provides the system gateways to the extended enterprise--DDN Internet, TRADOC PROFS, ATRRS, and other academic/professional utilities. This is the extension of technology-driven vertical and horizontal integration. Eventually, it can become the electronic paperless "faxing" of multimedia applications across broad telecommunications links. Finally, Classroom 21 appears to provide the hardware and software environment to develop work group computing. Nonetheless, the realization of Era II enhancements will be more a function of the reengineered student process, than this retooled technology.

Classroom 21 must be retooled with the latest and the greatest industry standard hardware and software. We must be careful not to lag industry standards; and more

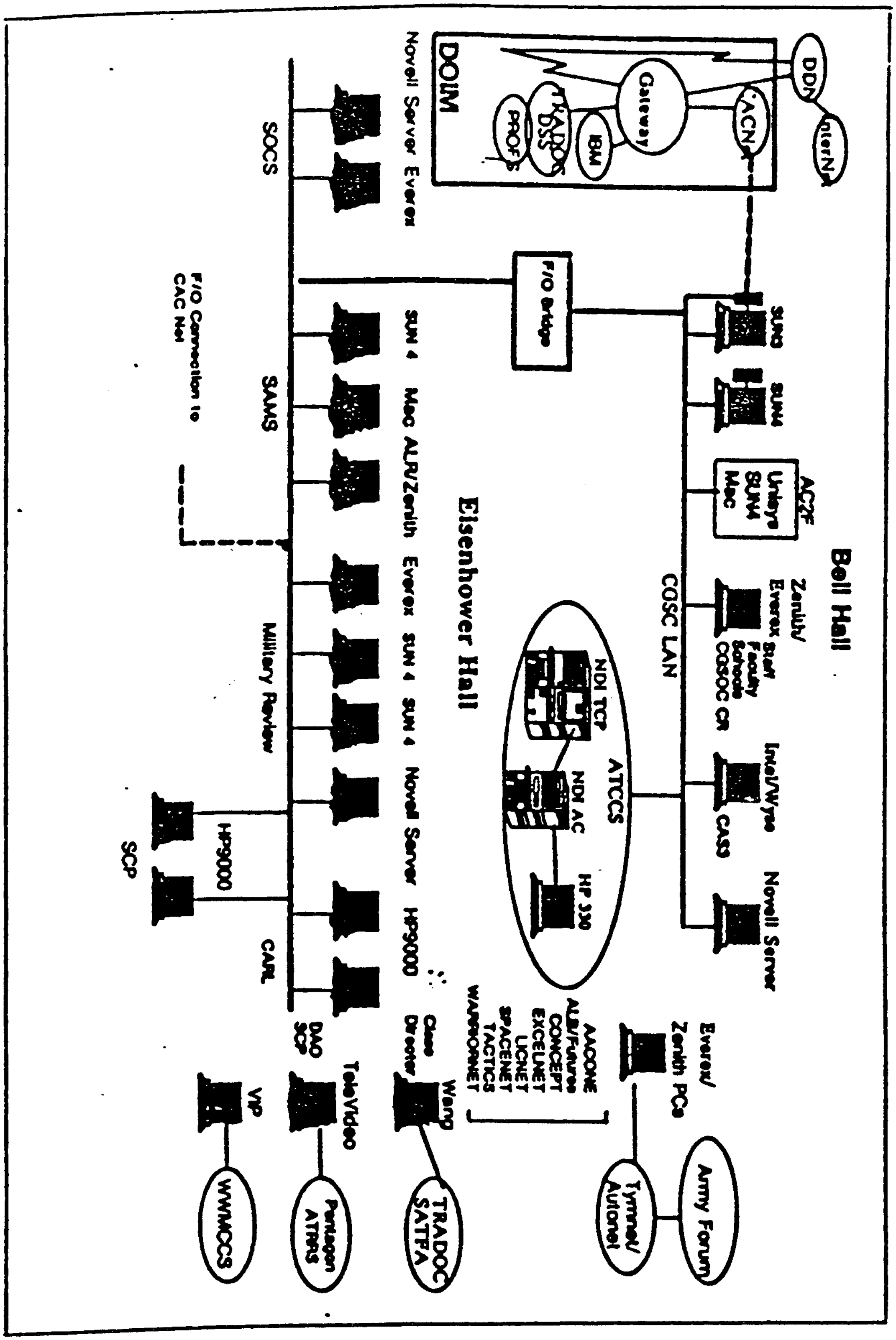

Fig. 5. The CGSC Future Integrated Network

importantly, not to buy industry outliers--those products that appear to do the job at lesser cost; yet have degraded upgradeability. The Army should have learned its lesson with WANG in the early 1980s.

Several software utilities must be present in the retooled Classroom 21 backbone architecture. First, automated combat and service support simulation packages must be available to conduct wargaming courses of action. There is absolutely no reason that students should persist in developing bad habits by applying invalid rules of thumb to wargaming by hand. This devolves into a virtually meaningless exercise because there is absolutely no rationality in the method of assessing battlefield effects.[5] Second, an active bulletin board should be available for student, administration, and faculty use. Third, every student must get a unique, password-protected file drawer on the backbone system that can be accessed remotely. This access supports productivity enhancements from split-based work in the classroom and at home, across the staff group. Fourth, the MCS AC or TCP should be loaded with current applications software to provide a second platform per staff group to produce presentation graphics, documents, and analysis. This not only provides a platform to support the second work group often designated for course requirements, but drives students to develop skills using key ATCCS components. Fifth, a range of output devices--from dot matrix to color laser printers for VGTs--must be addressable through the network. Hopefully these devices will be used selectively because the vast majority of course requirements will be conducted electronically. A system of password authorizations can be applied to monitor or control usage. Finally, voice messaging should be a network utility. Agencies should be able to make official calls to students at school, not home. Students would then be able to log-on or call-in to receive this multi-media enhancement of current E-mail systems.

This retooling process should be based on a work process perspective. Who do you want to prepare what products, where, when, and with what information technology tools? Some of these retooling principles are addressed in Figure 6.

This Era II classroom should be an open system characterized by both portability--software applications and information can be easily moved to various computers of various sizes and brands--and interoperability--computers from different vendors with different capabilities can communicate together; i.e., share resources, information, and even software applications. This is the critical link for making split-based computing (work and home) feasible. This combination of open systems and standard user applications must be interoperable so that connectivity at different levels throughout the network is transparent to the user. Therefore applications, rather than "flat" ASCII or EBCDC protocol files, can be transferred throughout the network. This process, characterized by Tapscott and Caston as Electronic Document Interchange (EDI), is the backbone of

1. IT architecture should utilize standard, shareable, and reusable components across the enterprise.
2. Users are provided necessary accessibility to meet their work functions.
3. Information should be captured in computer-readable form as close to the source of origin as possible (electronic submissions)
4. Once captured, information should be stored and exchanged using electronic means so that manual transcription and reentry are avoided.
5. Wherever possible, the various applications and tools should present a common GUI to enhance user friendliness and reduce training requirements.

Figure 6. Selected Retooling Principles. Source: Adapted by author from Tapscott and Caston, Paradigm Shift (New York: McGraw Hill, 1993), Chapter 10.

the extended enterprise. It is far more than fancy E-Mail--merely person-to-person text within a fixed environment. Rather, EDI is application-to-application within a wide area network. Therefore, users will not have to convert applications files before and after transmitting them across the network; often having lost format, formula, and control character utilities in the process. EDI significantly reduces administrative costs because there is so much less paper handling. Products are staffed and sent decisionmaker-to-decisionmaker electronically. This open system should reduce vendor risk in users' home-based personal computers, enhance the migration to new technology because needed bridges can be built into the network as opposed to individual systems, and provide increased architectural flexibility and scalability.[6]

Realigning I.S. Management for Classroom 21

The current information systems (IS) architecture has management and control dispersed from the Combined Arms Center (CAC) Director of Information Management (DOIM) to the CGSC Management of Information Systems Division (MISD), where systems are distributed to users. This facilitates locating computing assets in departments and classrooms, while maintaining strong central control over system operations and product development within the College. This structure should be principally maintained because it places control closer to the user. This configuration should enhance responsiveness to user needs in conjunction with Tapscott and Caston's principles of information system alignment as shown in Figure 7.

CGSC needs a strong centralized IS structure to overcome rotational knowledge vacancies, as well as assure the linkage of the CGSC IS structure to what is currently available in the broader Army. CGSC should mirror what is going on in HQDA, MACOMs, and units. IS requirements will, in general, be technology pushed, rather than student-demand

1. The requisite IS structure will enable rapid development of systems.
2. IS functions & business operations operate in harmony.
3. IS structure will provide tailored service to clients.
4. The structure will be cost effective.
5. The structure will optimize user participation in implementing change.
6. IS function maintains industry standard capability.

Figure 7. Principles of IS Alignment. Source: Adapted by author from Tapscott and Caston, Paradigm Shift (New York: McGraw Hill, 1993), 264-266.

pulled. A centralized IS alignment within the College facilitates the integration and support of evolving information technology. Therefore, IS professionals are only resourced in one place and provide consistent technological assistance and automation support throughout CGSC. They become the subject matter experts in determining which software should be designated as standard for each application. Thus, the College operates one document processor, one presentation graphics program, one spreadsheet, and one database.

This management configuration keeps the centrifugal dispersion of IS technology under a tightly-held organization that troubleshoots the integrity of software, data, and user files; sets backbone standards; ensures upgrades adhere to these standards; serves as the central vendor interface; and provides user support. Further, this alignment will take advantage of economies of scale and scope. This could be critical given the Officer Distribution Plan for FA53 Officers and the scarcity of funds to hire a professional civilian staff.

Tapscott and Caston would conclude, on the contrary, that centralization of IS functions is, overall, an ineffective alignment strategy because it generally correlates to low IS contribution to the business. This may not necessarily be a drawback in an academic, military environment. The key will be to ensure that walls do not develop between the IS staff and its broader set of clients. The CGSC IS team must be given the mission of keeping in touch with business developments and IT opportunities so that the College stays nearly on par with industry. The military contracting system is not agile enough to create industry leaders. Our challenge is to stay close to these leaders; rather than becoming complete laggards, as is currently the case. Therefore, CGSOC needs a centralized IS staff alignment within an Era II corporate culture.

> The goal is to have the architectural cake and eat it too--dispersed, entrepreneurial development and implementation of systems at the same time as a standardized enterprise platform that can maintain the integrity of the enterprise technology infrastructure.[272]

The centralized CGSC IS staff must be an equal partner, motivated by the same performance needs as its key user groups. Furthermore, it will have to be augmented substantially to provide adequate user support during the technology and learning transition process. This could be accomplished by increasing authorizations for the MISD, hiring a contractor during the implementation phase, or designating support groups within each of the key user departments--faculty, administration, and student class. Unless the IS structure is enhanced, it will easily become overwhelmed; thereby creating system reliability and learning barriers to Era II transition.

Reengineering for Era II Success

The reengineered CGSOC process must create value in automation for users through a combination of requirements and utilities. This reengineering must occur at all levels across all functions. It should drive process change for not only the CGSOC student, but the faculty and College administration. This reengineering should embody at least three of Tapscott and Caston's principles. First, information will be available to answer user inquiries at all times. This is a combination of automated access to the MISD for system help and to other users throughout the network so that the client-server tasking cycle is quick. Users will have to be motivated to "watch their lanes"--their automated mailbox/directory. Second, systems required for high performance work will be available to users. Students, faculty, and administrators will find support for advanced applications through the integrated system links to the extended DoD and academic enterprise. These applications could span advanced simulation, specialized optimization, specific graphical utilities, or tactical applications including exploitation of imagery and electronic mapping. Third, focused job training and knowledge-based system support will be provided to create a working-learning environment.[7] This enables users to work their way up the learning curve at their own pace. This reengineering effort will require an unlearning, resocialization, and relearning process throughout the College--administration, faculty, and students.[8] The end result must be that resident students are treated as CGSOC staff officers, despite their work environment being a classroom. As staff officers, they take on new responsibilities for their own learning and administration.

This change should organizationally facilitate work group computing--the critical success factor in achieving an Era II CGSOC. Consequently, three aspects of change must be addressed: curriculum; classroom process; and administration.

Curriculum Evolution

The key to developing a curriculum that will drive requirements for and utility from an Era II information systems framework is an automation competent faculty. This does not imply that all faculty must be computer geeks. Rather, all must be application literate. This skill requirement has significant ramifications for the instructor recruitment cycle. However, skill-shortages in the pool of potential instructors should be a short-run phenomena, since most will be CGSOC resident course graduates; where they will have developed the requisite background. The College must structure a leader development program focusing on application skills with an institutional training, operational assignment (could be as an instructor), and self-development component. An enhanced MISD could be used as the backbone for this program. The application-competent faculty will not be developed over night. Rather, departments will have several heroes that can take the lead in integrating applications into course requirements, developing fellow instructors, and interfacing with truly application-gifted students and MISD to assess the effectiveness of current programs and modify them for future success.[9]

Second, automation skills must be made a terminal learning objective of resident CGSOC. Furthermore, automation skills should be added as the sixth demonstrated ability on CGSC Form 1002: Evaluation Form. The following applications should be required, exercised, and evaluated during the course: E-Mail, document publishing, presentation graphics, automated research using CD-ROM and on-line products, spreadsheets, simulation, and databases. An extensive diagnostic take-home exam should be given during in-processing to determine the extent of each student's application skills. Students would have the option of either taking or not taking the diagnostic test. They would be free to use their home computers, provided acceptable software programs are available; or CGSC computers in designated classrooms and labs. The diagnostic test would be hands-on and product oriented--no multiple choice cop-out. For example: given a situation and supporting data, the student could be tasked to conduct some spreadsheet and/or database analysis, and construct a decision briefing composed of between 4 to 6 slides.[10]

If a student fails to take the exam, then he or she is tracked into a mandatory institutional remedial training program designed to develop the minimum necessary skills for the course. If they choose to take the exam and do well, they are certified to continue with routine course work. If they take the exam and do not meet the minimum standards, then they can be placed in a self-development program with evaluation gates that determine if adequate progress is being made. They could alternatively be placed in the institution's remedial training program, depending on their lack of demonstrated skill. These latter options could be tailored by application based on the student's demonstrated proficiency.

This effort will probably be resource intensive in terms of time, hardware, software, and remedial instruction. However, the benefit of providing each student an assessment of his/her automation skills and a tailored process whereby they could significantly increase their capability can be a crucial benefit of CGSOC. It may very well become the cornerstone in motivating each student to embrace, as opposed to resist, the Era II classroom 21.

Third, CGSOC courses must integrate applications into student requirements. As a current comparison, C430: Resource Planning and Allocation, the operations research and systems analysis core instruction, has absolutely no computer application exercises. Even the most introductory undergraduate courses in this topic do; why not CGSOC? Course directors should be required to submit a report that addresses how their course supports the terminal learning objective of applications familiarity. Some courses can obviously incorporate multiple applications ranging from spreadsheet analysis to presentation graphics. Others may only be able to exercise document publishing and automated research.

In The Fifth Discipline, Peter Senge recommends prototyping process developments to ensure that new initiatives "get it about right." The challenge is not to search for, find, and develop the 100% solution. Rather, organizations can use prototyping to quickly test and adopt an 80% solution that greatly facilitates the learning organization.[11] The tactics curriculum provides an applications-rich environment to prototype Era II classroom processes. Document processing, presentation graphics, spreadsheet analysis, database management/analysis, simulation, and electronic imagery could be integrated into student requirements for A301: Applied Tactics, A304: Advanced Fires; and A305: Advanced Intelligence, by January 1995 (term II, AY94-95). Lessons learned from these prototype efforts could then be applied to A459: Corps Logistics, and A501: Operational Warfighting for term III AY94-95. All core courses could follow in adopting requirements that would benefit from the Era II paradigm for AY95-96 based on the AY94-95 experience. Furthermore, requirements for complementary courses should be internetted. For example, tactical plan development for A301 should be networked with service support plan development in A459. The A301, A304, A305, and A459 preparation for Prairie Warrior should also be networked.

Work Group Computing in the Staff Group

The staff group process must develop value in the shared creation of products using computer applications.

The staff group is where the enhanced capability of retooled information systems can be coupled with the upgraded requirements of a reengineered curriculum to significantly enhance the productivity and learning of CGSOC students. The work process flow for a group could evolve as depicted in figure 8. The staff group learning process will be characterized by electronically linking the faculty, student, and staff group to the CGSC network. Split-based, distributed computing will be possible through the networked access of both the classroom PC and home PC, to student or staff group files resident on the backbone. This process also highlights the routing of inputs to the student, and output from the staff group electronically through the CGSC network.

This environment is characterized by greatly reduced hard-copy output and costs due to the emphasis on electronic preparation, editing, staffing, submission, and grading of course requirements. The student will have increased access to broader Army and academic automated references and archives to greatly enhance the quality of research underlying their products. This access spans the gamut from Field Manuals on CD-ROM, to after-action reports from the Combat Training Centers, to interacting with staff officers at TRADOC or HQDA on current issues such as digitization of the battlefield. General Sullivan terms CGSOC as one of his braintrusts. Work group computing in the classroom facilitates the transfer of knowledge and experience across this braintrust to develop a broader educational

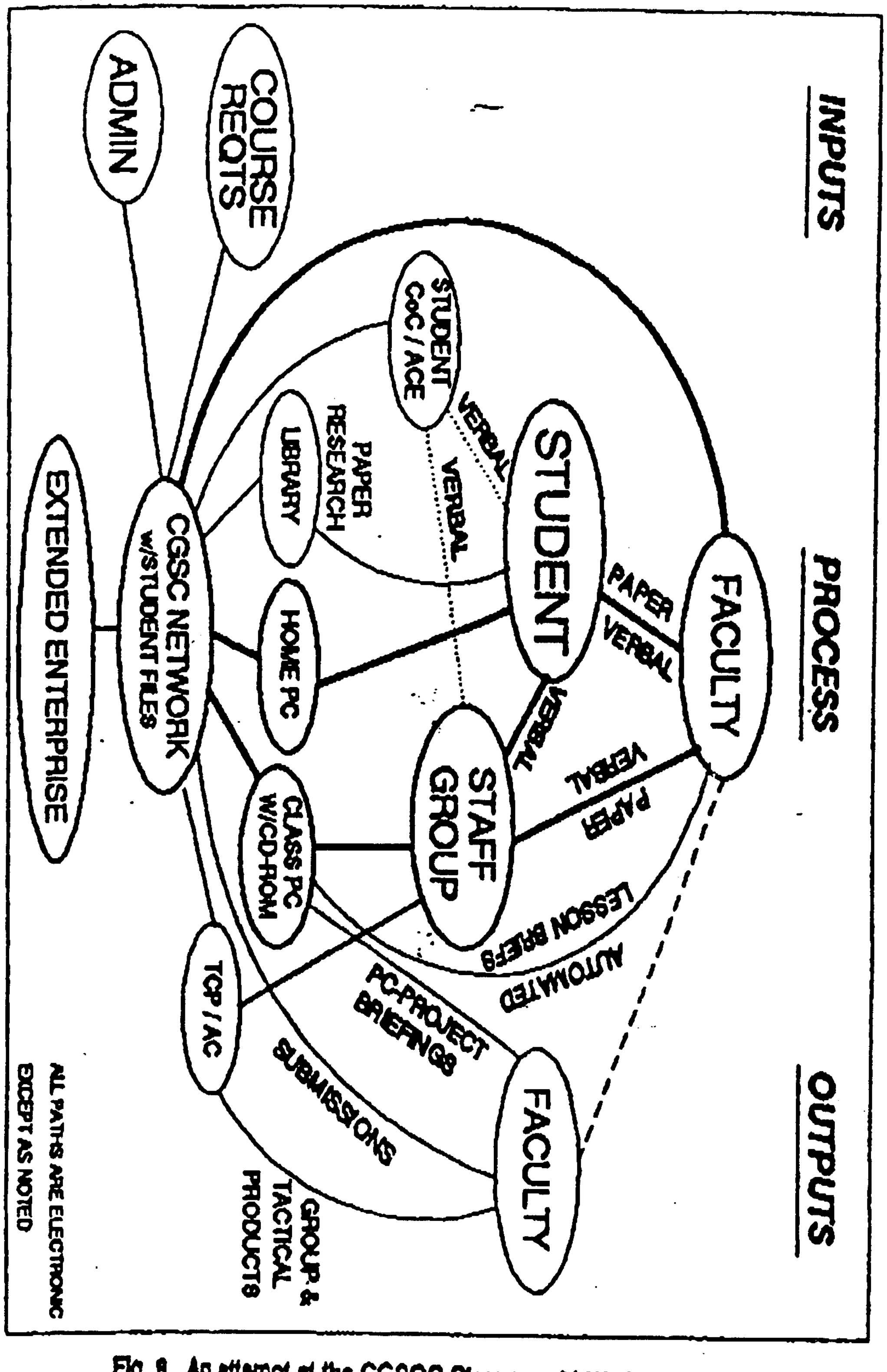

Fig. 8. An attempt at the CGSOC Classroom 21 Work Process Flow.

opportunity. Further, access to the braintrust is extended to the broader Army. The entire class could participate in an A716-like opportunity where students interact with Army leadership to discuss current issues.

Students should gain personal utility from the CGSOC Era II network. They should be able to access databases and applications for professional use. Furthermore, they should be able to experiment with hardware and software in the network. This personalized test-bed can be of great benefit in determining what configuration to buy for their own personal computers. They can also use software primers available on the system to become familiar with the standard packages used at their next duty assignment. The bottom-line is that the CGSOC experience should provide students with an opportunity to experience the benefits of work group computing so that they can implement their lessons learned in future assignments.

For example, the chief of staff for a course of action development exercise could disseminate assignments and guidance for the group project with a suspense for input to his "file drawer" by 1700. He would then integrate this input, prepare a completed draft product, and distribute it back to his group members' "file drawers" by 1900. He could further specify that staffed comments must be provided back to his electronic address by 2100. At 2100, he can then consolidate the input, edit the final product, and either electronically distribute and submit it, or spool it to an output device in Bell Hall. This process creates a well-staffed product in which all students have played at least an initial preparation and final review role; ready for class by 0730 the next morning. This revolutionizes the current process often characterized by a CoS who has to keep the whole group at school until all initial products are submitted. Once the CoS is sure that all issues are adequately addressed, he/she takes the input home and prepares the final group product. There is very little group learning in this process. Other members of the group may, or may not, have an opportunity to edit this consolidated group product. The Era II proposal adopts aspects of work group computing that can vastly enhance the learning potential for all staff groups.

Additionally, the adoption of an Era II technical network and organizational paradigm will facilitate the adoption of Army-wide field grade standards in the CGSOC classroom. Course standards should be similar to the document, graphics, and presentation standards accepted in any Quarterly Training Brief, HQDA or TRADOC staff decision memorandum and brief, or Brigade Tactical Operations Center orders brief. Products that are unacceptable in the Army, such as imprecisely hand-drawn or poorly computer-crafted graphics, should not be accepted in the classroom. Also, graduate-level research requirements can be adopted for critical analyses as more services are available on CD-ROM and through the extended enterprise network. The issue here is not raising the ceiling on standards, rather the floor. Many students prepare first rate academic and professional products. These students are going to take advantage of Era II information technology regardless of what the College does. However, the lower segment of the class will not benefit, unless motivated (even at times negatively) by clearly defined standards that drive them to leverage technology. CGSOC can use classroom 21 as the foundation to produce graduates who confidently meet or exceed the commonly expected automation familiarity requirements of field grade officers throughout the Army.

Course Administration

CGSOC administration should be nearly paperless. There should be little need for the staff group structure and student chain of command. The Class Director's Office should distribute administrative information direct to every student on an electronic class bulletin board. They could also operate, in conjunction with the CAC Public Affairs Office, an on-line Earlybird or daily news summary. Students should be required to check electronic distribution twice daily--they certainly check their paper-laden distribution boxes many more times than that. The class chain of command then, should only be necessary to troubleshoot last minute taskings and disseminate any sensitive issues. Regardless, verbal and paper dissemination should be exercised as the exception, not the rule.

Academic Counselors and Evaluators (ACE) would become exactly that. They would no longer serve as redundant means of unnecessary face-to-face, or paper administrative communications. All their administrative communications with students should be through E-mail. This altered process in no way relinquishes them of the responsibility to observe and assess the performance of their students. On the contrary, it should greatly streamline their other administrative functions so that they can focus on their critical professional development role. Consequently, face-to-face counseling would continue and hopefully become more effective. Ideally, in support of our lead by example ethic, the ACE should become the proponent for initial automation applications skill assessment and orientation during class in-processing.

Students should directly register for courses electronically. ACEs and concentration proponents would be able to audit schedules to ensure requirements are met. CGSOC Form 1002s and term grade reports would be delivered electronically to each student. In addition, the reclama process could be automated.

Financing the Paradigm Shift

The financial implications of this transition can be staggering given the scarcity of Army resources. The costs could easily approach $10 million. An attempt to prioritize the investment in Era II functions is depicted in Figure 9. In short, the College should invest in the network above all else if funds are lacking . This creates the minimum conditions for enticing students, faculty, and administrators to use the CGSC system. Next, the College should ensure that the latest and the greatest applications are available on the network; and that they are remotely accessible. If the network provides significant utility, then students and faculty will attain the capability to access it for applications. Finally, new classroom automation platforms, probably 486-based PCs, must be procured to serve, along with the network backbone, as the centerpiece of work group computing.

Tier I:
1. Upgrade backbone architecture and communications.
2. Enhance CGSC-internal network.

Tier II:
3. Upgrade network applications software.
4. Procure new classroom automation platforms.

Tier III:
5. Enhance extended enterprise networking.
6. Upgrade network utility devices.
7. Procure new Data Service Center automation platforms.

Tier IV:
8. Provide enhanced IS user support.

Fig. 9. An attempt to prioritize the Era II investments for CGSC classroom 21.

The Tier I investment must be made in creating a network that provides access among users through a common system. First, the backbone architecture and communications must be upgraded to provide each student with a unique directory in the CGSC system where personal files can be saved and accessed remotely from home. This investment makes split-based computing and the electronic transfer of information among students and faculty possible. Second, the CGSC local/wide area network must be enhanced to provide utility for the user. Fiber optics probably provides the most efficient flexibility for future wide area network advancements. This internal network solidifies the classroom link to the CGSC backbone system.

Now that access to the backbone has been ensured from both inside and outside the College, the available system applications can be upgraded in Tier II to provide enhanced utility for the user. Advanced document processing, database, modeling, and graphics capabilities can be resident as applications on the backbone. These software products could provide enhancements over the students' PC-based versions. They further allow clients with older PC models, as a remote terminal, to use the latest and greatest industry standard software products at literally no cost. Next, new staff group WGC platforms should be procured. These must employ a mouse-driven, graphical user interface and enlarged video display for automated briefings.

The Tier III investments are critical to achieving an Era II paradigm; however, they are probably not required to facilitate work group computing by students and faculty. The extended enterprise network can be enhanced to provide access to an increased array of data, services, and organizations for a much broader universe of clients. Utilities, such as specialized input or output devices, could then be added to the network to support advanced requirements. These may provide substantial benefit to highly skilled users. Finally, the Data Service Center must be retooled to support the same functions as the CGSC classroom platform.

CGSC cannot underestimate the requirements for adequate maintenance and user support, categorized as Tier IV. Without these functions, potential users will increasingly perceive barriers in system reliability and unfriendliness. However, CGSC may not have to invest in it. Rather, the College can leverage off the resident expertise of students and faculty. One option might be to assign FA53 or otherwise qualified students to an IS management course where their requirement would be to provide actual support to the living network and its users. What better training could their be? These students could be designated prior to the start of term I and habitually associated with particular staff groups. This notion is merely an extension of the computer OIC currently designated in each staff group.

Conclusion

The challenge is one of managing change.[26]

One may ask: Why should I buy into an Era II CGSOC? Is the retooling, realigning, and reengineering effort worth it? Hopefully, the College will determine that integrated network systems enhance the efficiency and effectiveness of the resident course process. Sooner or later, the competition of international and sister service command/staff colleges will transition to Era II frameworks. CGSC should remain a leading, as opposed to lagging, enterprise in senior military institutional education. The faculty and students should welcome this paradigm shift to an Era II information technology organization. It will not only make them more productive in the Army, but more marketable when they eventually transition out of the Army. Graduates and faculty alumni should be able look back on their CGSC experience as one when trends were set. It should provide a frame of reference as to what is organizationally achievable given the effective integration of information technology.

The leadership role in this evolution is critical. Taspcott and Caston say that: "Old paradigms die hard."[281] Change is even more difficult when the institutional leadership is not the champion for change. They are the ones who must develop the migration strategy that ensures a jointly shared vision, does not disenfranchise long term players, and incorporates short-term milestones with assessments that can validate and/or identify changes in the transition path. In addition to establishing the vision, the leader is also challenged with designing a coherent process that gets us to the desired endstate. This process of getting from Era I to Era II will make the difference between whether faculty and students internalize the change, or reluctantly comply with it. Finally, leaders must create organizational incentives for students and faculty to experiment with prototypes so that the adoption of technology-driven organizational processes can be broadly based and relatively free of pitfalls. These heroes must be acknowledged and rewarded. A summary of Tapscott and Castin's leadership lessons learned is depicted in Figure 10.

1. The critical success factor is senior management commitment.
2. Communicate throughout the organization so that all understand the "reimage."
3. Develop group ownership of the change. If all players have a stake in success, then Allison's bureaucratic politics model would forecast success.
4. Assume nothing is sacred from scrutiny. Let the system earn its place in the organization. You are sunk if you doom change to success. Determine ahead how you will assess success. You risk losing commitment, if groups are forced to implement a system they know is substandard. More importantly, they lose the motivation to try and fix it.
5. Over-resource the implementation phase to ensure reliability--people and hardware. If the IS staff is overcommitted, they will be unable to meet customer demand during implementation. Once the system is stabilized, then you can cut it back. Do this with contractors, or borrowed IS professionals.
6. Leaders must be upbeat about change. Foster enthusiasm.

Fig. 10. Paradigm Shift Leadership Lessons Learned. Adapted by author from 284-286.

This institution needs to answer one critical question: Are applications skills necessary for the professional development of field grade officers? If the answer is no, then forget Era II investment. Save your money and invest it in different programs! If it is yes, then have the moral courage to drive students to "get with the automation program." There will be those officers either unwilling or unable to meet the applications familiarity terminal learning objective of the course. In these hopefully rare cases, the CGSOC leadership must have the moral courage to identify these officer as ones who lack potential for future service in our Army; and rate them accordingly. After reading General Sullivan's National Security Paper: "America's Army," and Toffler and Toffler's War and Anti-War, you can hardly conclude otherwise.

> Only high-quality soldiers, leaders, staffs and organizations that can use customization, precision and information to their advantage will succeed in this environment. The military requirements of the information age are upon us today. . . . The kind of army that can use information age "tools" and succeed under these conditions differs from the mass-production army of the industrial age.[13]
>
> GEN Gordon R. Sullivan and COL James M. Dubik
> War in the Information Age

APPENDIX

BACKGROUND ON THE PARADIGM SHIFT FROM ERA I TO ERA II

In Paradigm Shift, Dan Tapscott and Art Caston trace the technology and organization change from Era I to Era II information systems, see Figure 11. In the early Era I period, Management of Information Systems (MIS) were characterized by dumb terminals linked, often with clumsy interfaces, to mainframe host computers. MIS evolved into Decision Support Systems (DSS) where dumb terminals were replaced with personal computers that could emulate terminals when on-line with the host, and process applications with internal software separately. DSS was characterized by four phases: (1) early development--when systems are first entering an organization and applications are being developed; (2) rapid growth--when these applications have been internalized and are proliferated across the organization; (3) mature growth--when the corporate rate of growth slows because change in the organization has slowed; and (4) decline--when the mix of old and new technology creates inconsistencies in applications and corporate vision. Expert Information Systems (EIS), little more than technical kludges that went cross-compartment within organizations to make information more visible to decisionmakers across an organization, were employed as an enhancement to DSS. This process attempted

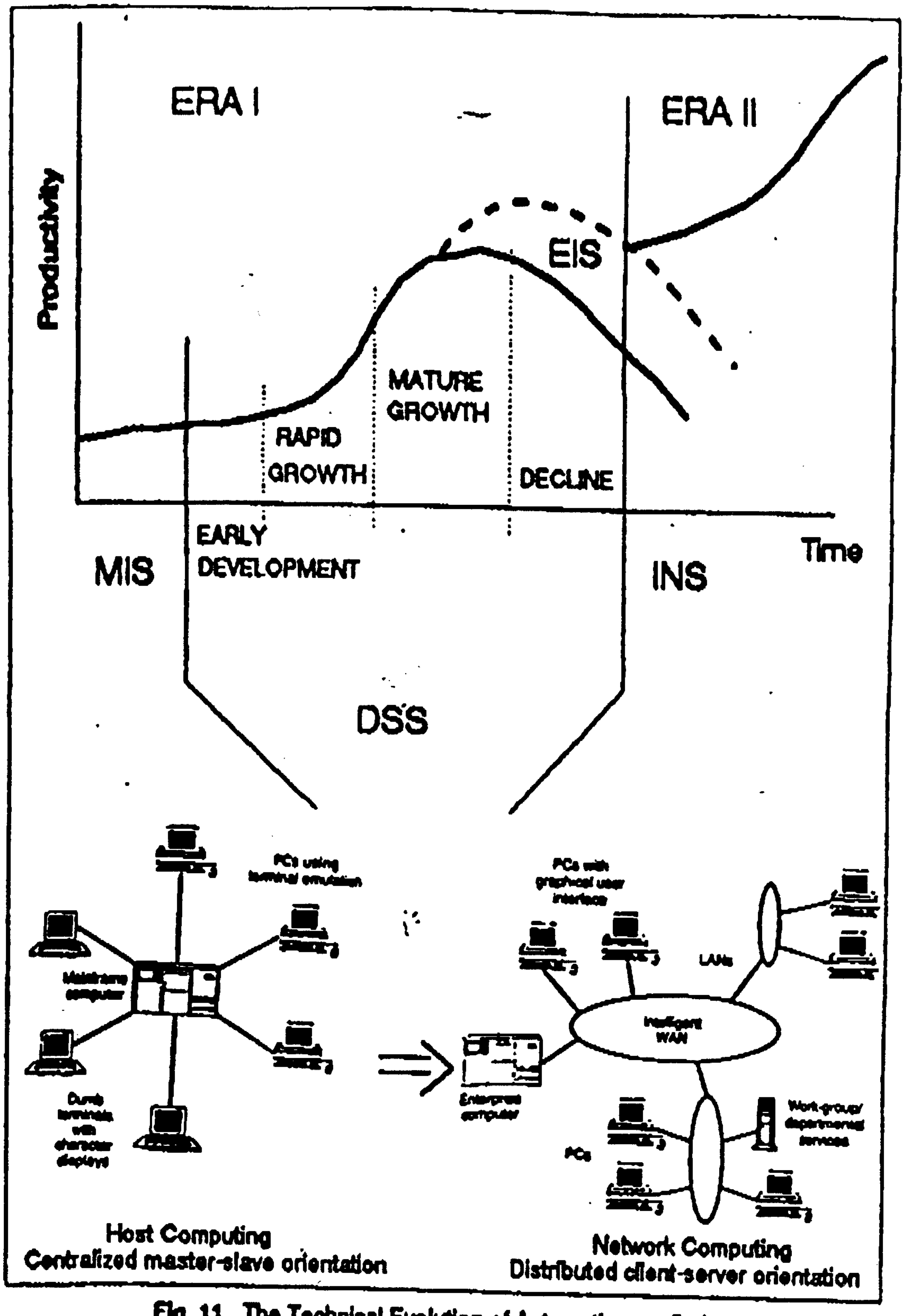

Fig. 11. The Technical Evolution of Automation applied to Organizational Productivity. [18]

to prolong and slightly enhance the mature growth phase; yet provided little long run competitive advantage. Era II information technology is based an a new enterprise architecture in information systems that employs integrated network systems. These network systems may provide the opportunity to initiate a second learning and effectiveness curve where organizations can leap-ahead of DSS mature growth into new early development and rapid growth phases.

The Era II system is characterized by three critical shifts in the application of information technology in new organizational paradigms. First, Era II systems shift from personal to work-group computing (WGC). There is no more need for stand-alone PCs imbedded in clumsy networks. This structure drives a different product work process than communications process. Second, system islands that were application or product specific are now linked into broader integrated systems supported by open system architecture. Third, systems have advanced beyond merely internal applications to truly inter-enterprise computing whereby processes have become horizontally and vertically integrated across different, geographically dispersed organizational units.

In essence, WGC facilitates the parallel, as opposed to serial, processing of applications within a horizontal staff or hierarchy. When properly implemented, WGC makes walls go away--the office is no longer a place, it is an interactive system. It leverages information from networked, multifunction workstations to create redesigned work processes and organizational structures; as depicted earlier in Figure 2. This shift should enhance the efficiency of staff communications, improve the collaborative development of products, and provide a more effective and encompassing environment for brainstorming. It should also improve decisionmaking by facilitating the incorporation of recommendations, the sharing of information, and the reduction of unnecessary bureaucratic input. In short, WGC drives better marginal productivity in our staffs because of increased access to shared information and a steeper applications learning curve due to greater worker interaction. WGC allows you to work the way you communicate--in parallel with others. Product creation is faster, easier, and better quality due to shared input.

Modern technology facilitates integrating systems across the organization. Data, functions, and applications can be processed and maintained where they are necessary; however, users at all levels (given security considerations) may be able to access disparate elements through a common interface available at their workstation. Integrating systems extends to also integrating mediums--data, text, voice, and ultimately image--despite the required expensive investment in wide area networks. Therefore, integrated systems can remove the isolation of functions within an organization. Individuals and teams can now operate in a network of client-servers where clients task servers and servers answer taskers. Consider the efficiency of direct client-server relationships between CGSC administration, faculty, and students by eliminating redundancy and adopting electronic, rather than paper-based, information exchange. All agencies will use the same backbone data, standard applications (that do not preclude local enhancements), and network protocols that support application interoperability as opposed to merely plain text transfer.

In the limit, the extended enterprise could make geography irrelevant from a work perspective. Internal corporate systems will be networked to inter-corporate systems. This increases access (again given the desired level of security filters) for a broader array of clients to an expanded set of data, applications, and functions. At CGSC for example, an extended enterprise system can link the A716 student in classroom 1 to COL Harper, Director of the Chief of Staff of the Army's Study Group, so that they can continue their discussion of Army change issues that was not completed during the 4 May course seminar.

The impact of these three shifts creates a set of technology themes in Era II. More importantly, these now-feasible technology themes are driving a complementary set of organizational themes that, when combined, foster paradigm shift. The adoption of technological themes without the corresponding organizational themes create a disconnect that limits both the effectiveness and efficiency of change, as summarized in Figure 12.

NEW TECHNOLOGY--NEW ENTERPRISE		
	TECHNOLOGY THEME	*ORGANIZATIONAL THEME*
1.	OPEN SYSTEMS: Portability of software and info across an interoperable network.	OPENNESS: Enterprise is a network of business functions that interoperate. Corporate walls blur.
2.	INTERCONNECTION: Shift from islands of technology to enterprise networks.	INTEGRATION: The corporation becomes an integrated network of sub-businesses.
3.	DISTRIBUTED COMPUTING: Shift from host-based to network-based computing. Computer intel pushed down.	EMPOWERMENT: Individuals empowered to create value in corporation. Intel is distributed throughout.
4.	REAL TIME: Systems capture info on-line in real time, and updates databases.	IMMEDIACY: Corporation strives to be a real-time enterprise that continuously and immediately adjusts to business conditions.
5.	COOPERATIVE PROCESSING: Applications processed where most efficient on network.	COOPERATION: Groups cooperate out of mutual self-interest.
6.	PEER-TO-PEER PROTOCOLS: Hierarchical protocols replaced by ones that treat network devices as peers.	COMMITMENT: Commitment to group. Accomplishment vs accountability.
7.	ARCHITECTURAL MODULARITY: Standardized, independent systems are networked to meet corporate requirements.	ORGANIZATIONAL INDEPENDENCE: Business team modules/clusters operate independently, but are networked to achieve objective.
8.	PLATFORM SPECIALIZATION: Era II architecture is specialized based on server customer requirements.	SKILL SPECIALIZATION: Knowledge of worker is keyed to specialization. Rewards to competency, not control.
9.	USER FRIENDLINESS: Easy to learn and use via GUI.	ACCESSIBILITY: Corporate members share a common vision. Employees have input to decisionmaking.
10.	GLOBAL NETWORKING: Store and forward info. Collective resources continuously available.	TIME AND SPACE INDEPENDENCE: Anyone can share with anyone else, regardless of spatial and time differences.

Figure 12. Technology themes drive organizational themes. Summarized from Tapscott and Caston, Paradigm Shift (New York: McGraw Hill, 1993), 209-212.

Endnotes

[1]This analysis will not address applications for CAS3, correspondent studies, SAMS, or Command Preparation.

[2]GEN Sullivan used the terms "Big A" and "little a" Army to characterize the operational versus support aspects of the Service. The author interprets this distinction as roughly indicating the "little a" Army as MTOE units that support the operational requirements of the CINCs. The "Big A" army is the TDA structure that supports the Title 10 functions of the Department of the Army.

[3]If the student were able to save files in a directory on the CGSOC network host and use a modem to dial into the CGSOC host, he could currently transfer ASCII files from the host to his home computer using a communications applications software, such as Kermit.

[4]Peter M. Senge, The Fifth Discipline: The Art and Practice of the Learning Organization (New York: Doubleday, 1990), 25.

[5]The use of a wargaming tool, such as the Theater Analysis Model (TAM), is required as a minimum. For most Tactics courses, a modified version of the Brigade and Battalion Simulation (BBS) could be used to conduct course of action analysis.

[6]Integrated network systems allow clients to use backbone application utilities while only having application kernels on their own system. Kernels for the CGSC network applications could be issued to students so that they can be loaded on home-based PCs. Then, students would be able to remotely access network-based utilities for linked operations. They can also pull data from the host and process it, stand-alone, using their own application software resident in their home-based PCs. A good example of a work-group, split-based-capable application is WordPerfect Office. These, and other, benefits of open systems are discussed in greater detail in Dan Tapscott and Art Caston, Paradigm Shift (New York: McGraw Hill, 1993), Chapter 6.

[7] A more detailed discussion of Tapscott and Caston's reengineering principles in found in pages 214-217.

[8] The unlearning, resocializing, and relearning process is also applied to changes in warfighting processes by GEN Gordon R. Sullivan and Colonel James M. Dubik in "War in the Information Age," Military Review (April 1994), 52. In essence, individuals have to discard system specific knowledge of former technology--unlearning. They then have to adapt their work processes to the reengineered organizational paradigm--resocialization. Finally, they have to learn the applications requirements to enhance productivity using the retooled technology.

[9] The class is routinely gifted with officers who possess technical graduate degrees in information systems, some at the Ph.D. level. Furthermore, many have served as professors at the U.S. Military Academy or in Tour With Industry assignments where they have experience with much more advanced computer networks. The faculty and administration should not be bashful in tapping this resource.

Prototype efforts similar to those proposed here were effective in developing standard requirements at the Canadian Staff College. Officers there are expected to prepare OPLANS using Word Perfect, presentation graphics using Harvard Graphics, logistical analysis using Canadian Army logistical analysis models on school-provided laptop computers, and course of action analysis using TAM.

[10] This diagnostic test and terminal learning objective process will create challenges in the integration of international officers into the resident course. This is merely the school analog to information system challenges in combined arms operations. Presumably most foreign nations would value the development of applications skills in their officers.

[11] Prototyping in discussed in Senge, Part IV, 273-339. The reference to "getting it about right" is adapted from GEN Sullivan's use of Sir Miscall Howard's now-famous phrase.

[12] Sullivan and Dubik, 55.

[13] The four stages of DSS are adapted from the author's class notes from course A561: Decision Support Systems, taught by Professor Miscall Treacy, Sloan School of Management, Massachusetts Institute of Technology, 1984.

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